DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF TRANSPORT

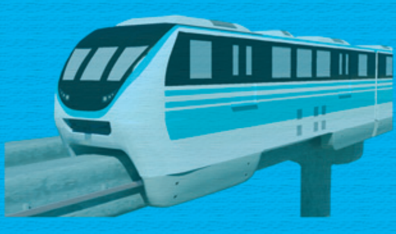
URBAN TRANSPORT SYSTEM DEVELOPMENT PROJECT

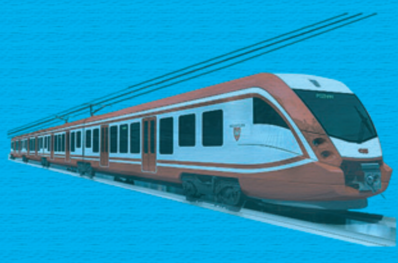
FOR COLOMBO METROPOLITAN REGION AND SUBURBS

Shaping the Future of Urban Transport in Sri Lanka...
CoMTrans URBAN TRANSPORT MASTER PLAN

FINAL REPORT

MAIN REPORT





AUGUST 2014

JAPAN INTERNATIONAL COOPERATION AGENCY

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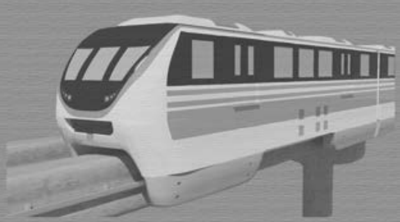

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Abbreviation	Official Name
AAGR	Average Annual Growth Rates
AGT	Automated Guideway Transit
AirMac	Air Resource Management Center
A/L	Advanced Level
ATM	Asynchronous Transfer Mode
BPO	Business Processing Outsourcing
BRT	Bus Rapid Transit
CCPI	Colombo Consumer Price Index
CCTV	Closed Circuit Television
CEA	Central Environmental Authority
CKE	Colombo – Katunayake Expressway
CLS	Cordon Line Survey
CMA	Colombo Metropolitan Area
CMC	Colombo Municipal Council
CoMTrans	Urban Transport System Development Project for Colombo Metropolitan Region and Suburbs
CPI	Consumer Price Index
CTC	Centralised Traffic Control
DMT	Department of Motor Traffic
DMU	Diesel Multiple Units
DSD	Divisional Secretariat Division
EMU	Electric Multiple Units
EPZ	Export Processing Zones
ERP	Electronic Road Pricing
EU	European Union
GCE	General Certificate of Education
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GLK	The Government of the Democratic Socialist Republic of Sri Lanka
GND	Grama Niladhari Division
GPS	Global Positioning System

Abbreviation	Official Name
GRDP	Gross Regional Domestic Products
HC	Hydro Carbon
HVS	Home Visit Survey
IC	Integrated Circuit
IE	Industrial Estate
IEA	International Energy Agency
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Petroleum Industry Environmental Conservation Association
IT	Information Technology
LA	Local Authority
LRT	Light Rail Transit
MC	Municipal Councils
MMC	Multi-Modal Transport Centre
MmTH	Multi-Modal Transport Hub
MODUD	Ministry of Defence and Urban Development
MOFP	Ministry of Finance and Planning
MOHPS	Ministry of Highways, Ports and Shipping
MOPTS	Ministry of Private Transport Services
MOT	Ministry of Transport
NPPD	National Physical Planning Department
NTC	National Transport Commission
O&M	Operation & Maintenance
OCH	Outer Circular Highway
OD	Origin and Destination
ODA	Official Development Assistance
O/L	Ordinary Level
P&R	Park and Ride
PRDD	Provincial Road Development Department
PCUT	Presidential Committee for Urban Transport
PDCA	Plan-Do-Check-Action
PPHPD	Passengers per Hour, per Direction
PPP	Public Private Partnership

Abbreviation	Official Name
PRDA	Provincial Department of Road Development
PS	Pradeshiya Sabha
RDA	Road Development Authority
RFID	Radio Frequency Identifier
RPTA	Road Passenger Transport Authority
SEMA	Strategic Enterprise Management Agency
SEW	Southern Expressway
SLLRDC	Sri Lanka Land Reclamation and Development Corporation
SLR	Sri Lanka Railways
SLTB	Sri Lanka Transport Board
TAZ	Traffic Analysis Zone
TDM	Transport Demand Management
TOD	Transit Oriented Development
TSS	Travel Speed Survey
UC	Urban Council
UDA	Urban Development Authority
UHF	Ultra High Frequency
USA	United States of America
VET	Vehicle Emission Testing
VHF	Very High Frequency
WP	Western Province
WPRDA	Provincial Road Development Authority
WPRPTA	Western Province Road and Passenger Transport Authority

Executive Summary

1. Introduction

The transport demand has increased remarkably over the past few years, especially in the Colombo Metropolitan Area (hereinafter referred to as CMA), which consists of the Colombo Municipal Council (hereinafter referred to as CMC) and the adjacent area, which is shown in Figure 1.1.

Source: CoMTrans Study Team

Figure 1.1 Colombo Metropolitan

Due to the increase in traffic demand, the speed of vehicles on the roads has declined resulting in higher vehicle operating costs for vehicle owners and environmental deterioration on the entire community. These impacts negatively affect not merely the economic development in the CMA, but also that of the country because roughly half of the country's economic activities are concentrated in this area. In addition, the nation's largest international seaport and airport are located within the area. The CMA, therefore, requires improvement and development of the transport system to tackle the increasing transport demand.

As the largest metropolitan area in Sri Lanka, the population of CMA was 3.7 million inhabitants in 2012. It is estimated that the total population of CMA will increase to 5.1 million people in 2035 and economic growth with urban development plans are expected. The total person trip demand would increase 1.75 times and the trip demand made by private modes of transport would increase rapidly due to the anticipated increase of household incomes.

Current traffic congestion becomes serious during the morning and evening peak periods within and around the boundary of CMC and is expanding its area. Furthermore, traffic congestion will worsen due to the anticipated increase of demand if appropriate countermeasures are not taken. Less utilisation of high occupancy vehicles, a lack of facilities for pedestrians and bus passengers, an insufficient capacity of public transport and poor enforcement of traffic rules aggravate the situation.

2. Urban Transport Problems in CMA

The urban transport problems have been explored to identify the urban transport planning issues.

2.1 Traffic Congestion

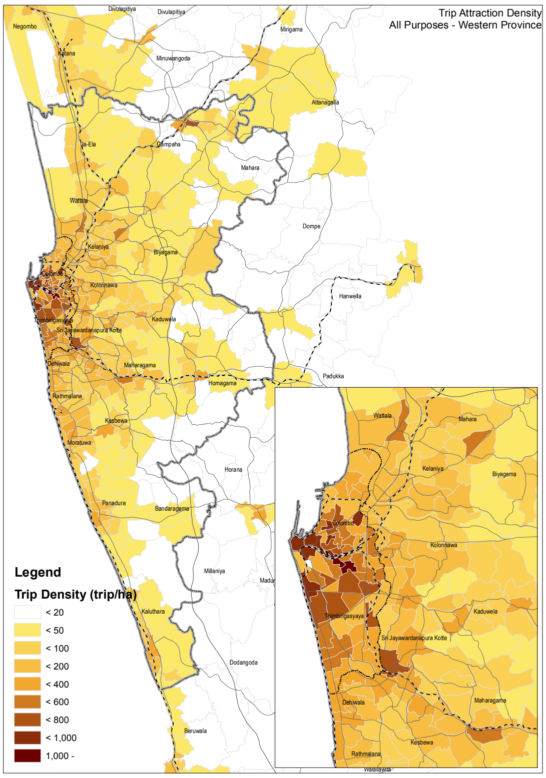
Traffic congestion has been worsening in recent years on the road network in the central area of CMA. Traffic congestion has brought about huge economic loss by increasing vehicle operating cost as well as travel time cost.

(1) Concentration of Trip Attraction

Concentration of trip attraction can be observed inside CMC. This concentration is one of the causes for traffic congestion in CMA as shown in Figure 2.1.

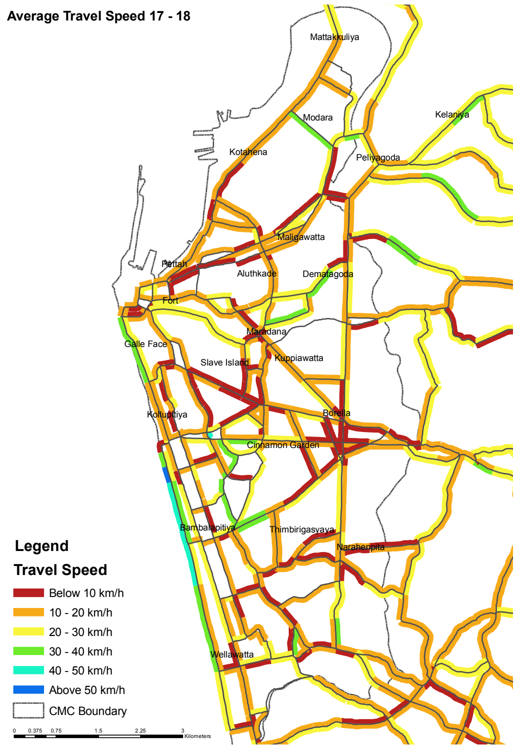
(2) Traffic Congestion in Morning and Evening Peak Hour

Traffic congestion is observed in the morning and evening peak periods at intersections of radial arterial roads, especially around the periphery of CMC and inner cities such as Borella, Maradana, Dematagoda, Town Hall and Nugegoda according to the travel speed survey as illustrated in Figure 2.2.



Source: CoMTrans Study Team

Figure 2.1 Concentration of Trip Attraction in CMC



Source: CoMTrans Study Team

Figure 2.2 Travel Speed in CMC in the Evening Peak Hour

2.2 Urban Transport Problems by Sub Transport Sector

Urban transport problems have been identified by sub transport sector as listed below;

(1) Problems of the Railways

- Insufficient Linkage of the Network
- Lack of Feeder Service for Railways
- Insufficient Integration among Public Transport
- Lack of Railway Access to the International Airport

- Slow Operational Speed of Trains
- Deteriorated Rolling Stock, Track and Signalling Systems
- Insufficient Line Capacity
- Insufficient Revenue of Sri Lanka Railways
- Insufficient Expenditure for Maintenance
- Low Level of Service of Kelani Valley Line

(3) Problems in Bus Transport and Other Road-Based Public Transport

- Low Bus Operation Speed due to Traffic Congestion on Roads
- Pettah-Centred Bus Network
- Lack of Integration with Railways and Other Bus Terminals
- Low Service Level of Bus Operation
- Difficulty in Improvement of SLTB's Bus Service
- Inconvenient Bus Operation for Passengers due to Bus Rental System of Private Bus Operation
- Difficult Coordination between Public and Private Bus Operations
- Insufficient Support for Bus Fare Discount for the Transport Poor
- Insufficient Management on Bus Operation
- Market-Driven Regulatory Scheme of Road-Based Public Transport Modes

(4) Problems on Road Network

- Insufficient Road Network
- Lack of Pedestrian Space
- Lack of Road Network Master Plan for the CMA
- Lack of Road Design Standards for Urban Roads
- Low Accessibility of the Existing Expressway Network
- Need to Enhance Access to Colombo Port for Cargo Transport
- Lack of Linkage of Expressway Network

(5) Problems on Traffic Control and Traffic Management

- Traffic Congestion at Intersections
- Reduction of Traffic Capacity due to On-street Parking
- Traffic Accidents involving Pedestrians and Motorcycles

3. Urban Transport Planning Issues in Colombo Metropolitan Area

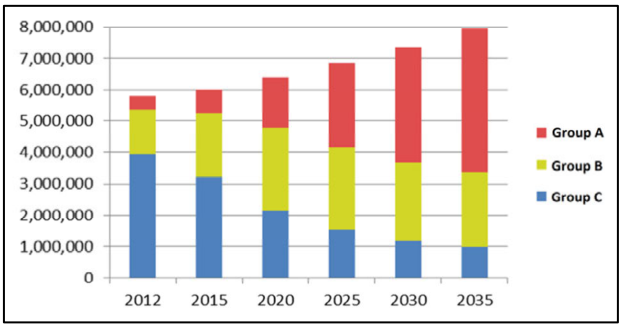
3.1 Perspective of Socio-Economic Aspect and Urban Structure

(1) Urban Development in the City Centre and Suburbanisation

Urban development projects are planned mainly in the city centre and job opportunities will increase in the central area. Since the residential area will disperse and the urban area will be expanded to the suburb, it implies that commuter trips to the city centre will increase and the travel distance of commuters will be longer due to the dispersion of the residences of the population.

(2) Increase in Real Household Income

As high economic growth is expected in the nation, real term household income will increase. In accordance with GRDP growth, real household income would also increase proportionally. It is estimated that the composition of Group C households, of which the monthly income is lower than Rs 40,000, would decrease from 67.8 % in 2012 to 12.5 % in 2035 as shown in Figure 3.1. In contrast the composition of Group A households, of which the monthly income is higher than Rs 80,000 would increase from 7.6% in 2012 to 56.3% in 2035.



Note: 2012 Estimation from CoMTrans Home Visit Survey.
2015-2035 projection, CoMTrans Study Team
It is considered that income 80,000 and over is Group A , income between 40,000 and 79,999 is Group B and, income below 39,999 Rs is Group C.

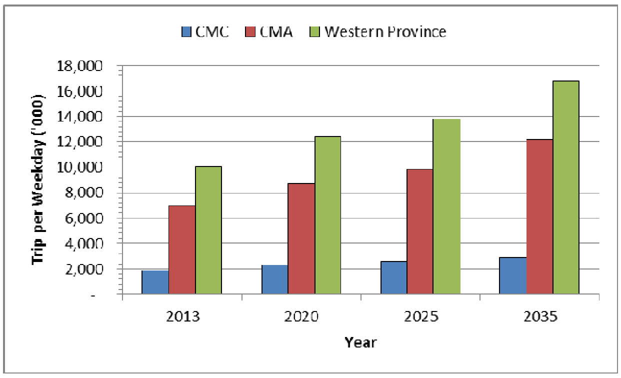
Figure 3.1 Projected Population by Income Level in the Western Province

(3) Increase in Ownership of Private Modes of Transport

The increase of household income would bring about an increase of ownership of private passenger cars and motorcycles. The increase of private modes of transport naturally increases traffic demand on the roads and would cause serious traffic congestion.

(4) Projected Transport Demand

In 2035 the total person trip production in the CMA would increase to almost 12.2 million person trips per day and this is 1.75 times of the present demand of 6.9 million person trips per day as illustrated in Figure 3.2.



Source: CoMTrans Estimate

Figure 3.2 Increase of Person Trip Demand by Region: 2013 – 2035

3.2 Planning Issues for Urban Transport System Development

It is anticipated that traffic congestion will continue getting worse and worse without efforts on the improvement of public transport systems and the restriction of private modes of transport by the Government. Planning issues in urban transport system development are identified as follows:

(1) Dealing with Peak Transport Demand and Concentration of Traffic in the City Centre

Traffic congestion is brought about by peak traffic demand in time and spatial concentration of vehicular traffic in the city centre. To tackle the traffic congestion problem, one way is to flatten the peak demand. Another countermeasure is to distribute traffic concentration in the city centre to sub centres. This would be achieved by developing urban centres in suburban areas where a sufficient number of job opportunities should be provided. By distributing job opportunities in sub centres, these sub centres would attract the employed population from the surrounding areas and could reduce traffic concentration in the city centre.

(2) Anticipated Shift to Private Modes of Transport

According to the historical trend of modal shift in the last 28 years, the number of passengers crossing CMC boundary by private mode of transport increased approximately 2.5 times while the number of passengers using public transport remained roughly static. The vehicle ownership in recent years also shows a surge in the number of passenger cars, three-wheelers and motorcycles.

Group A households are captive to private modes of transport according to the Home Visit Survey results. Taking into consideration the fact that economic growth is expected in the CMA with huge urban development projects, the modal shift to private modes of transport will be accelerated if no government intervention is taken.

The share of public transport will continuously decrease with economic growth if the government does nothing. While some U.S. cities are recently trying to increase the share of public transport to reduce externalities of private mode of transports, a limited number of cities have succeeded to regain a share of public transport. Once car ownership and a share of private mode of transport increases, it is difficult to reverse it due to the captive characteristics of car users.

With the decrease of travel speeds on the roads due to the abovementioned severe traffic congestion, the speed of buses would decrease. This might accelerate the shift to private modes of transport. It is highly expected to break this vicious circle though provision of convenient, fast and high capacity public transport modes.

(3) Necessity to Develop Extensive Congestion-Free Public Transport Network

To deal with the traffic congestion problem in the city, the reduction of vehicular traffic demand is the main issue to pursue. Since the total travel demand in Colombo Metropolitan Area would increase in the planning period, a shift to public transport from private modes of transport is a challenging task for the Government. As traffic demand increases, traffic congestion on the road network would be worse and travel speed would be reduced in the future. The operation speed of ordinary buses will also be lower due to traffic congestion.

Public transport systems generally provide less convenient and longer travel time compared to private modes of transport, which can provide door-to-door service. Consequently, the public transport network to be introduced should be at a high level of service and congestion free by providing dedicated transport space in order to compete with private modes of transport.

In this regard, a heavy rail system, a medium-sized transit system and a bus rapid transit system can be regarded as public transport systems with a high level of service in terms of operational speed and punctuality. It is therefore recommended to formulate the public transport systems for the Colombo Metropolitan Area with these congestion free systems and cover the public transport service area as widely as possible.

(4) Transport Facilities for the Physically Handicapped

At present barrier free facilities such as elevators and escalators are not yet provided at railway stations and bus terminals. Thus it is not convenient for physically handicapped people to use public transport. It is required to provide such facilities to support them to travel as normal people in the city.

(5) Transport System to Promote Health

Transport facilities for walking and bicycles have not had attention paid to it for a long time. Walking and bicycling has become popular since these modes are environmentally friendly and good for health. Walking is the most basic means for travel; therefore, the walking environment should be improved and developed in the future. Development of a pedestrian network separated from car traffic is good from the viewpoint of safety and good health overall. Furthermore, improvement in the walking environment would support the promotion of public transport use since when people use buses and the railways, they usually access the railway station and bus stops on foot.

4. Objectives for Urban Transport System Development

The analysis of the present urban transport problems and the planning issues in the Colombo Metropolitan Area have led to the identification of four major objectives which the urban transport system development needs to pursue.

(1) Equity in Transport to All the Members in Society and Affordability of Public Modes of Transport

A minimum level of transport service should be provided to all members of society. In the CMA, the mobility of Group C is limited due to their insufficient income. The role of public transport is thus of great importance in providing affordable means of transport for the Group C people to access urban services. At the same time, it is necessary to develop transport facilities for the physically challenged. Such facilities are seldom seen in the CMA at the present time and the gradual improvement of transport facilities is needed.

A rail-based transport system is better than a bus rapid transit (BRT) and other types of public transport systems since a rail-based transport in general have a larger passenger transport capacity than ordinary bus transport. Usually, rail-based transport has a grade separated structure and is not disturbed by other modes of transport; consequently, it runs faster than BRT since BRT usually must stop at intersections. However, it requires a huge amount of investment as well as having a higher operation cost. This implies that the system needs to charge the passengers a higher transport fare. According to the Home Visit Survey, the Group C with a monthly income less than Rs 40,000 pays about Rs 4,000 for transport. This implies that about 10% of household income is consumed for transport. According to worldwide household expenditure statistics, the average transport expense is usually around 10% of household income and if it exceeds the 10%, households must sacrifice some other expense. Most households therefore, cannot afford to pay more for transport than at the present level. If the fare of new or improved public transport system is much higher than the presently prevailing fare level, the majority of residents will not be willing to pay for a higher transport fare. Until their household income increases to a certain level, the Government should provide financial support for developing the new transport systems and probably for operation costs in the beginning.

(2) Efficiency in Transport Systems to Support Economic Activities

Traffic congestion has resulted in a considerable amount of economic loss to society because of longer travel times, lack of punctuality and the deterioration of the environment. Efficiency in transport can be achieved by balancing transport demand and transport network capacity. Alleviation of traffic congestion can be dealt with in the following three ways: 1) by increasing road capacity through the development and improvement of the road network; 2) by optimising the utilisation of the existing road capacity by using a traffic control system and providing traffic information; and 3) by decreasing excessive vehicular traffic demand through transport demand management and diverting private mode users to public modes of transport.

At the same time, the promotion of public transport usage would also contribute toward economic efficiency by reducing vehicular traffic demand on the congested urban road network. Mass transit systems have an advantage over private modes of transport in terms of travel costs and lower consumption of space in the context of an urban area. The combination of all the approaches mentioned above will create an efficient transport system.

(3) Environmental Improvement and Health Promotion related to Transport

Air pollution caused by motorised vehicles should be minimised through emission controls for automobiles, promotion of public transport and traffic demand control, especially in the congested areas. Countermeasures to reduce PM10 should be the main focus, particularly in the CMA. In addition, aesthetics should also be considered for developing an urban transport system.

Recently people are more concerned with health and tend to do physical exercises. Walking and bicycling are good for health and transport facilities such as pedestrian paths and cycling roads should be developed for supporting these activities.

(4) Traffic Safety and Security in Transport

Since lives are invaluable and death and injury due to traffic accidents will bring great grief to family members and friends, traffic safety should be enhanced and the number of accident victims should be minimised through the enforcement of laws and regulations, intensive public campaigns, and training and education for drivers as well as the general public.

Improvement of traffic facilities through engineering design would contribute to the reduction of traffic accidents. Furthermore the security of children and women in public transport should be improved and it would partly contribute to increase the use of public transport.

5. Urban Transport Policy

To achieve the four different objectives for transport system development, the following transport policies are essential for the CMA;

1) Promotion of Public Transport Use
2) Alleviation of Traffic Congestion
3) Reduction of Traffic Pollutants/Traffic Noise and Promotion of Health
4) Reduction of Transport Accidents and Improvement of Security

These four transport policies are inter-related. The promotion of public transport is a principal measure to reduce dependence on private modes of transport. Mere improvement of public transport services, however, would not entice people who are accustomed to using private modes of transport to shift to public modes.

6. Urban Transport System Development Scenarios

The following four urban transport system development scenarios were evaluated to find the most appropriate option for long term transport system development for the CMA.

1) Base Case Scenario
2) Intensive public transport system development scenario
3) Mixed public transport and road network development scenario
4) Intensive road network development scenario

In addition, if these cases will not be able to alleviate traffic congestion, a further option can be added. Employment of transport demand management is this option and it includes car traffic restraint schemes such as Electric Road Pricing (ERP). Performance of each transport system development scenario is evaluated from the following aspects.

1) Efficiency: Economic Internal Rate of Return(EIRR) and NPV(Net Present Value)
2) Equity: Service area of quality public transport (railway, monorail and BRT)
3) Environmentally Friendly: Global Warming: Emission of CO_2
4) Traffic Safety: Economic loss due to traffic accidents

Table 6.1 Evaluation of Urban Transport System Development Scenarios

Evaluation Item	A1	A2	B1	B2	C1	C2
	Intensive Highway Development	Intensive Highway Development & TDM	Combined Public Transport and Highway Development	Combined Public Transport and Highway Development & TDM	Intensive Public Transport	Intensive Public Transport Development & TDM
Economic Internal Rate of Return (%)	19.7%	21.2%	19.3%	22.7%	19.1%	22.9%
Net Present Value (billion Rs.)	622	765	564	779	541	797
Population in the Public Transport Service Area [1)]	1.26 million people		1.36 million people		1.40 million people	
Reduction of CO_2 Emission (million ton)	4.2	6.4	5.8	7.7	5.8	8.3
Reduction of Loss due to Traffic accident (million Rs.) [2)]	510	724	756	921	710	1066
Overall Evaluation	B-	B+	B-	A-	B-	A

Source: CoMTrans Estimate Note: 1) Public transport service area is defined as the area within 800 meter radius from railway stations and BRT shelters. 2) Loss of traffic accidents are discounted value at 12%.

C2 is recommended as the most appropriate urban transport system development scenario, which include developing the public transport system extensively and at the same time employing Transport Demand Management (TDM) to promote the shift to public transport.

7. Strategies for Urban Transport System Development

The strategies for developing Urban Transport Systems in the Colombo Metropolitan Area can be divided into two stages; one is a strategy at the planning stage and the strategies should be taken into consideration when planning urban transport systems and land use. The other strategies are those related to project implementation.

7.1 Strategies for Integration with Urban Planning

(1) Centre Development for Mass Transit Systems

Urban structure and transport systems should be integrated. For instance, a highway oriented transport network is suitable for low-density land use which can be seen in the suburbs of the United States. In contrast, a mass transit system is appropriate for high-density urban land use.

Sub-centre development is one way to deal with traffic concentration in the city centre. In order to develop the sub centres, strong transport linkage is required between the city centre of Colombo and the sub centres. Mass transit systems should be installed between these centres to support the travel needs of the people and goods. Conceptually, to support the viability of public transport systems, it is preferable that a city grows compactly in a form of poly-centric decentralisation. Guided urban development is essential to develop cities to be consistent with urban transport systems. In this regard, metropolitan-wide urban land use planning is also required.

(2) Development of Public Transport Systems to be Synchronised with Urban Development

The Colombo Metropolitan Area has expanded outward from the city centre. In suburban areas the population density has not been high thus travel demand is not high at present time. In the future, as urbanisation continues, travel demand would increase and then mass transit systems might be required. Mass transit systems should be developed in accordance with urban development. Travel demand along the corridor should be monitored to determine the development timing of the mass transit system. This phased development should be taken into account in particular for the BRT system to be developed along the planned Middle Ring road in the suburban area.

(3) Transit Oriented Development (TOD)

To make mass transit systems viable, high density urban development in the area surrounding rail-based transit system stations is preferable. In the city centre, high-rise office buildings and commercial facilities, such as shopping malls within walking distance from a station are desirable to increase passenger demand on the transit system. In suburban areas, high rise apartments near stations are a preferable form of land use for the mass transit system. To materialise these developments, high floor ratios should be promoted in the urban development plan. On the other hand, outside of the area surrounding the station the floor area ratios should be limited to prevent high density urban development. The urban transport master plan should take into consideration urban development structures. CoMTrans therefore proposes that the integration of urban development with urban transport systems is of utmost importance. The strategy for the integration includes sub-centre development and Transit Oriented Development.

7.2 Strategies for Transport Planning

(1) Development of Extensive Public Transport Networks

Public transport systems at a higher level of service should be developed in the form of networks so that people can reach their destinations within the system. A higher level of public transport service means a congestion free transport system; namely, railway, medium-size transit systems such as monorail and bus rapid transit(BRT). A public transport network should consist of several trunk lines with feeder services and it should cover as wide an area as possible.

(2) Application of Transport Demand Management (TDM) and Car Traffic Restraint Scheme

Transport demand management (TDM) is necessary to alleviate traffic congestion in the CBD because new road construction, or even road widening is very difficult in the CBD and will be limited due to physical constraints such as the availability of land for the roads. Road pricing is a scheme to alleviate traffic congestion by charging vehicles entering congested areas in the city centre and it also raises funds for developing and improving the urban transport systems. Improvement of public transport is prerequisite for employing TDM.

7.3 Strategies in Project Implementation

(1) Introduction of Private Sector Funding in Transport Infrastructure Development

This system reduces the government investment for transport infrastructure development replaced by private sector funding and encourages the participation of private organisations for operation and maintenance. It is common that urban highways are developed under BOT (Build Operate Transfer) scheme or PPP (Public Private Partnership) scheme in many cities thus when urban expressways are developed, it should encourage participation of the private sector in the form of BOT or PPP. However public transport system development is usually difficult to finance by only the private sector. In most common cases, public transport fares are regulated by the Government at low levels since the government should provide means of transport for low income households. Therefore it seems difficult to make public transport projects financially profitable merely with passenger fare revenue. In many countries a common practice for financing public transport is to provide infrastructure by the public sector and provide operation by the private sector.

(2) Introduction of a Value-Capture System for Public Transport Development

Rail-based transport is not disturbed by ordinary traffic and this mode can provide fast speeds and large passenger capacity transport service. Railway passengers enjoy the fast and convenient railway service for travelling in the urban areas. In addition, railway service can increase the sales of department stores and shopping malls near stations and promote the values of land and housing along the railway corridor. However the railway company is not able to gain all the value added accrued from the railway development.

Since a rail-based transport system requires huge initial investment cost, the methodology of cost recovery should be done through value capture of development. In the case of private railway companies in Japan, they develop housing areas along the railway corridor. After they provide new railway service, the land values increase and they sell the housing at a higher price and get profits from the real estate business. They are also starting retail businesses as well by building shopping malls at the terminal stations. From this kind of commercial business they can profit in addition to passenger transport service. To support the rail-based transit development project financially it is recommended to take this kind of business model into consideration.

(3) Methodology of Space Preparation for Urban Development

To develop the desirable urban structure, sometimes land acquisition is required but it is no easy to implement; thus, new implementation methods should be introduced. There are two methodologies that can be applied in Sri Lanka.

Land Re-adjustment

This is a typical method of Japan's urban development to create a comfortable residential area. An irregular-shaped plot is re-plotted to a rectangular shape by reducing the site area. The reduced site area is provided for roads and sometimes parks or community facilities, and part of the land is sold to cover expenses for compensation and construction cost for road improvement. Then all lands are re-plotted and roads can be constructed. Although each land owner lost a part of the land, the land owners will gain more value since the land value will be increased as the road condition becomes much better than before.

Urban Renewal Project

This is also a typical method in the Japanese context to create urban centres within a commercial or business district. Land owners can organise an urban renewal association. Often a developer coordinates to organise the association and the Government is also involved. The lands are unified and shared with the owners and the developer. A part of the land is provided for public purposes, mainly roads. Thus, a building is constructed and all the members gain benefits by allocating the floors.

Both are still challenging methods for the Sri Lankan context. However, implementation methods are essential and should be recommended in order to achieve the Master Plan.

8. Urban Transport System Development Programmes

8.1 Urban Transport System Development Programme (1) for Promotion of Public Transport Use

The following policy measures are proposed for promoting public transport use;

1) Monorail Systems

   Multi-Modal Transport Hub and Multi-Modal Centre (MMC)

   Park & Ride and Station Plaza Development

   Provision of Direct Access to Multi-modal Transport Hubs for Inter-city Bus Services

2) Modernisation of Existing Railway System

3) Construction of Airport Connection Line

4) Development of Access Roads to Stations of Railways and New Transit System
5) Introduction of Bus Rapid Transit (BRT)
6) Road Development for Introducing BRT
7) Bus Priority System and Bus Location System for BRT
8) Regulatory Scheme for Road-Based Public Transport Modes

8.2 Urban Transport System Development Programme (2) for Alleviation of Traffic Congestion

The following policy measures are proposed for alleviating traffic congestion;

1) Ring Road Development
2) East - West Arterial Road Development in Eastern Part of Suburban Area
3) Expressway Network Development
4) Flyover Development
5) Port Access Road
6) Traffic Control
   - Traffic Signal Control Improvement
   - Traffic Information System
   - Parking Information System
7) Transport Demand Management (TDM)

8.3 Urban Transport System Development Programme (3) for Reduction of Air Pollutants/Traffic Noise and Promotion of Health

The following policy measures are proposed for reducing air pollutants and traffic noise as well as promoting health;

1) Establishment of Environmental Management Scheme
2) Establishment and Enhancement of Air Pollutant Emission Standards for Newly Manufactured and Imported Vehicles
3) Enhancement of Vehicle Inspection and Maintenance Programmes
4) Low Sulphur Diesel Programme
5) Promotion of Natural Gas Vehicles
6) Promotion of Hybrid Cars and Electric Vehicles
7) Promotion of Walking and Bicycle Use for Energy Saving and to Promote Health
8) Provision of Sidewalk for Urban Roads

8.4 Urban Transport System Development Programme (4) for Reduction of Fatalities and Injuries in Traffic Accidents and Improvement of Security

The following policy measures are proposed for reducing fatalities and injuries in traffic accidents;

1) Education on Traffic Safety
2) Rehabilitation and Installation of Traffic Signal System
3) Rehabilitation of Railway Signal System
4) Analysis on Causes of Traffic Accidents
5) Provision of Sidewalks and Pedestrian Crossings
6) Establishment of Urban Road Design Standard for Sidewalks

9. Implementation Plan for CoMTrans Master Plan

It is, in principal, necessary to undertake various analytical steps with regard to the "project life cycle" as defined by the Government in order to estimate the impact of the "CoMTrans Master Plan" implementation on the public investment budget.

However, since the CoMTrans Master Plan is a transport network development plan, in which all projects are inherently inter-linked, it suffices to analyse accumulated required investment totals over the three planning horizons (short, medium and long-term), the total planning period (2015-2035) and investigate how these totals compare to the Government's policy targets established for public investments in the transport sector.

9.1 Total Investment Cost Required for CoMTrans Master Plan Implementation

Table 9.1 shows the needed investment volume for CoMTrans realisation without assuming any particular financing model.

- The total investment volume over the planning period from 2015 to 2035 is estimated at Rs 2,780,900 million, of this 59% of the total is for net investments and about 41% for implied O&M cost.
- The distribution of the investment and O&M combined cost components is estimated at 35% over the short-term, 31% over the intermediate term and the balance of 34% over the long-term.
- This total volume may exceed the capacity to finance at a 100% self-financing rate from public budget and envisaged public investment resources.

9.2 Government Budget Requirement to Implement CoMTrans Master Plan

The "reduction in burden" on the public budget could be achieved if the expressways are predominantly financed under a PPP scheme and the O&M burden for the monorail and also the BRT system could be shifted to private sector interests. The main message of the numbers is:

- Total net additions to investment over the whole planning period would be reduced from Rs 2,780,960 million to Rs 2,256,500 million or roughly by 19%
- The major gain would originate from reductions to the public investment budget, and
- Minor gain would also be achieved through reducing the impact on the Government's O&M expenditure.

Table 9.1 Total Investment Requirements for the Entire CoMTrans Master Plan Realisation

					unit: million RS
		Short	Intermediate	Long	Total
		2015-2020	2021-2025	2026-2035	
		6 years	5 years	10 years	21 years
Investment					
	Monorail	173,800	89,800	144,600	408,200
	Railway	67,800	146,400	74,500	288,700
	BRT	12,300	9,300	0	21,600
	Bus	0	0	0	0
	Multi-Modal Transit Facility	21,700	0	0	21,700
	Road	462,800	345,000	74,300	882,100
	- Expressway	407,100	138,300	0	545,400
	- Other Roads	55,700	206,700	74,300	336,700
	Traffic Management	2,800	7,500	7,500	17,800
	Total	741,200	598,000	300,900	1,640,100
O & M					
	Monorail	52,100	65,900	204,100	322,100
	Railway	46,100	75,000	187,300	308,400
	- Additional Investment	20,300	53,500	144,300	218,100
	- Existing Infrastructure	25,800	21,500	43,000	90,300
	BRT	10,300	14,100	28,300	52,700
	Bus	81,000	67,500	135,000	283,500
	Multi-Modal Transit Facility	3,900	3,300	6,500	13,700
	Road	43,500	38,100	76,200	157,800
	- Additional Investment	0	200	400	600
	- Existing Infrastructure	40,700	33,900	67,900	142,500
	- Expressway	2,800	4,000	7,900	14,700
	Traffic Management	200	500	1,800	2,500
	Total	237,100	264,400	639,200	1,140,700
Grand Total		978,300	862,400	940,100	2,780,800
% Composition		35%	31%	34%	100%
Source: CoMTrans Estimate					

If it is assumed that the maximum allocation to the urban transport sector is 2% of GRDP in the Western Province, in the short term a shortage of development funds is expected. Consequently to fill the gap between the government budget and amount required for investment, it should consider utilising external financial sources such as ODA.

10. Institutional Setup and Regulatory Framework for Urban Transport

10.1 Transport Administration in Sri Lanka

The National Transport Policy sets the following administrative structure to ensure the adequate provision of transport infrastructure and services. The transport administrative structure is divided into five steps, i.e. policy, planning, implementation and monitoring, regulation, infrastructure provision, and service provision. Although transport policy is made by the MOT assisted by the NTC and other stakeholders and the planning is done by the NTC, the reality is that there are central and provincial governments involved in vertical sphere, and some numbers of institutions involved in horizontal sphere, even if only at the central government level. If including subsidiary institutions, such as the DMT, MOFP and so on, the number of stakeholders increases.

The complexity of the existing urban transport administration makes the urban transport administration in CMA inefficient and this makes it difficult to carry out new transport measures and integrated transport policies, such as inter-modal transfer/connection, a common transport pass system and so on. As stated in the National Transport Policy, the efficiency of transport administration lies in how such complexity can be dealt with in a planned manner. In order to ensure the planning function is strengthened and becomes a responsibility of the assigned agencies, the Government indicated in the National Transport Policy that it would establish a coordination mechanism for urban transport through the Presidential Committee for Urban Transport (PCUT), which is in line with the CoMTrans Team's recommendation as well. An ideal structure for the urban transport administration in CMA would be to establish an agency that is powerful in policy making, planning, monitoring budget allocation, and implementation of public transport service delivery, but lean in institutional structure, i.e. not creating another mega institution to hire many staff members and to fight over vested interests with the existing institutions.

10.2 Towards the Realisation of CoMTrans Master Plan

In line with the National Transport Policy, the CoMTrans suggests the establishment of an Urban Transport Council under the President. The council is expected to be a central high-level body that represents all main political decision makers in urban transport, including the Western Provincial Council. The members consist of appropriate ministers and/or deputy ministers from national government and the chief minister or transport minister of the Western Province Council. The council is to be led by the senior minister in charge for transport in the Administration. The council is set-up for making decisions on urban transport policy and planning in CMA, so it would not replace the existing transport sub-committee under the Cabinet nor the Parliament. The sub-committee for transport under the Cabinet shall be the final resort for the urban transport council, as well, to politically solve transport issues which encompass widespread areas.

(1) Institutional Arrangement

The council must be established as a standing council until its functions are transferred to the envisaged urban transport authority in the future. However, it is not intended to create another institution such as a ministry, department or authority. Therefore, it is suggested to establish a sub-division under the Planning Division of the MOT to support the council as secretariat. The functions of the secretariat are to support all administrative and technical tasks appointed by the council; yet, considering the scarcity of professionals in urban development and transport planning in the government sector, it is suggested that the academia, e.g. University of Moratuwa, provides technical support to the secretariat. Since the council consists of higher-level members, establishment of a technical committee or technical task force shall be taken into account once the council is formally established. The functions of the technical committee, among others, are to update the transport data collected for the CoMTrans master plan, and to formulate roll-over transport annual action plans, to monitor the progress of the master plan, and to provide technical inputs to the council.

It should be underlined that the council, the secretariat in the MOT and the technical committee must be legally supported as formal bodies, i.e. being established under a presidential decree and announced in a Gazette. It should be also noted that the proposed council is not, apparently, a monolithic bureaucracy which consolidates all present departments and agencies, but it is an efficient strategic policy setting body that coordinates and governs all the components of urban transport. It is also not a funding agency, but one of its duties is to make funding decisions under the framework of given functions of the council to support and recommend budget allocations to MOFP, which allocate budget directly to agencies based on its decisive criteria. The council is envisaged to be responsible for every facet of urban mobility including private modes and public transport and will also have some influential role in city development planning in close cooperation with NPPD, UDA, the Western Provincial Council and local authorities.

(2) Legalising the CoMTrans Master Plan

Unless the CoMTrans master plan becomes a legally binding master plan, there would be no base for the newly established urban transport council to implement the plan, taking into account that respective ministries and local government must already have their own plans to develop roads, public transport service delivery and so on.

Considering that the anticipated members of the council will be almost the same as the members of the steering committee of the CoMTrans master plan study, it is expected that first the CoMTrans master plan would be agreed among the steering committee members and the MOT submit it as a legally binding master plan to the Administration to be endorsed. It is crucial that the short-term projects shall be jointly scrutinised with the National Planning Department of the MOFP, in terms of feasibility of budget allocations for forthcoming project proposals.

(3) Risks for the Realisation of CoMTrans Master Plan

In the past, similar recommendations were made in several studies; yet, no coordination body was established. As stated in previous sections, several issues have hindered the realisation of the recommended measures, i.e. lack of continual political willingness and adverse political interventions, unclear delineation of functional responsibilities among transport related institutions, lack of coordination mechanisms, absence of legal basis for the master plan and absence of legal basis for the implementing institutions.

The biggest issue encountered for the realisation of the master plan is the unpredictable political influence and wandering political directions, which are hard to control or prevent. However, once the master plan becomes a legally binding document, it will be at least a roadmap for urban transport development in CMA. The previous JICA study team failed to make its master plan a legally binding plan, so it had weakness in the implementation stage; so it is strongly suggested that the Steering Committee agrees upon the CoMTrans master plan and make it a legally binding plan within the study period. Once the master plan is endorsed by all stakeholders, the council can be established and functional responsibilities between the council and related line ministries, agencies and local authorities become crystal clear since the proposed projects and implementing agencies are indicated in the master plan.

11. Conclusions

Economic development has accelerated after the end of the civic conflict and travel demand has also increased rapidly. Colombo is the centre of economic activity in Sri Lanka thus the increase in traffic demand has been remarkable. In the Colombo Metropolitan Area, 6.9 million trips are made each day at present and it is estimated to grow to 12.2 million trips in 2035. It goes without saying that a mass transit system is needed to meet the increasing travel demand. In the CoMTrans master plan it is recommended to develop a monorail system together with a Multi-modal Transport Hub, Multi Modal Centre and Park & Ride systems. It is desirable to develop a rail-based transport system, which is not disturbed by ordinary road traffic. The rail-based transport system, however, requires a considerable amount of investment for development. Consequently, it usually takes a long time to develop the extensive rail-based transport network.

On the other hand, at present buses run at low speeds because buses are caught in the general traffic congestion on the roads, thus punctuality of operation is not ensured. A large number of residents now try to avoid using buses because of the low level of bus services such as over-crowding, lack of punctuality and lack of comfort. Therefore, a higher level of public transport service should be urgently provided to prevent the shift from public to private modes of transport. Furthermore, having merely one route of the rail-based transport system is not sufficient to attract people to public transport use but an extensive network should be formulated like a web to cover the major travel destinations in the metropolitan area. Improvement of transport nodes such as station plazas could make it easy and convenient to use public transport systems.

It should also be noted that the ability to pay for transport of the majority of the residents is low and it is therefore difficult to set public transport fares high enough to enable the private sector to provide a high level of public transport services.

In the short term and intermediate term, the public transport network should be formulated by combining the existing Sri Lanka railway which needs upgrading, a monorail system and BRT system. In the long run, a rail-based transport system is needed to provide a higher level of services as well as a higher passenger capacity. The development of a BRT system ensures the space for future rail-based transport system development with a higher level of services.

Improvement of public transport services alone cannot suppress the deeply rooted preference to use private modes of transport; consequently, traffic restraint schemes should be employed in the central area of CMA where traffic congestion is often observed.

Another important measure is to develop sub-centres in suburban areas and to distribute the urban functions, which are currently concentrated in CMC. By creating an alternative urban structure, traffic congestion problems would be alleviated to some extent.

Although promotion of public transport is the most important policy to alleviate the transport problems in the master plan, the road network has not been well developed and the capacity is significantly low in suburban areas. In particular, the progress of road network development has not caught up with the expansion of urbanised areas, therefore, road network development is also important in suburban areas.

Transport infrastructure development requires a long period in order to be realised, thus in order to deal with the current transport problems, immediate actions are necessary. The short-term countermeasures include the installation of area-wide traffic signal systems and the improvement of present signal control. Traffic control such as one way systems is also taken into account for the alleviation of traffic congestion in specific areas.

12. Recommended Immediate Actions

(1) Legal Framework for Transport Network Development

The target year of the CoMTrans urban transport master plan is 2035, which is 21 years from now. Developing transport infrastructure needs a long time. Once the urban transport master plan is agreed among the relevant stakeholders, it should be authorised and have legal binding for future development. This implies that the Right of Way (ROW) should be reserved for future development of transport facilities - railway and road networks. If urban development such as commercial building and residential complex developments are allowed in the areas set aside for the planned transport network, it would become difficult to develop the transport network in a desirable form. It is therefore proposed to establish a legal framework for setting aside a space for future transport system development.

(2) Enhancement of Urban Land Use Regulations

CoMTrans emphasises the importance of integration between land use and the transport systems, thus Transit Oriented Development (TOD) is recommended in this regard. It needs high density urban development in the areas surrounding railway stations and important public transport hubs. Urban land use regulations which designate a type of land use and floor area ratio is needed for guiding land use to a desired pattern. In Sri Lanka, however, the floor area ratio has not been determined for every plot and no limitation on floor area is given to a block exceeding a certain size of plot area. Without limitation of the floor area ratio it is difficult to guide land use in the area surrounding the railway stations into high density, for instance high rise office buildings and apartments. Urban land use plans with guidance for the floor are ratio should be prepared for materialising TOD, otherwise it will be difficult to promote. If such regulations cannot be established, it would lead to failure in TOD and also it would worsen the traffic congestion.

(3) Post Evaluation of Projects in the Urban Transport Master Plan

It is definitely important to conduct a post evaluation to understand the performance of the relevant agencies. If some projects are delayed in implementation, it requires exploring the reasons why the projects have not been executed as scheduled. If the projects have been implemented, the impacts of the projects on transport as well as economic activities should be examined carefully. It should be then fed back to the next stage and the plan should be modified and improved into a more efficient and convenient system. The circumstances surrounding the urban transport will change over time and the initial plan would not be suitable for a new situation. The urban transport master plan, which is prepared for the long period of 20 years, should be regarded as a rolling plan. It should be reviewed regularly and updated to fit in the new circumstances. A Plan-Do-Check-Action (PDCA) cycle should be applied for master plan implementation and monitoring.

(4) Development of Urban Transport Database System

The CoMTrans conducted the first large-scale Person Trip Survey in Sri Lanka including Home Visit Survey and other relevant transport surveys. The data collected gives base data not only for transport planning but also for urban planning. In line with the master plan review and updating mentioned above, this database is useful for post evaluation of the master plan. The database should be updated and modified periodically for review and updating the master plan. Since the database covers a broad range of fields; demography, land use, economic activities, industry, and transport, the establishment of an urban transport database centre is desirable for maintenance of the database. The database centre could be established in the Ministry of Transport or a University. In addition, it is necessary to build the capacity of the transport planning experts who can undertake a transport analysis and plan using this database.

(5) Further Investigation on Traffic Safety

Thanks to the accident data provided by the police, an extensive traffic accident database is available and it was analysed in the Study. Further detailed analysis on Black Spots is proposed to identify the places where traffic accidents frequently occur. The analysis will lead to the identification of causes of accidents and required countermeasures.

(6) Promotion of Health in the Transport Sector

Developing of a pedestrian path network and bicycle road network, which connects major parks in the urbanised areas is proposed in the master plan. Construction of these facilities encourages walking, jogging and cycling by the citizens in the metropolitan area. These kinds of facilities contribute to green transport which aims at healthy and environmentally friendly transport.

(7) Bus Operation Reform

Bus operation can be made more efficient and systematic without a huge investment. Currently real-time monitoring of bus operation can be achieved with a GPS device. Fare collection with an IC card through a communication device is also available now. The technical solutions are available for the difficulties in monitoring and management of bus operation. Now is a good opportunity to reform bus operation to provide better service for passengers. Installation of a GPS device on the buses enables bus fleet tracking on a real time basis, and then the management of bus companies can control their buses on the roads. Moreover, the introduction of the IC ticket system makes it possible to provide a subsidy for private bus companies, if the government would like to provide subsidy for private companies, since the exact number of discount tickets can be counted.

(8) Feasibility Study for Project Implementation

A number of transport infrastructure development projects as well as soft measures have been proposed in the CoMTrans master plan. Although the feasibility study on Monorail and MmTH project has been conducted, the feasibility studies on the other projects are also important for alleviation of traffic congestion and the promotion of public transport. This includes BRT system development for developing an extensive quality public transport network integrated with the monorail and employment of ERP for demand management. It is recommended to conduct these feasibility studies at the earliest possible time.

Main Report

CHAPTER 1 Introduction

1.1 Background

The transport demand has increased remarkably over the past few years, especially in the Colombo Metropolitan Area (hereinafter referred to as CMA)[1], which consists of the Colombo Municipal Council (hereinafter referred to as CMC) and the adjacent area which heavily depend on urban transport.

Due to the increase in traffic demand the speed of vehicles on the roads has declined resulting in higher vehicle operating costs for vehicle owners and environmental deterioration on the entire community. These impacts negatively affect not only the economic development in the Colombo Metropolitan Area, but also that of the country because roughly half of the country's economic activities are concentrated in this area. In addition, the nation's largest international seaport and airport are located within the area. The Colombo Metropolitan Area, therefore, requires improvement and development of the transport system to tackle the increasing transport demand.

As the largest metropolitan area in Sri Lanka, the population of CMA was 3.7 million inhabitants in 2012. It is estimated that the total population of CMA will increase to 5.1 million people in 2035 and economic growth with urban development plans are expected. The total person trip demand would increase 1.75 times and the trip demand made by private modes of transport would increase rapidly due to the anticipated increase of household incomes.

Current traffic congestion becomes serious during the morning and evening peak periods within and around the boundary of CMC and is expanding its area. Furthermore, traffic congestion will worsen due to the anticipated increased demand if appropriate countermeasures are not taken. Less utilisation of high occupancy vehicles, a lack of facilities for pedestrians and bus passengers, an insufficient capacity of public transport and poor enforcement of traffic rules aggravate the situation.

It seems difficult for the government to invest for all of the transport infrastructure projects since a huge amount of investment is required for development. Appropriate allocation of funds should be examined not merely for one sector but for all sub sectors relevant to urban transport. It is also of great importance to promote private sector participation in transport system development and reduce the burden on the government in transport infrastructure development and transport service provision.

1.2 Study Objective

In order to develop an efficient urban transport network and the promotion of a reliable and safe transport system, the objectives of the Urban Transport System Development Project for Colombo Metropolitan Region and Suburbs (herein under referred to as the Project) are:

[1] Section 4.1 explains how to define the Colombo Metropolitan Area

- To prepare reliable transport data that can be utilised to evaluate and formulate transport development plans/projects in a scientific manner by conducting an area-wide transport survey.
- To formulate a comprehensive Urban Transport Master Plan for the Colombo Metropolitan Area including the six transport corridors prioritised by the Ministry of Transport with the justification of selected priority/leading projects for short-term, mid-term, and long-term implementation.
- To conduct a feasibility study on the prioritised project under the comprehensive urban transport master plan.

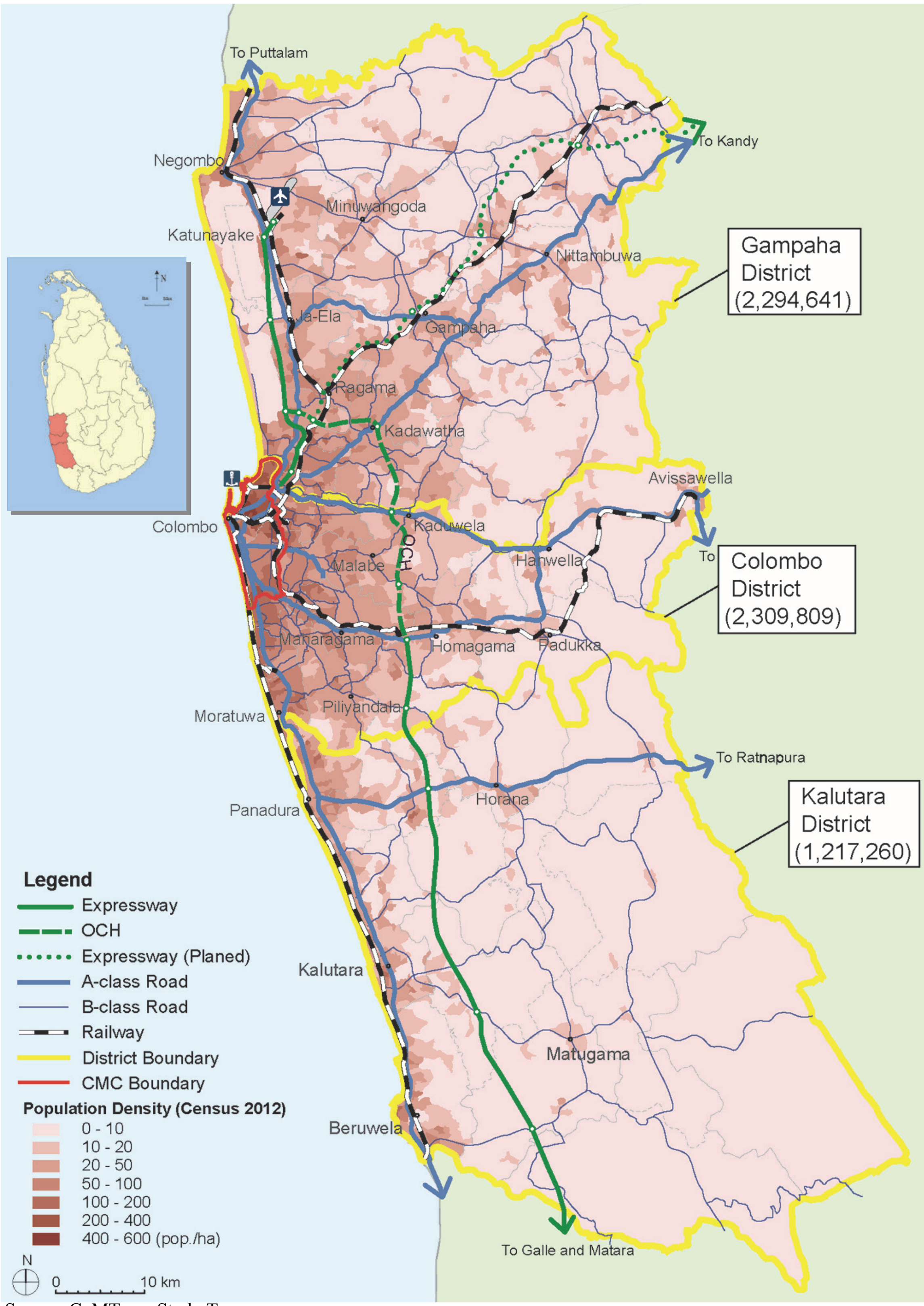
The target year for the Urban Transport Master Plan is 2035. The master plan includes an immediate implementation plan (2015), short-term (2020), intermediate-term (2025) and long-term (2035) transport system development plans.

1.3 Study Area and Planning Area

The Study area covers the entire Western Province where the transport surveys were conducted as shown in Figure 1.4.1. The Western Province is comprised of the Gampaha, Colombo and Kalutara Districts. Seven municipal councils (MC) among 23 municipal councils in Sri Lanka are located in the Western Province including the Colombo municipal council, the largest municipality in Sri Lanka, and the Sri Jayawardenapura Kotte municipal council, an administrative capital. The planning area is the area for the Urban Transport Master Plan and it should cover the urbanised area in the planning horizon of Year 2035. The planning area including the Colombo Metropolitan Area (CMA) identified in the Study is described in Chapter 4.

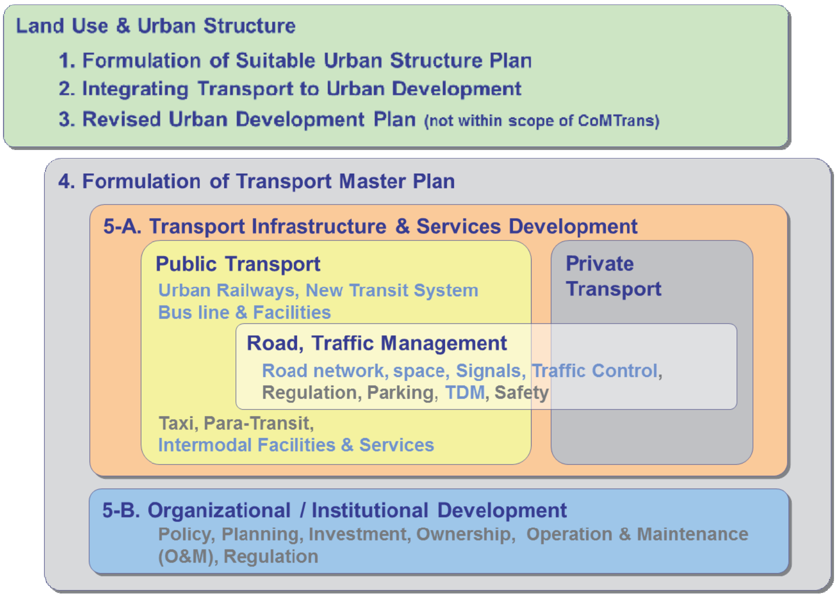
1.4 Scope of the Study

The scope of the urban transport master plan formulation includes an urban structure and land use plan though detailed urban planning was not conducted in the Study. The urban transport master plan is formulated in a well organised manner which integrates various types of public transport systems and road networks. Furthermore it should be incorporated with traffic control and transport management as well. To materialise the projects proposed in the master plan, institutional setups and financial arrangements are also taken into consideration. Figure 1.4.2 shows the overall scope for the urban transport master plan.



Source: CoMTrans Study Team

Figure 1.4.1 Study Area



Source: CoMTrans Study Team

Figure 1.4.2 Scope of Urban Transport Master Plan

1.5 Structure of Final Report

The Final Report consists of the following reports:

- Main Report (this report)
- Summary Report
- Technical Reports

Technical reports deal with the technical aspects of the contents of the main report which include transport surveys conducted in the Study, urban structure and land use, identified present urban transport problems of transport sub sectors and the proposed development plans, transport models and demand forecasting, institutional aspects for master plan implementation, and the strategic environmental assessment.

1.6 Structure of Main Report

The Main Report of the Final Report consists of the following Chapters:

- Chapter 2 presents the basic feature of the Colombo Metropolitan Area from three aspects; population, urban structure and economic activities. The population part describes changes in the population between 2001 and 2012 referring to the Population Census 2012 and discusses the socio-economic characteristics based on the Home Visit Survey. The urban structure part reviews current land use and urban structure, mentioning urban development characteristics and its problems. The economic indicators part presents the growth of and Gross Regional Domestic Products (GRDP) as well as household income distribution in CMA.

- Chapter 3 describes the current person travel demand to understand the features of the present transport situation. Person trip demand by trip purpose and by mode of transport is examined. In the latter part of the chapter, the situation of the current urban transport system is presented, including railway and bus transport as well as private vehicles. Both demand and service level is examined, from the view point of the network and demand.
- Chapter 4 discusses the perspective of a socio-economic framework and urban structure in the Colombo Metropolitan Area. Integration between an urban transport system and land use is discussed. The future population is estimated by income level and occupation for the future years of 2020, 2025 and 2035.
- Chapter 5 presents the Integrated Urban Transport Master Plan. In the beginning of this chapter, the future perspectives of the urban transport including future demand forecast are described. Objectives of the urban transport system development are identified based on the problems which are mentioned in the previous chapter. To achieve the objectives, an urban transport policy and policy measures are listed. A corridor analysis was conducted and the most suitable mode of transport is selected. Based on the corridor analysis, three urban transport system development scenarios have been prepared. The base case is based on the corridor analysis which has identified the mode for each corridor. Another three types of urban transport system development scenarios (Intensive Highway Development, Public Transport Intensive and Combined Public Transport and Highway Development) have also been prepared for comparison. Urban transport development scenarios are evaluated from various aspects and the most suitable option is selected. Strategies are then explained to materialise urban transport system developments. In addition, the outline of the intercity transport system is described for the integration of an intercity transport system with urban transport systems at interchange points such as a Multi-modal Transport Hub and a Multi Modal Centre. In line with urban transport policy, urban transport system development programs are established and major components of the program are described. Finally CoMTrans urban transport master plan is established and a phased development plan is also prepared which consists of a short-term development plan, an intermediate development plan and a long-term development plan.
- Chapter 6 discusses institutional aspects and financial arrangement. After formulating the urban transport master plan for the Colombo Metropolitan Area, it is of great importance to consider a way how to make it happen. To implement the projects included in the master plan, institutional setup is required and relevant regulations shall be established. Furthermore financial arrangement is also important for implementing the projects since the government has a limited budget for infrastructure.
- Chapter 7 presents the conclusion of the Study. An urban transport master plan should integrate relevant sectors in transport and it should also be integrated with urban structure and land use. In the master plan the variety of transport infrastructure development projects such as road network and public transport system development are proposed. Comparing the different transport system development scenarios, CoMTrans recommends the intensive public transport system development for the Colombo Metropolitan Area which focuses on public transport projects. In addition, it is also recommended that regulatory reform and financial arrangement are important for materialising the proposed projects.

CHAPTER 2 Socio-economic Conditions and Urban Structure

2.1 Population

2.1.1 The Census Details

(1) Historical Growth

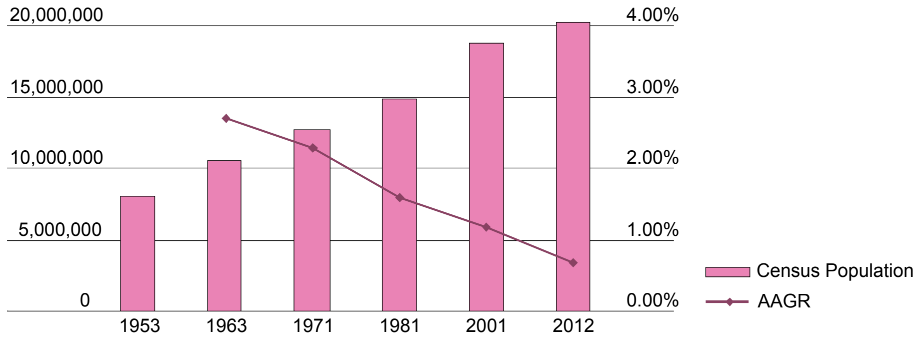
After 1950, the Department of Census and Statistics undertook a census in Sri Lanka in the years of 1953, 1963, 1971, 1981, 2001, and 2012. Population and Average Annual Growth Rates (AAGR) of Sri Lanka, the Colombo District, the Gampaha District, the Kalutara District, and the Western Province of the census years are shown in Table 2.1.1 and Figure 2.1.1, and Figure 2.1.2.

The population of Sri Lanka was 20,263,723 in 2012. Historically, the AAGR has been slowing down gradually. It was over 2% till 1971, but the latest AAGR from 2001 to 2012 was 0.69%. The population of the Western Province was 5,821,710 in 2012 and the AAGR was 0.72%. The AAGR of the Western Province has kept pace with that of the country. Within the Western Province, the AAGR of Colombo District is 0.23%, which is much lower than in other areas.

Table 2.1.1 Population and Average Annual Growth Rate (1953-2012)

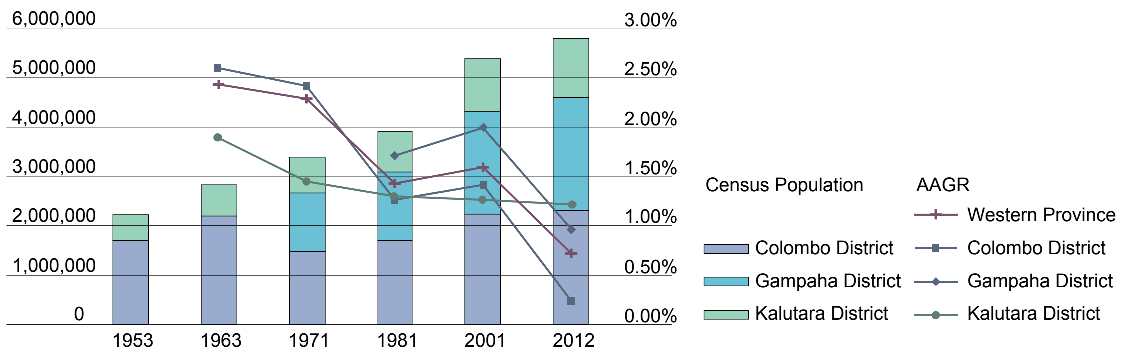
Census Population	1953	1963	1971	1981	2001	2012
Sri Lanka	**8,097,800**	**10,582,100**	**12,689,897**	**14,846,750**	**18,797,257**	**20,263,723**
Western Province	**2,232,276**	**2,838,877**	**3,401,779**	**3,919,807**	**5,381,197**	**5,821,710**
Colombo District	1,708,726	2,207,420	1,498,393	1,699,241	2,251,274	2,309,809
Gampaha District*			1,173,872	1,390,862	2,063,684	2,294,641
Kalutara District	523,550	631,457	729,514	829,704	1,066,239	1,217,260
Average Annual Growth Rate		**'53-'63**	**'63-71**	**'71-'81**	**'81-'01**	**'01-'12**
Sri Lanka		**2.71%**	**2.30%**	**1.58%**	**1.19%**	**0.69%**
Western Province		**2.43%**	**2.29%**	**1.43%**	**1.60%**	**0.72%**
Colombo District		2.59%	2.42%	1.27%	1.42%	0.23%
Gampaha District*				1.71%	1.99%	0.97%
Kalutara District		1.89%	1.45%	1.30%	1.26%	1.21%

Note:* Gampaha district was declared as a new administrative district, separated from Colombo District in 1978.
Source: Census of Population and Housing 2001 and 2012, Department of Census and Statistics



Source: Census of Population and Housing 2001 and 2012, Department of Census and Statistics

Figure 2.1.1 Census Population of Sri Lanka



Source: Census of Population and Housing 2001 and 2012, Department of Census and Statistics

Figure 2.1.2 Census Population in the Western Province

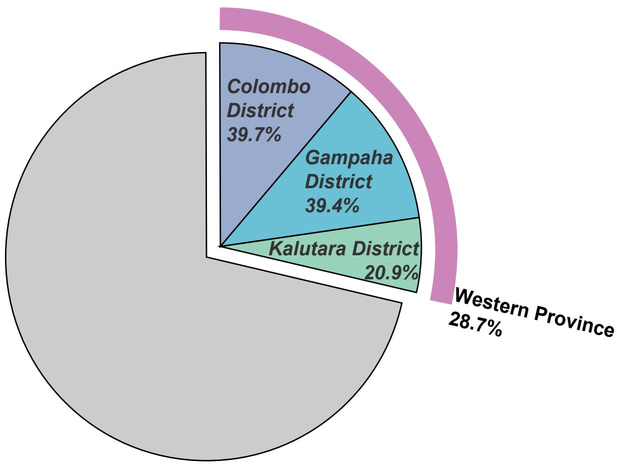
(2) Population Share

The Western Province had 28.7% of the total population of Sri Lanka in 2012. The population share has stayed almost the same as in the census of 2001. Within the Western Province, 40% of the population is in the Colombo District and another 40 % is in the Gampaha District, while the Kalutara District has only 20%. The population share of the Gampaha district is rising gradually, and now it is reaching the same population as the Colombo District. The population share is shown in Table 2.1.2 and Figure 2.1.3.

Table 2.1.2 Population Share in Sri Lanka and the Western Province (2001 and 2012)

Census Population	2001			2012		
	Population	Share in Sri Lanka	Share in Western P.	Population	Share in Sri Lanka	Share in Western P.
Sri Lanka	18,797,257	100.0%	-	20,263,723	100.0%	-
Western Province	5,381,197	28.6%	100.0%	5,821,710	28.7%	100.0%
Colombo District	2,251,274	12.0%	41.8%	2,309,809	11.4%	39.7%
Gampaha District	2,063,684	11.0%	38.3%	2,294,641	11.3%	39.4%
Kalutara District	1,066,239	5.7%	19.8%	1,217,260	6.0%	20.9%

Source: Census of Population and Housing 2001 and 2012, Department of Census and Statistics



Note: Western Province – Population Share (%) of Sri Lanka
Colombo, Gampaha, and Kalutara District – population share (%) of the Western Province

Source: Census of Population and Housing 2012, Department of Census and Statistics. Calculated by CoMTrans Study Team

Figure 2.1.3 Population Share of the Western Province (2012)

(3) Population by Age Group and by Gender

Population by age group was published in the 2001 Census on a detailed level. However, only preliminarily results are available from the census of 2012. Populations by gender and three age groups, which are: less than 15 years, 15 to 59 years, and 60 years and over, according to Grama Niladhari Division (GND) are published by the Department of Census and Statistics.

Population by age group is shown in Table 2.1.3. The population was aging from 2001 to 2012 in Sri Lanka as well as in the Western Province. In the Western Province, the elderly increased from 0.53 million to 0.77 million, and the population share of the elderly increased from 9.9% to 13.2%. District wise, Kalutara District shows a relatively high percentage of the population who is over 60 years old. In comparison to the rest of Sri Lanka, the Western Province has fewer in the younger generation but more in the working-age and elderly populations.

The percentage of those in the over-60-year-old population by GND are mapped in Figure 2.1.4. In rural areas and the central area of CMC, the percentage of over the 60-year-old population is high, showing over 15%. Suburban areas show a lower percentage of the aged population.

These population data by age group and gender would be the basis for future population projections, especially for students and the employed population.

In terms of population by gender, the female population was slightly higher than the male population. 48.5% of the Sri Lankan population and 48.8 % of the Western Province's population was male. The male population is equally distributed.

Table 2.1.3 Population by Age in Sri Lanka and the Western Province (2001 and 2012)

2001	Total	Census Population			Population Share		
		Under 14	15-59	60 and over	Under 14	15-59	60 and over
Sri Lanka	18,797,257	**NA ***	**NA ***	**NA ***	**NA ***	**NA ***	**NA ***
18 District *	**16,929,689**	**4,449,026**	**10,916,791**	**1,563,872**	**26.3%**	**64.5%**	**9.2%**
Western Prov.	**5,381,197**	**1,219,985**	**3,630,374**	**530,838**	**22.7%**	**67.5%**	**9.9%**
Colombo Dis.	2,251,274	482,280	1,552,726	216,268	21.4%	69.0%	9.6%
Gampaha Dis.	2,063,684	476,269	1,392,743	194,672	23.1%	67.5%	9.4%
Kalutara Dis	1,066,239	261,436	684,905	119,898	24.5%	64.2%	11.2%
2012	**Total**	**Census Population**			**Population Share**		
		Under 14	**15-59**	**60 and over**	**Under 14**	**15-59**	**60 and over**
Sri Lanka	**20,263,723**	**5,228,927**	**12,566,467**	**2,468,329**	**25.8%**	**62.0%**	**12.2%**
Western Prov.	**5,821,710**	**1,356,695**	**3,696,417**	**768,598**	**23.3%**	**63.5%**	**13.2%**
Colombo Dis.	2,309,809	516,741	1,484,820	308,248	22.4%	64.3%	13.3%
Gampaha Dis.	2,294,641	536,758	1,467,497	290,386	23.4%	64.0%	12.7%
Kalutara Dis	1,217,260	303,196	744,100	169,964	24.9%	61.1%	14.0%

Note: * 18 Districts are; Colombo, Gampaha, Kalutara, Kandy, Matale, NuwaraEliya, Galle, Matara, Hambantota, Ampara, Kurunegala, Puttalam, Anuradhapura, Polonnaruwa, Badulla, Moneragala, Ratnapura, and Kegalle.

Out of the five Districts in the Northern Province, Jaffna, Kilinochchi and Mullaitivu were not covered during the Preliminary and Final Census. Vavuniya and Mannar were covered partially. In the Eastern Province, Trincomalee and Batticaloa were covered partially. As such, estimates for the Districts which were not covered or partially covered, are based on the information collected during the Listing and Numbering operation of the 2001 Census, wherever possible, wherever the Listing and Numbering operation was also not complete the Registrar General's Estimates based on the registration of Births and Deaths, have been used.

Source: Census of Population and Housing 2001 and 2012, Department of Census and Statistics

Note: Expressways/Highways are shown on the map as reference.
Source: Census 2012, by Department of Census and Statistics. Mapped by CoMTrans Study Team

Figure 2.1.4 Share of Aged Population Over 60 years (2012)

(4) Estimation of 5-year Age Group Population

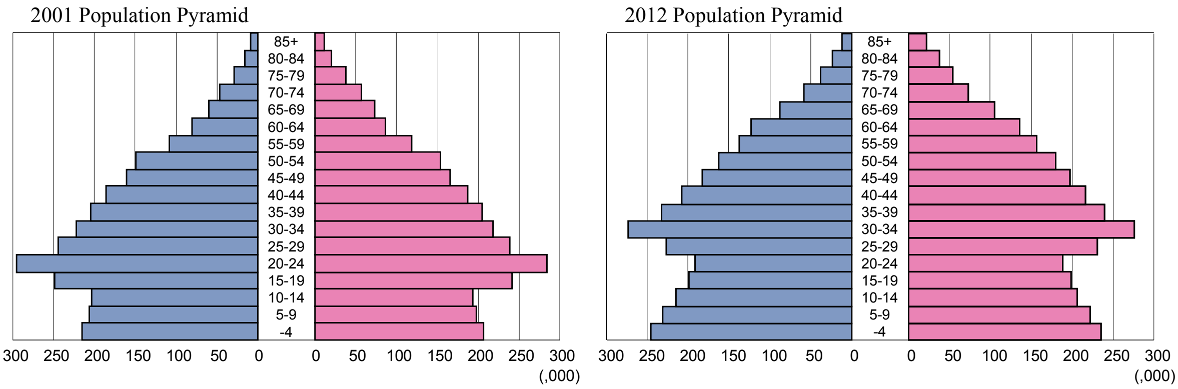
The 2001 Census gives the population by each age and sex in 2001. As for the population in 2012, although the detailed results of the 2012 Census are not available yet, population by age and sex can be estimated from crude birth rates and crude death rates. The Registrar General's Department published Statistics on Vital Events 2000-2010" in 2011, and the registered number of Live Births and Deaths of Usual Residents by district from 2000 to 2007 are available. The birth rates and death rates up to 2007 are calculated by the CoMTrans Study Team, and the birth rates and the death rates from 2008 to 2011 are assumed to be the same level as in 2007. Thus, by using these rates, the 5-year age group populations are estimated by CoMTrans Study Team.

The 5-year age group populations in 2001 and 2012 are shown in Table 2.1.4, and the Population Pyramids in 2001 and 2012 are shown in Figure 2.1.5.

Table 2.1.4 Population by Sex and 5-year Age Group of the Western Province (2001 and 2012)

Population	2001 Census			2012 Estimation		
Age Group	Male	Female	Total	Male	Female	Total
Less than 4	214,669	205,959	420,628	246,027	235,435	481,462
5-9	206,153	197,097	403,250	231,906	223,027	454,933
10-14	203,570	192,537	396,107	214,386	205,915	420,301
15-19	249,063	240,969	490,032	198,305	198,601	396,906
20-24	296,307	284,486	580,793	191,065	189,242	380,307
25-29	243,825	238,584	482,409	227,127	231,172	458,299
30-34	222,523	218,354	440,877	273,075	277,091	550,166
35-39	204,606	205,221	409,827	232,004	240,385	472,389
40-44	185,462	187,408	372,870	207,224	216,659	423,883
45-49	160,929	164,649	325,578	182,153	197,099	379,252
50-54	148,519	152,883	301,402	162,076	180,019	342,095
55-59	108,798	117,788	226,586	136,980	156,143	293,123
60-64	79,783	86,971	166,754	122,136	136,028	258,164
65-69	60,545	72,803	133,348	87,405	104,846	192,251
70-74	46,404	57,317	103,721	58,267	73,137	131,404
75-79	29,825	38,399	68,224	37,915	54,723	92,638
80-84	16,330	21,053	37,383	23,522	37,617	61,139
85 and over	9,085	12,323	21,408	11,675	21,328	33,003
Total	2,686,396	2,694,801	5,381,197	2,843,248	2,978,467	5,821,715

Note: Populations by age group in 2012 are estimated by the CoMTrans Study Team
Source: Census of Population and Housing 2001 and 2012, Department of Census and Statistics



Note: Populations by age group in 2012 are estimated by the CoMTrans Study Team
Source: Census of Population and Housing 2001 and 2012, Department of Census and Statistics

Figure 2.1.5 Population Pyramids of Western Province (2001 and 2012)

2.1.2 Migration

(1) External (International) Migration

The Department of Census and Statistics published the Statistics Abstract 2012, and it includes data of Arrivals and Departures by Nationality in 2011. These are shown in Table 2.1.5.

Table 2.1.5 Number of Arrivals and Departures by Nationality (2011)

	Sri Lankan	Asians (Exc. Sri Lankan)	Europeans	North Americans	South Americans	Africans	Australians	Others	Sub Total Foreigners	Total
Arrivals	1,206,135	606,104	470,165	70,780	1,863	9,939	56,475	1,246	1,216,572	2,422,707
Departures	1,235,288	609,429	462,254	69,532	1,754	9,243	54,845	1,225	1,208,282	2,443,570
Differences	-29,153	-3,325	7,911	1,248	109	696	1,630	21	8,290	-20,863

Source: Statistical Abstract 2012, Department of Census and Statistics and Department of Immigration and Emigration

In 2011, a net 29,153 Sri Lankans migrated outside of the country. On the other hand, a net 8,290 foreigners came into Sri Lanka. This resulted in a total net 20,863 persons departing the country. The total population of Sri Lanka was almost 20 million; therefore 0.1% net of the total population left the country in the year of 2011.

(2) Internal Migration

Internal migrant population data (from one district to another district) is available only in the “Natural Increase and Net Migration by District from 1971 to 1981”, shown in Table 2.1.6. Although it is outdated, it shows out-flow migration from the Colombo District and the Kalutara District. Annually, almost 10,000 people left the Colombo District.

Table 2.1.6 Natural Increase and Net Migration by District (1971-1981)

District	Natural Increase	Migration Increase	Ratio of Migration Increase to Natural Increase
Colombo District	297,784	-96,936	-32.6%
Gampaha District	181,980	35,010	19.2%
Kalutara District	131,783	-31,593	-24.0%
Western Province	611,547	-93,519	-15.3%

Source: Department of Census and Statistics

Although recent reliable migration data are not available, migration can be assumed to be taking place. The difference between the closed population from 2001 to 2012, which only considers the natural increase during this period, and the census population of 2012 indicates the estimated migration population.

Table 2.1.7 summarises the population differences.

Table 2.1.7 Annual Estimated Migrations by District from 2001 to 2012

	* Closed Population 2012	Census Population 2012	Estimated Annual Internal Migration	Average Annual Migration Rate
Colombo District	2,516,820	2,309,809	-18,819	-0.81%
Gampaha District	2,334,040	2,294,641	-3,582	-0.16%
Kalutara District	1,216,481	1,217,260	71	0.01%
Western Province	6,067,341	5,821,710	-22,330	-0.38%

Note: *Closed Population is obtained from Census population 2001 and estimated Birth and Death Rates
Source: CoMTrans Study Team

In the whole Western Province, the closed population in 2012 was higher than the actual population in 2012. This implies that migration moved outward. This trend is much more notable in the Colombo District. Approximately 19,000 people left annually.

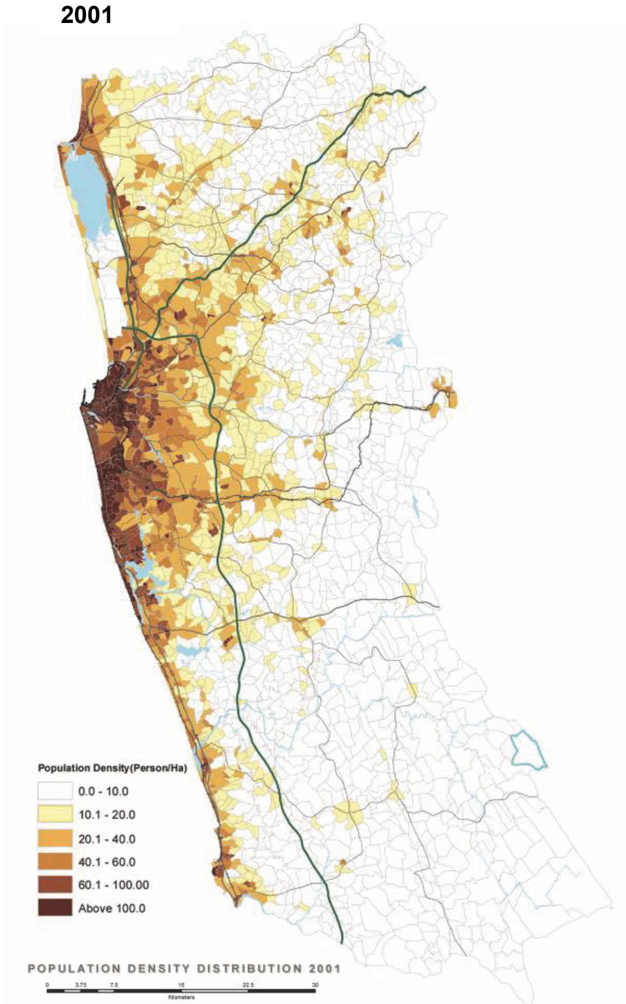
2.1.3 Spatial Distribution and Growth Trend

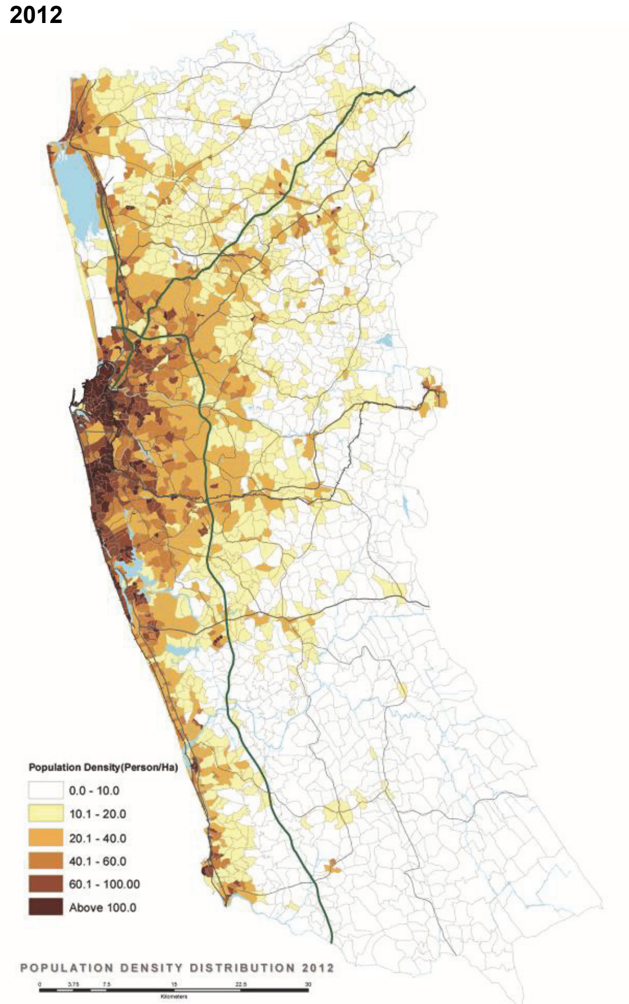
(1) Spatial Distribution

Population Densities in Residential Areas were calculated by the CoMTrans Study Team based on the population by GND in the Census in the years 2001 and 2012 and are shown in Figure. The density maps show populated areas which can be considered as urbanised.

Generally, populations are concentrated around Colombo, namely the areas of Colombo MC, Dehiwala – Mt. Lavinia MC, Sri jayawardanepura MC, Kollonawa UC, Boralesgamuwa UC, the west part of Kaduwela MC, west part of Maharagama UC in Colombo District, and Peliyagoda UC, Kelaniya PS, and Wattala UC in Gampaha District. Coastal Areas also have higher population densities as well. In the suburban areas, high density areas are concentrated along major roads, such as Kandy Road, High Level Road, Galle Road, Negombo Road, and Horana Road, and railway lines. Around Negombo and Minuwangoda, which are close to Bandaranayake International Airport, population density is also high.

In 2012, high density areas expanded towards the north and east. Suburbanisation can be seen, especially around the OCH Corridor and the south western part of Gampaha District. The Kalutara District still is in a rural condition. Generally, coastal areas and major road corridors are highly populated.





Note: Calculated by CoMTrans Study Team
Expressways/Highways are shown on the map as reference.

Figure 2.1.6 Population Density in Residential Areas in the Western Province (2001 and 2012)

The population density of the Colombo Municipal Council is 13,779 persons per sq. kilometres. This density is comparable with the other central areas of major cities. The population density of the Colombo Metropolitan Area (CMA) is 3,699 persons per sq. kilometres. It is lower than the central areas of Sao Paulo and Bangkok in the same scale of area. When compared to those of Ho Chi Minh City and Taipei metropolitan areas, the density is almost in the same range. It can be said that the population of CMA is standard as an urban area.

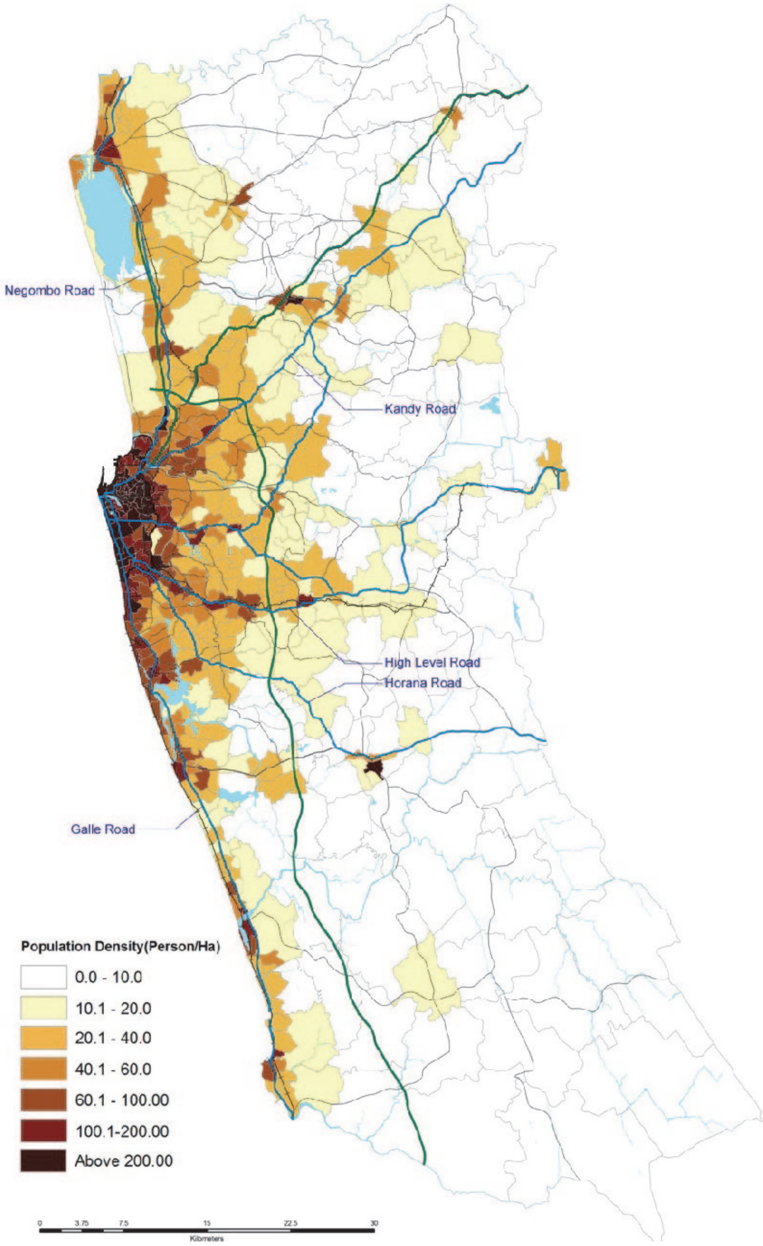
Table 2.1.8 Population Density in Metropolitan Area and Central Area, 2010

Country	Metropolitan Area	Metropolitan Area (sq. km)	Population Density of Metropolitan area (persons/sq. km)		Country	City	Central Area (sq. km)	Population Density of Central Area (persons/sq. km)
UK	London	1,596	4,811		**Chile**	Santiago	22	8,964
Vietnam	HCMC	2,095	3,419		**France**	Paris	105	20,807
Taiwan	Taipei	2,457	2,748		**Argentina**	Buenos Aires	203	14,520
Sri Lanka	Colombo (CMA)	996	**3,699**		**Taiwan**	Taipei	376	6,968
Argentina	Buenos Aires	4,758	691		**Vietnam**	HCMC	494	11,905
Philippines	M. Manila	4,863	4,405		**UK**	London	589	7,838
Chile	Santiago	5,947	1,211		**Korea**	Seoul	605	17,489
China	Shanghai	6,341	3,030		**Japan**	Tokyo	621	13,934
Japan	Tokyo	6,467	4,799		**Philippines**	M. Manila	639	21,131
Thailand	Bangkok	7,762	1,542		**Indonesia**	Jakarta	664	15,211
Brazil	Sao Paulo	7,944	2,469		**China**	Shanghai	822	13,038
Korea	Seoul	11,771	1,880		**USA**	NYC	834	9,808
France	Paris	12,012	912		**Sri Lanka**	Colombo (CMC)	40	13,779
Indonesia	Jakarta	13,601	1,772		**Brazil**	Sao Paulo	1,523	7,216
USA	NYC	18,443	1,051		**Thailand**	Bangkok	1,569	5,800

Source: Transport Development in Asian Megacities
Census of Population and Housing 2012, Department of Census and Statistics

Employed Population Densities at Work Places in 2013 are also estimated based on the data from the Department of Census and Statistics, and HVS, and it is shown in Figure 2.1.7.

The employed population is highly concentrated in CMC. High Level Road Corridor and Galle Road Corridor, and around major local urban centres, such as Negombo, Minuwangoda, Gampaha, Mirigama, and Horana, also have many of the employed population concentrated in them.

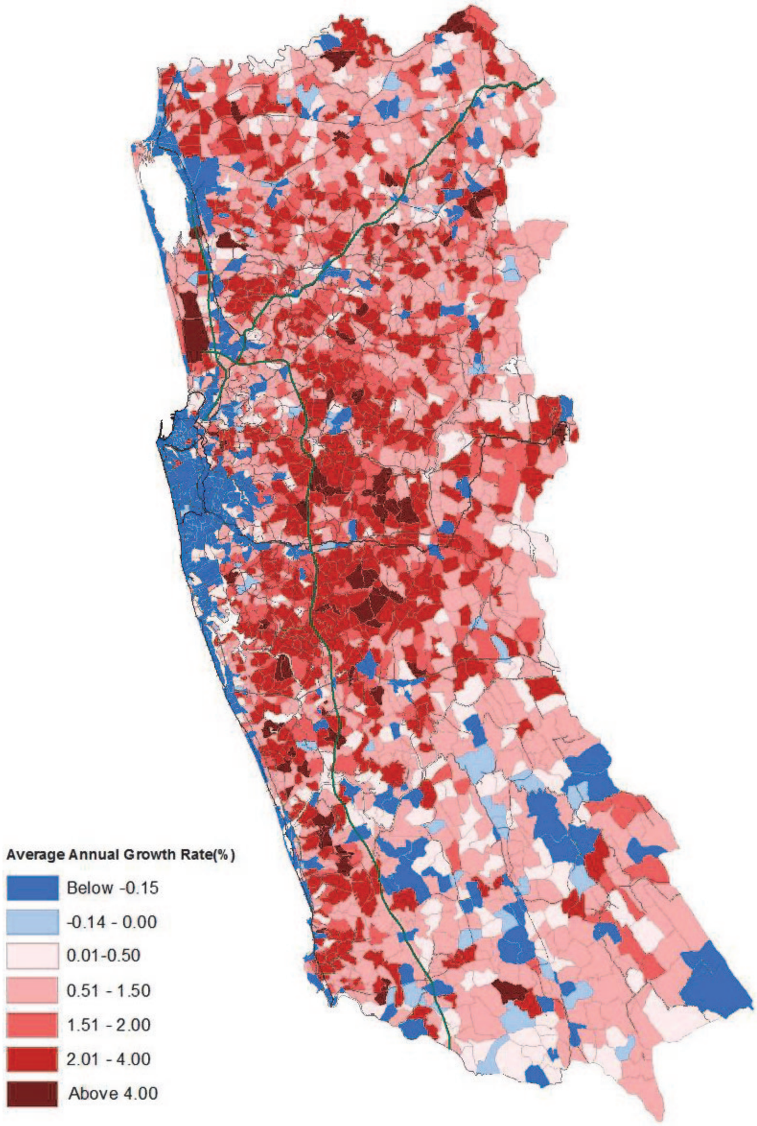


Note: Calculated by the Traffic Analysis Zone (TAZ). TAZ is described in Chapter 3.
Expressways/Highways are shown on the map as reference.
Source: CoMTrans Home Visit Survey 2013

Figure 2.1.7 Employed Population Density at Working Places in Western Province (2013)

(2) Growth Trend

Population changes from 2001 to 2012 are shown in Figure 2.1.8. This more clearly gives an idea of how urbanisation has been progressing in the Western Province. It shows that the population in the centre of Colombo is decreasing, and is increasing in the suburban areas.



Note: Calculated by CoMTrans Study Team.
Expressways/Highways are shown on the map as reference.

Figure 2.1.8 Average Annual Growth Rate of Population in Western Province from 2001 to 2012

Population decrease occurred in the Colombo MC and some surrounding areas, the coastal strip in the southern part of the Western Province, and the centre of Negombo. The population of some rural areas in Kalutara District also decreased.

Population growth was clearly seen in the suburbs of Colombo, including Homagama PS, Maharagama UC, Kaduwela MC, and Biyagama PS. Regional Towns in the Western Province, such as Avissawela, the west of Negombo, and the inner costal area of the Kalutara district show population increases as well. Especially, major population growth was seen around and outside of the planned OCH area.

2.1.4 Social Status

As for the Social Status, a comparison between Population Census 2001 and HVS 2012 is shown in Table 2.1.9 and Figure 2.1.9. In the Population Census in Sri Lanka, social statuses are based on the population who are ten years old and over. In the Western Province, 43% of the population are employed and 15% are students. While the employed population of the Western Province has increased slightly in number, the share to the total population aged ten years and over has decreased. The student population by HVS shows a larger number than in the 2001 Census. More details of Employed and Student population are described in the following sections.

Table 2.1.9 Population by Social Status based on Population Census 2001 and CoMTrans Home Visit Survey 2013

	Employed	Student	Household work	Retired/ Income recipient	Unemployed	Other	Unknown	Total 10 years and over
2001								
Colombo Dis.	855,142	283,252	465,670	122,092	57,089	102,997	38,625	1,924,867
Gampaha Dis.	756,186	263,193	444,734	113,443	68,239	82,264	11,881	1,739,940
Kalutara Dis.	356,837	147,485	227,064	64,345	38,940	46,817	11,023	892,511
Western P.	**1,968,165**	**693,930**	**1,137,468**	**299,880**	**164,268**	**232,078**	**61,529**	**4,557,318**
% to Total W.P.	43.2%	15.2%	25.0%	6.6%	3.6%	5.1%	1.4%	100.0%
Sri Lanka (18 District)*	***5,941,574***	***2,531,798***	***3,311,142***	***271,706***	***531,928***	***1,298,527***	***119,660***	***14,006,335***
*% to Total SL**	*42.4%*	*18.1%*	*23.6%*	*1.9%*	*3.8%*	*9.3%*	*0.9%*	*100.0%*
2013								
Colombo Dis.	836,029	362,051	533,770	168,260	140,154	22,049	498	2,062,811
Gampaha Dis.	772,231	352,192	534,573	141,738	126,041	30,139	232	1,957,146
Kalutara Dis.	377,234	182,424	270,838	71,157	77,959	18,924	34	998,571
Western P.	**1,985,494**	**896,668**	**1,339,181**	**381,155**	**344,155**	**71,112**	**764**	**5,018,528**
% to Total W.P.	39.6%	17.9%	26.7%	7.6%	6.9%	1.4%	0.0%	100.0%

Note: * 18 Districts are; Colombo, Gampaha, Kalutara, Kandy, Matale, NuwaraEliya, Galle, Matara, Hambantota, Ampara, Kurunegala, Puttalam, Anuradhapura, Polonnaruwa, Badulla, Moneragala, Ratnapura, and Kegalle, where the detailed data of the 2001 Census is available.

2001 - Census of Population and Housing 2001, Department of Census and Statistics
2013– Estimation based on the result of CoMTrans Home Visit Survey 2013.

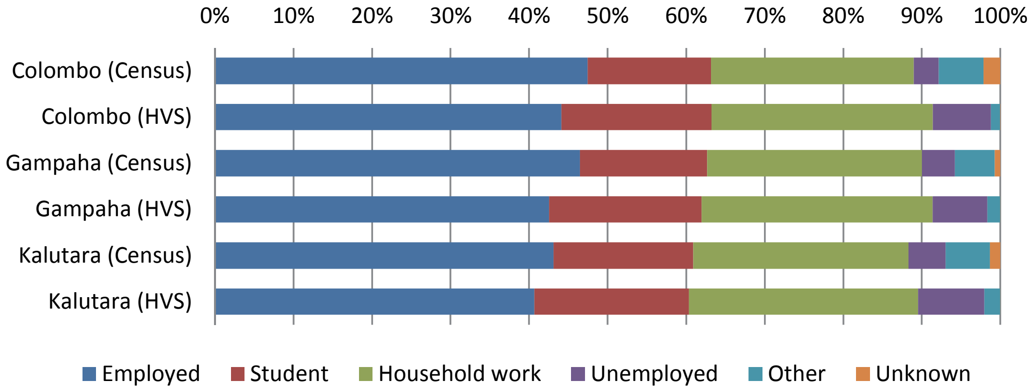


Figure 2.1.9 Population by Social Status based on Population Census 2001 and CoMTrans Home Visit Survey 2013

2.1.5 Employed Population

(1) Current Status of the Employed Population

The data of the employed population is available in the 2001 Census, however, the details of the employed population in the latest 2012 Census have not been published yet. Therefore the CoMTrans Study Team has estimated the employed population according to the trends of the Labour force Participation Rate and Unemployment Rate. At the same time, from the results of the HVS, it is possible to estimate employed populations as well. The employed populations are shown in Table 2.1.10.

According to the 2001 Census, approximately 2.0 million people are employed in the Western Province, which is 92% of the total economically active population. This rate was slightly higher than the national level.

The employed population was also estimated from the population of 2012, and the Labour Force Participation Rate and Unemployment is estimated in the "Sri Lanka Labour Force Survey Annual Report 2011" by the Department of Census and Statistics. Applying that rate, the employed population in 2012 is estimated as 2.1 million in the Western Province. In this case, the unemployment rate is 3.5% which was the number estimated by the Department of Census and Statistics described in the "Sri Lanka Labour Force Survey Annual Report 2011".

Further, estimations from the CoMTrans Home Visit Survey are also available and it is calculated that there are 2.0 million people in the employed population.

Table 2.1.10 Employed Population(2001, 2012 and 2013)

	Total Population	10 Years and Over Population	% of 10 Years and Over Population to total	Economically Active Population (Labour Force)	Labour Force Participation Rate	Employed Population	Rate of Employed Population to Labour Force	Unemployed population	Unemployed Rate
2001 (Population Census)									
Colombo District	2,251,274	1,924,867	85.5%	912,231	47.4%	855,142	93.7%	57,089	6.3%
Gampaha District	2,063,684	1,739,940	84.3%	824,425	47.4%	756,186	91.7%	68,239	8.3%
Kalutara District	1,066,239	892,511	83.7%	395,777	44.3%	356,837	90.2%	38,940	9.8%
Western Province	5,381,197	4,557,318	84.7%	2,132,433	46.8%	1,968,165	92.3%	164,268	7.7%
Sri Lanka (18 District)*	16,929,689	14,006,335	82.7%	6,473,502	46.8%	5,941,574	91.8%	531,928	8.2%
2012 (Estimation based on the trend)									
Colombo District	2,309,809	1,949,971	84.4%	906,812	46.5%	880,294	97.1%	26,518	2.9%
Gampaha District	2,294,641	1,928,701	84.1%	827,437	42.9%	794,200	96.0%	33,237	4.0%
Kalutara District	1,217,260	1,006,643	82.7%	464,611	46.2%	448,743	96.6%	15,868	3.4%
Western Province	5,821,710	4,885,316	83.9%	2,196,538	45.0%	2,120,539	96.5%	75,999	3.5%
2013 (Estimation based on CoMTrans Home Visit Survey)									
Colombo District	2,309,809	2,062,811	89.3%	976,183	47.3%	836,029	85.6%	140,154	14.4%
Gampaha District	2,294,641	1,957,146	85.3%	898,272	45.9%	772,231	86.0%	126,041	14.0%
Kalutara District	1,217,260	998,571	82.0%	455,193	45.6%	377,234	82.9%	77,959	17.1%
Western Province	5,821,710	5,018,528	86.2%	2,329,649	46.4%	1,985,494	85.2%	344,155	14.8%

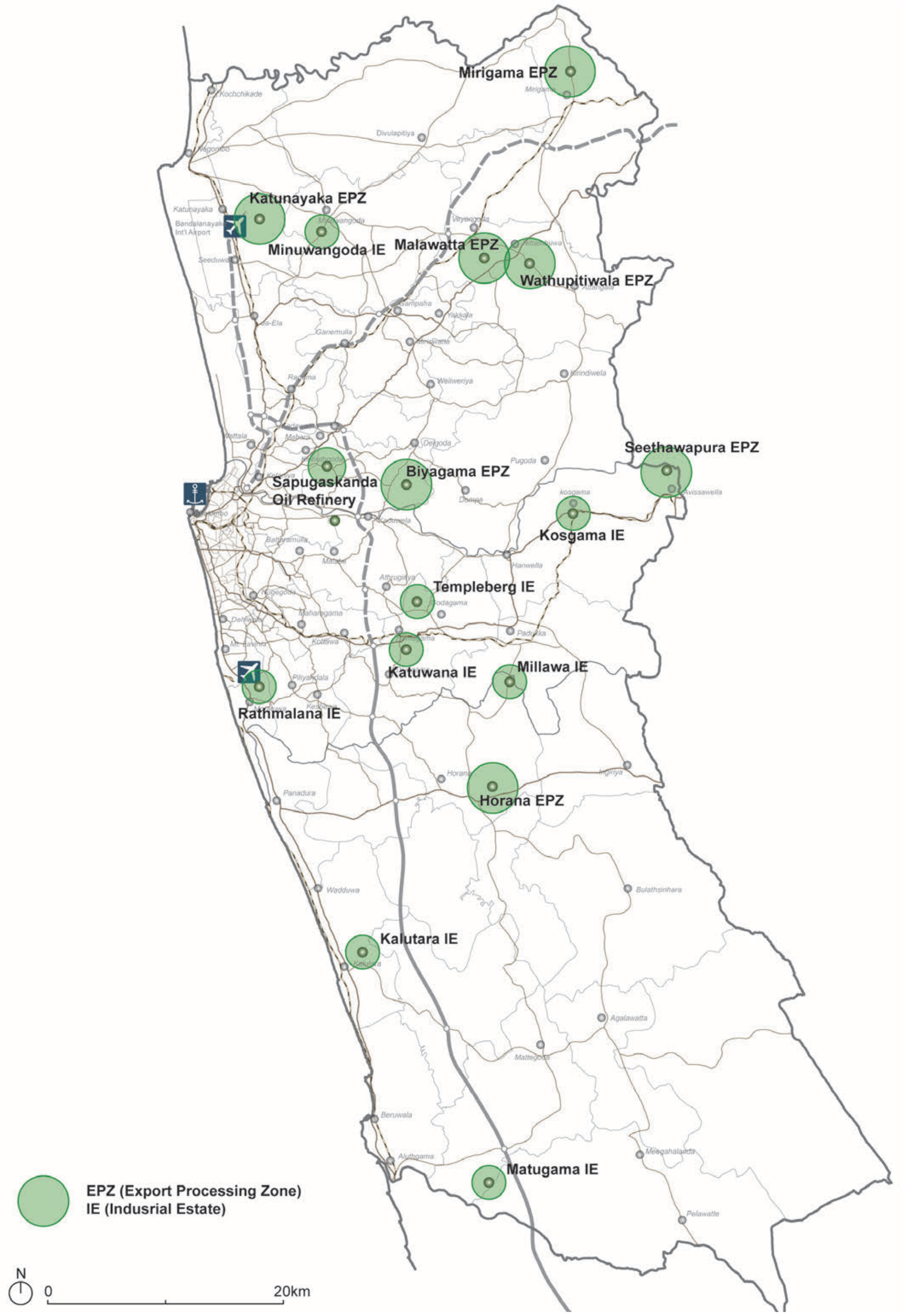
Note: * 18 Districts are; Colombo, Gampaha, Kalutara, Kandy, Matale, NuwaraEliya, Galle, Matara, Hambantota, Ampara, Kurunegala, Puttalam, Anuradhapura, Polonnaruwa, Badulla, Moneragala, Ratnapura, and Kegalle, where the detailed data of Census of Population and Housing 2001 is available.

2012 Estimation based on the trend by the CoMTrans Study Team. Total population: Census of Population and Housing 2012, ten years and over population: estimated by CoMTrans Study Team, Labour Force Participation Rate and Unemployment Rate: Sri Lanka Labour Force Survey Annual Report 2011, Department of Census and Statistics

2013 Estimation based on CoMTrans Home Visit Survey 2013

(2) Current Status of the Employed Population by Industrial Sector

Figure 2.1.10 shows the locations of EPZ (export processing zones) and other IE (industrial estates). In the suburbs of Colombo, there is a major EPZ located at Biyagama and other IEs such as Katuwana IE located to the south of Homagama and Templeberg IE located nearby Athurugiriya. In the Gampaha District, fairly many industrial areas are found at Mirigama, Katunayake, Minuwangoda, Mawawatta, and Mathupitiwala. On the other hand, the Kalutara District has less industrial areas. They affect the number in the secondary sector population.



Source: CoMTrans Study Team

Figure 2.1.10 Locations of Export Processing Zones and Industrial Estates

According to the 2001 Census and the CoMTrans Home Visit Survey 2013, populations by industrial sector are shown in the following Table 2.1.11and Figure 2.1.11.

In 2001, there were clear differences between the three districts. In the Colombo District, 69% of the working population were engaged in the tertiary sector and the primary sector was only at 2%. In the Gampaha District, more secondary industries were active; approx. 41% were working for that group. In the Kalutara district, 16% were working for the primary industry, which was lower than the national level but the highest of the three districts. It is very clear that the share of primary industry of the Western Province was much less than the national level and it had a higher population share of the tertiary industry.

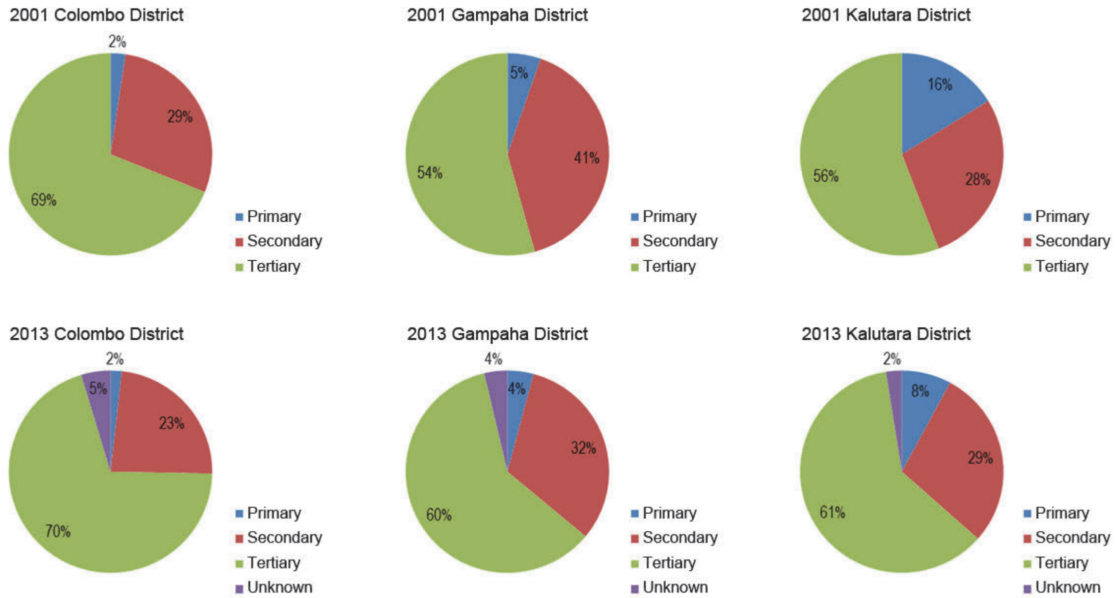
In 2012, the share of the industrial sector is estimated from HVS. The primary sector decreased except in the Kalutara District. On the other hand, more than 60% are engaged in the tertiary sector.

Table 2.1.11 Employed Population by Major Industry Sector in Western Province (2001 and 2013)

2001	**Primary**		**Secondary**		**Tertiary**			
	No.	**%**	**No.**	**%**	**No.**	**%**		
Colombo District	20,392	2.4%	245,492	28.7%	589,258	68.9%		
Gampaha District	40,055	5.3%	305,194	40.4%	410,937	54.3%		
Kalutara District	57,668	16.2%	99,675	27.9%	199,494	55.9%		
Western Province	**118,115**	**6.0%**	**650,361**	**33.0%**	**1,199,689**	**61.0%**		
Sri Lanka (18 District)*	**1,707,720**	**28.7%**	**1,331,126**	**22.4%**	**2,902,728**	**48.9%**		
2013	**Primary**		**Secondary**		**Tertiary**		**Unknown**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Colombo District	13,327	1.8%	175,955	23.5%	523,821	70.0%	34,912	4.7%
Gampaha District	27,553	4.1%	212,235	31.9%	401,103	60.3%	24,448	3.7%
Kalutara District	24,614	7.9%	89,529	28.6%	190,524	61.0%	7,837	2.5%
Western Province	**65,494**	**3.8%**	**477,719**	**27.7%**	**1,115,448**	**64.6%**	**67,196**	**3.9%**

Note: * 18 Districts are; Colombo, Gampaha, Kalutara, Kandy, Matale, NuwaraEliya, Galle, Matara, Hambantota, Ampara, Kurunegala, Puttalam, Anuradhapura, Polonnaruwa, Badulla, Moneragala, Ratnapura, and Kegalle, where the detailed data of the 2001Census is available.

2001 – Census of Population and Housing 2001, Department of Census and Statistics
2013 – Estimation based on the CoMTrans Home Visit Survey 2013



Note: 2001: Census of Population and Housing 2001, Department of Census and Statistics
2012: Estimation based on CoMTrans Home Visit Survey 2013

Figure 2.1.11 Employed Population by Major Industry Sector in the Western Province (2001 and 2012)

2.1.6 Student Population

In the 2001 Census, the following details of the student population are available, but the detailed results of the 2012 Census are not published yet. In the Western Province in 2001, 1,187,674 people were students, which was 22% of the total population. School students of Grade 1 to GCE Advanced Level made up 17.7% of the total population. As for university students, only 0.6 % of the total population were attending a university. The rate is slightly higher than the national level, however it was still very low.

The Colombo District and the Gampaha District have more than 370,000 school students in each District, while the Kalutara District has around 200,000 school students. In the Colombo District, there are 20,000 students since many major universities are concentrated in the District. Other educational facilities are also located in the Colombo District. The student populations in the Western Province are shown in the Table 2.1.12.

On the other hand, the estimated student population is calculated from HVS and it is shown in Table 2.1.13.

Table 2.1.12 Student Population in Western Province (2001)

	Sri Lanka (18 District)*	% to Total Population	Colombo District	Gampaha District	Kalutara District	Western Province	% to Total Population
Total Population	**16,929,689**		2,251,274	2,063,684	1,066,239	**5,381,197**	
Pre School	**382,287**	2.3%	53,700	48,501	24,268	**126,469**	2.4%
School Student **	**3,593,726**	21.2%	373,938	372,318	205,138	**951,394**	17.7%
University	**65,506**	0.4%	20,021	8,743	3,302	**32,066**	0.6%
Vocational / Technical Institution	**74,557**	0.4%	15,226	11,505	5,708	**32,439**	0.6%
Other Educational Institute	**124,291**	0.7%	22,224	15,293	7,789	**45,306**	0.8%
Total Student	**4,240,367**	**25.0%**	**485,109**	**456,360**	**246,205**	**1,187,674**	**22.1%**

Note: * 18 Districts are; Colombo, Gampaha, Kalutara, Kandy, Matale, NuwaraEliya, Galle, Matara, Hambantota, Ampara, Kurunegala, Puttalam, Anuradhapura, Polonnaruwa, Badulla, Moneragala, Ratnapura, and Kegalle, where the detailed data of the 2001 Census is available.
** School Student indicates Grade 1 to G.C.E. A/L.

Source: Census of Population and Housing 2001, Department of Census and Statistics,

Table 2.1.13 Estimated Student Population in Western Province (2013)

	Colombo District	Gampaha District	Kalutara District	Western Province	*% to Total Population*
Total population	2,309,809	2,294,641	1,217,260	**5,827,710**	
Kindergarten	5,316	6,739	4,780	**16,834**	*0.3%*
Student (Grade1 - G.C.E(A/L))	464,530	473,349	253,853	**1,191,731**	*20.5%*
Student (grade1 - grade5)	168,094	178,546	97,922	**444,562**	*7.6%*
Student (grade6 - grade8)	112,834	116,168	62,365	**291,367**	*5.0%*
Student (grade9 - grade10)	70,883	70,231	38,259	**179,373**	*3.1%*
Student (G.C.E. (O/L))	53,912	51,151	24,817	**129,880**	*2.2%*
Student (G.C.E. (A/L))	58,807	57,253	30,490	**146,549**	*2.5%*
University Student	22,778	15,924	5,956	**44,659**	*0.8%*
Student (Graduate)	22,367	15,623	5,525	**43,515**	*0.7%*
Student (Post Graduate)	224	176	431	**831**	*0.0%*
Student (Ph.D.)	187	125	0	**313**	*0.0%*
Other Students	11,455	12,520	5,183	**29,158**	*0.5%*
Total Student	**411,039**	**422,834**	**228,143**	**1,062,017**	***18.2%***

Source: CoMTrans Home Visit Survey 2013

2.1.7 Population by Household Income

The population by household income group is only available from the HVS conducted by the CoMTrans Study Team. It is considered that income below 39,999 Rs is Group C, income between 40,000 and 79,999 is Group B and income 80,000 and over is Group A. This classification is defined by the transport mode which people in each income level used. The share of private car users is very high for Group A and extremely low for Group C. On the other hand, a high percentage of Group C walk or use a bicycle for their trips.

The income status is summarised in the following Table 2.1.14.

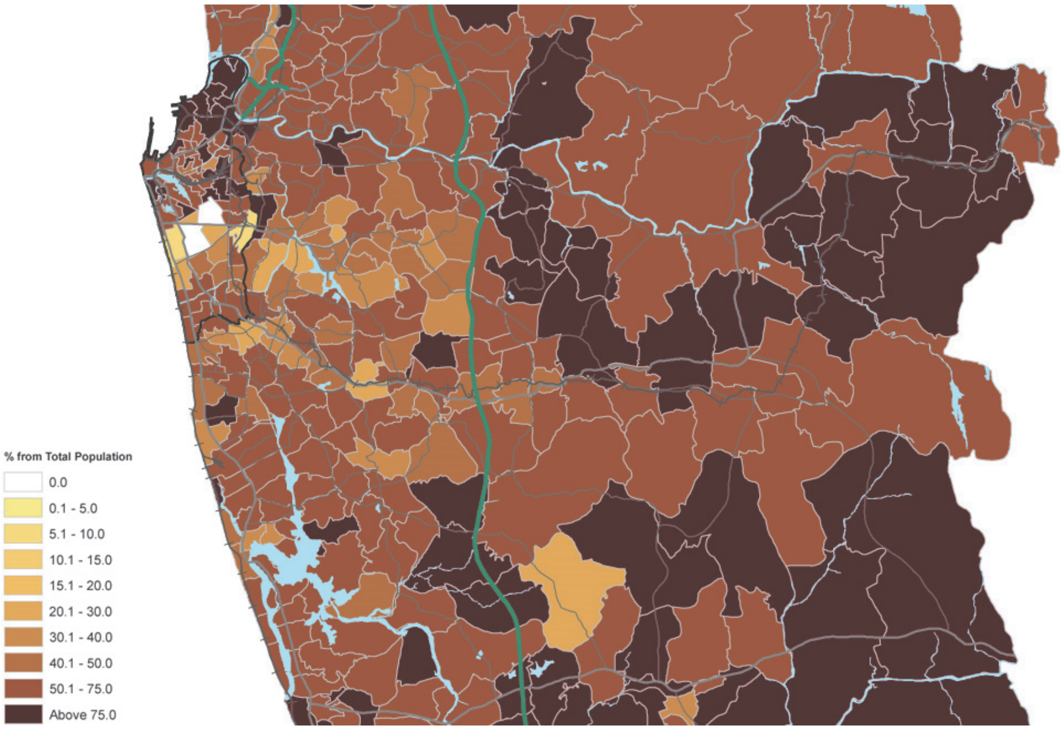
In 2012, more than 60% of the population earned less than 40,000 Rs per month. On the other hand, there are very few in the Group A population, less than 10 %.

Table 2.1.14 Population by Household Income Level in the Western Province According to HVS (2013)

Income	Group C	Group B	Group A							Unknown
	Less than Rs. 40,000	**Rs. 40,000 - 79,999**	**Total of Group A Income (Rs. 80,000 and Above)**	Rs. 80,000 - 119,999	Rs. 120,000 - 159,999	Rs. 160,000 - 199,999	Rs. 200,000 - 299,999	Rs. 300,000 - 399,999	Rs. 400,000 and Above	
Colombo Dis.	**1,339,059**	**616,243**	**247,922**	**140,430**	**59,631**	**20,116**	**14,050**	**8,009**	**5,686**	**2,758**
Share	*60.8%*	*28.0%*	*11.3%*	*6.4%*	*2.7%*	*0.9%*	*0.6%*	*0.4%*	*0.3%*	*0.1%*
Gampaha Dis.	**1,444,092**	**520,258**	**146,562**	**109,387**	**19,157**	**8,847**	**6,880**	**1,814**	**477**	**3,494**
Share	*68.4%*	*24.6%*	*6.9%*	*5.2%*	*0.9%*	*0.4%*	*0.3%*	*0.1%*	*0.0%*	*0.2%*
Kalutara Dis.	**835,680**	**204,107**	**42,254**	**30,422**	**4,358**	**3,982**	**3,129**	**135**	**228**	**4,556**
Share	*77.2%*	*18.9%*	*3.9%*	*2.8%*	*0.4%*	*0.4%*	*0.3%*	*0.0%*	*0.0%*	*0.4%*
Western Prov.	**3,618,830**	**1,340,608**	**436,736**	**280,239**	**83,145**	**32,945**	**24,059**	**9,957**	**6,391**	**10,808**
Share	*67.1%*	*24.8%*	*8.1%*	*5.2%*	*1.5%*	*0.6%*	*0.4%*	*0.2%*	*0.1%*	*0.2%*

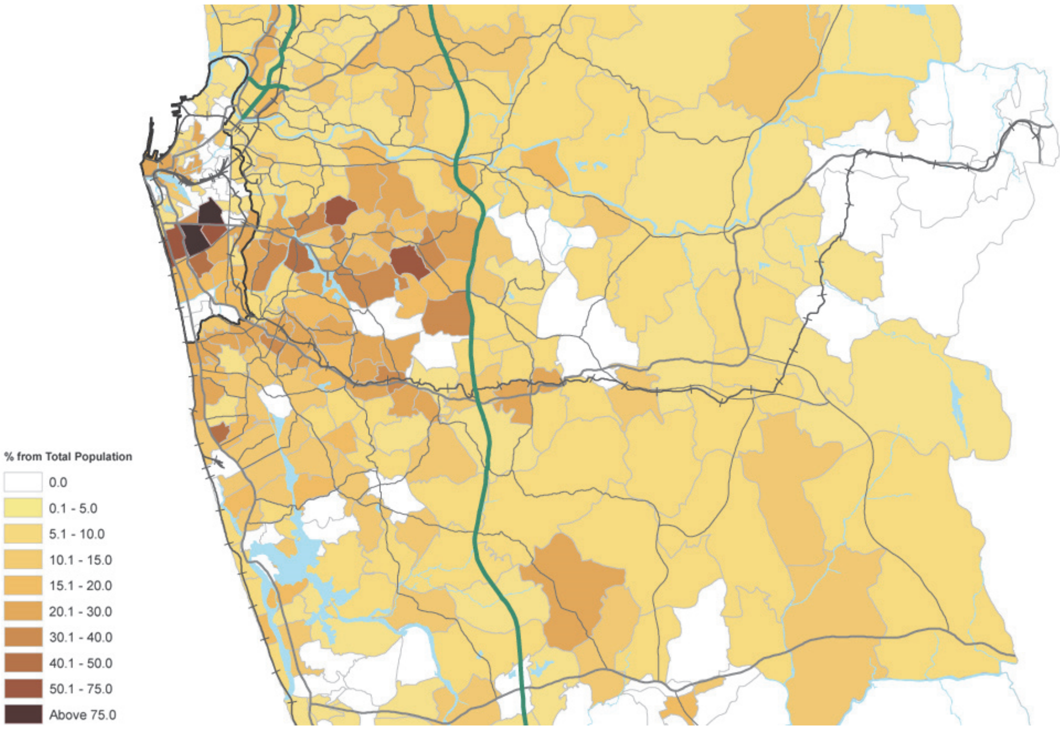
Note: Range is co-related with the HVS
Source: CoMTrans Home Visit Survey

Figure 2.1.12 and Figure 2.1.13 shows the percentage of Group C and Group A population according to TAZ. The percentage of the Group C population is high in the northern part of CMC and rural area. On the other hand, the middle of CMC has high percentage of the Group A population. TAZs along Malabe Corridor have a relatively large Group A population.



Source: CoMTrans Home Visit Survey

Figure 2.1.12 Percentage of Group C Population (2013)



Source: CoMTrans Home Visit Survey

Figure 2.1.13 Percentage of Group A Population (2013)

2.2 Land Use Patterns and Urban Structure

2.2.1 Land Use Patterns

(1) Expanding Urbanised Areas

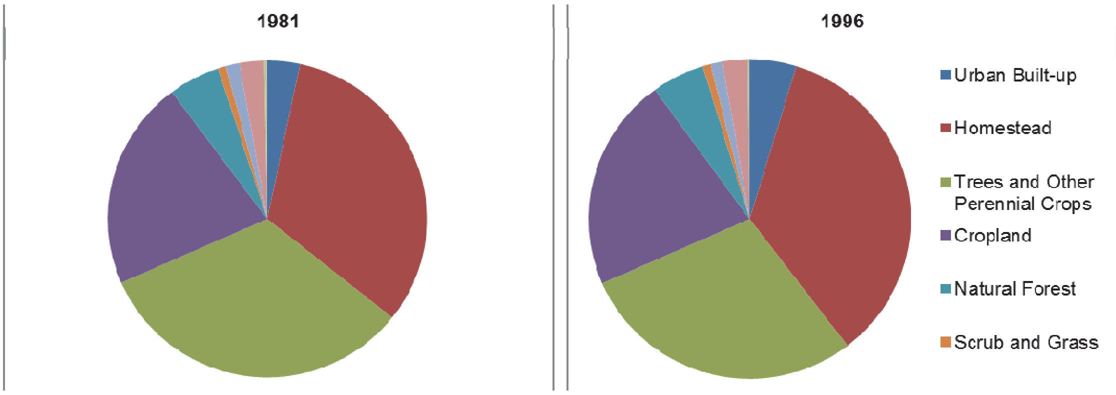
In the "Colombo Metropolitan Regional Structure Plan" of 1998, there are data regarding general land use patterns in 1981 and 1996 as shown in Table 2.2.1 and Figure 2.2.1. Land Use of urban areas is only classified as Urban Built-up areas and Homesteads. In the Western Province, Urban Built-up Land expanded from 3.3% in 1981 to 4.7% in 1996. Generally, the Trees and Other Perennial Crops in 1981 were converted to Urban Built-up and Homesteads by 1996. In addition, according to the plan, the changes of the land use are due to the following influences of;

- Establishment of Industrial Zones and estates, such as Katunayake, Biyagama, Horana, Ekala, Katuwana, Sapugaskanda, Kelaniya, etc.
- Expansion of tourism activities in Colombo, Negombo, Mt. Lavinia, Beruwala, etc.
- Shifting of the parliament to Sri Jayawardanepura – Kotte together with some administrative functions to the Battaramulla area.
- Development of Housing Schemes in Kesbewa, Homagama, Kaduwela, Bandaragama, Ja-ela, Negombo, Mahara, Kadawatha, Panaluwa, Ranpokunugama, Mattegoda, and Rukmale.

Table 2.2.1 General Land Use Patterns of Western Province(1981 and 1996)

Land Use Category	Percentage Share of Total Land Area							
	Colombo District		Gampaha District		Kalutara District		Western Province	
	1981	1996	1981	1996	1981	1996	1981	1996
Urban Built-up	12.2%	17.6%	1.6%	2.3%	0.9%	1.2%	3.3%	4.7%
Homestead (Residential Area)	21.2%	22.0%	49.8%	52.9%	22.0%	24.8%	32.4%	34.9%
Trees and Other Perennial Crops (Tea, Rubber, Coconut, etc.)	41.2%	35.1%	23.0%	29.5%	37.6%	33.8%	32.7%	28.8%
Cropland (Paddy, Abandoned Paddy, etc.)	16.4%	16.9%	17.7%	17.7%	26.7%	27.4%	21.4%	21.6%
Natural Forest	2.2%	2.2%	1.0%	0.9%	10.4%	10.3%	5.2%	5.3%
Scrub and Grass	1.8%	1.6%	0.7%	0.7%	0.4%	0.5%	0.8%	0.8%
Wetland	1.6%	1.3%	2.5%	2.2%	0.4%	0.4%	1.4%	1.2%
Water	3.3%	3.3%	3.3%	3.3%	1.4%	1.4%	2.5%	2.5%
Barren Land	0.1%	0.0%	0.4%	0.5%	0.2%	0.2%	0.3%	0.2%
Total Land Area (km^2)	**697.9**	**697.9**	**1,398.7**	**1,398.7**	**1,597.6**	**1,597.6**	**3,694.2**	**3,694.2**

Source: Colombo Metropolitan Regional Structure Plan 1998



Source: Colombo Metropolitan Regional Structure Plan 1998

Figure 2.2.1 General Land Use Patterns of the Western Province 1981 and 1996

(2) Land Use Pattern and Maps in the Survey Area

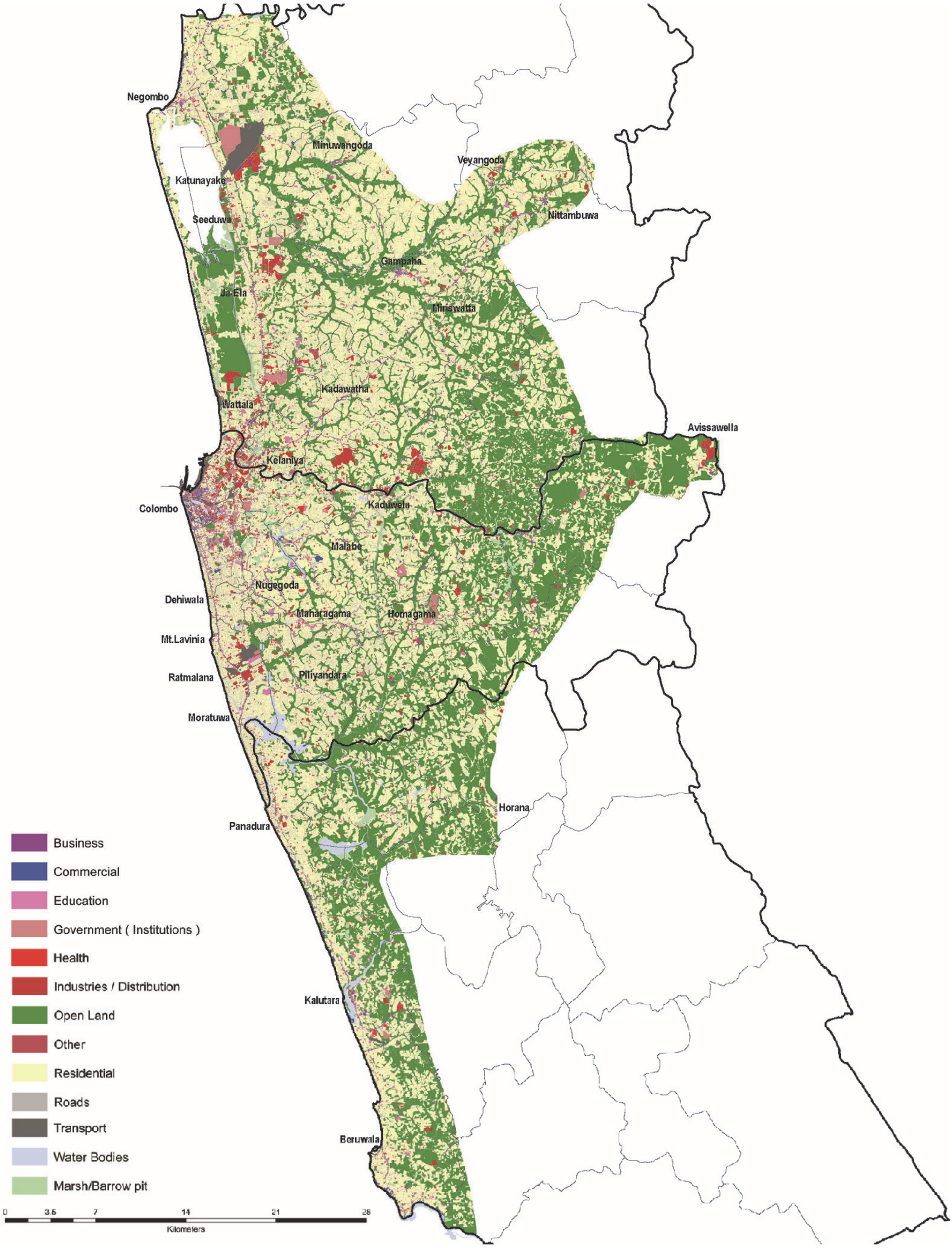
The Land Use Survey was conducted by the CoMTrans Study Team in 2013 in order to determine the current land use pattern. Areas that are already urbanised and those presumed to be urbanised by the target year of 2035 were considered as the land use survey area. It has approximately 1,700 km^2, which is 45% of the Western Province. The results of the Land Use Survey in the Western Province are shown in Figure 2.2.2 and Table 2.2.2. The details of the survey are mentioned in the Technical Report No.4.

The built-up area in the land use survey area is approximately 1,000 km^2, and most of the land is used for residential purposes, more than 920 km^2 out of 1,730 km^2. This is 53% of the total survey area. However, houses in suburban and rural areas have gardens. Therefore, population density is still low. The Eastern part of the area is still open land, or plantation, agricultural land and forestry. The sum of the residential use and the open land shares almost 90% of the total.

Urban land use, such as business and commercial, are concentrated around the Colombo Municipal Council (CMC). Other urban centres, such as Gampaha, Ragama, Negombo, Kaduwela, Maharagama, Nugegoda, and Kalutara have only a small concentration of urban land use. Very thin ribbon development is also typically observed along the major arterial roads, especially Kandy Road, High Level Road, Negombo Road and Galle Road. Except for the centres and ribbon development, commercial and business use areas in the suburbs and rural areas are very small and scattered. Only 7 km^2 are used for commercial purposes. The urban land use, except for the residential use, is 108 km^2, which is 6.2% of the total survey area.

Educational use or schools are well distributed around the area. At least the opportunity for primary education is provided equally.

In addition, the results of the land use survey, as well as the other transport surveys, would be criteria to define the Colombo Metropolitan Area (CMA), which is described in Chapter 4.



Source: CoMTrans Study Team

Figure 2.2.2 Land Use Map for Land Use Survey Area (2013)

Table 2.2.2 Land Use Pattern in Land Use Survey Area (2013)

Land Use Classes	Colombo District (km^2)	Gampaha District (km^2)	Kalutara District (km^2)	Total (km^2)	Share of the Survey Area
11- Commercial	3.3	2.0	1.7	7.0	0.4%
12 - Residential	294.4	462.3	165.7	922.4	53.2%
13 - Business	5.6	4.9	1.8	12.3	0.7%
14 - Health	1.4	0.7	0.2	2.3	0.1%
15 - Education	7.2	5.8	2.5	15.5	0.9%
16 - Industries / Distribution	13.6	20.5	2.7	36.8	2.1%
17 - Government / Institutions	5.8	5.3	0.7	11.8	0.7%
18 - Transport	5.8	7.6	0.7	14.1	0.8%
19 - Other Built-up Land	3.3	2.6	1.8	7.7	0.4%
21 - Open Land	181.8	260.7	150.7	593.2	34.2%
22-1 - Wet Land	7.7	8.1	2.9	18.7	1.1%
22-2 - Water Bodies	14.6	7.8	13.5	35.9	2.1%
23 - Roads	21.5	24.8	8.8	55.1	3.2%
Sub Total in the Survey Area	566.0	813.1	353.7	1,732.8	100.0%
Outside of the Survey Area	114.0	589.5	1,292.7	1,996.2	-
Total	680.0	1,402.6	1,646.4	3,729.0	-

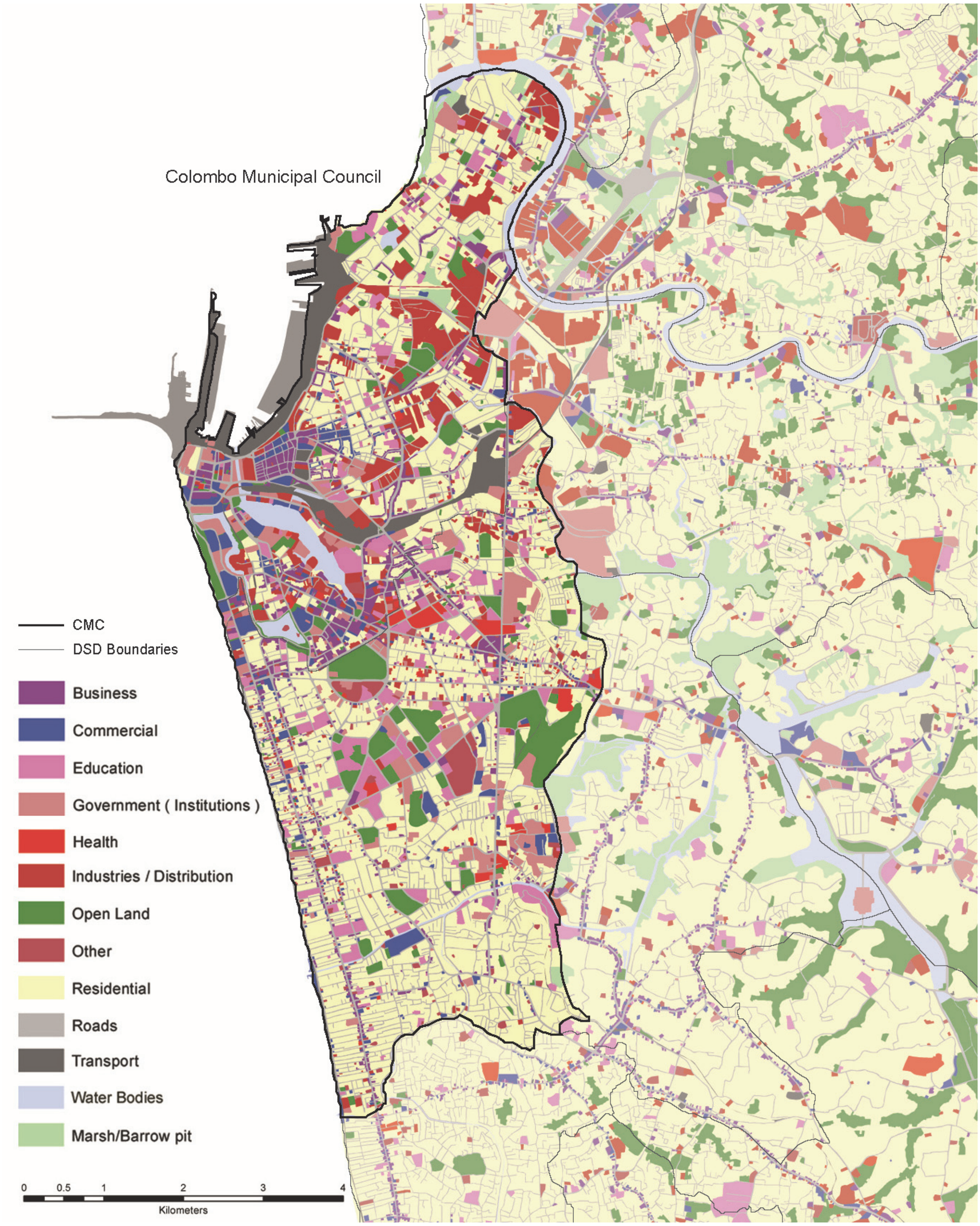
Note: Land Use Patterns by DSD are shown in the Technical Report No.4
Source: CoMTrans Study Team

(3) Land Use Pattern and Map in the Colombo Municipal Council

Land use in Colombo Municipal Council (CMC) is enlarged in Figure 2.2.3 and the extent of each land use is summarised in Table 2.2.3.

In the Colombo Municipal Council Area, business and commercial land use areas are concentrated around Fort, Pettah, Maradana, Kolupittiya, and Borella and along Galle Road. Large scale government and institutional facilities are seen around the Cinnamon Gardens and Maradana area, but many small ones are scattered around the city. Parks and playgrounds are also seen in the Cinnamon Gardens where rich green environments can still be found. The northern parts of the city show that the lands are used in a mixture. On the other hand, residential uses are spread throughout the southern part of the city.

Almost 42 % is residential land use, 3.5% are dedicated to commercial use and 4.5% to business use. It is supposed that outside of CMC there is more residential use than in CMC. Other remarkable uses are educational facilities and government/institutions. Each occupies more than 5% of the CMC, while only less than 1% of total land use survey areas are occupied by those uses. It can be concluded that CMC has many government offices and schools.



Source: CoMTrans Study Team

Figure 2.2.3 Land Use of Colombo Municipal Council (2013)

Table 2.2.3 Land Use Pattern in Colombo Municipal Council Area (2013)

Land Use Classes	Colombo DSD (km^2)	Thimbirigasyaya DSD (km^2)	Colombo Municipal Council (km^2)	Share (%)
11- Commercial	0.7	0.7	1.4	3.5%
12 - Residential	5.4	11.5	16.9	41.9%
13 - Business	1.1	0.7	1.8	4.5%
14 - Health	0.1	0.4	0.5	1.2%
15 - Education	0.7	1.7	2.4	6.0%
16 - Industries / Distribution	2.2	0.5	2.7	6.7%
17 - Government / Institutions	0.7	1.3	2.0	5.0%
18 - Transport	2.5	0.2	2.7	6.7%
19 - Other Built-up Land	0.3	0.7	1.0	2.5%
21 - Open Land	0.8	1.8	2.6	6.5%
22-1 - Wet Land	0.3	0.1	0.4	1.0%
22-2 - Water Bodies	1.5	0.3	1.8	4.5%
23 - Roads	1.6	2.5	4.1	10.2%
Total	17.9	22.4	40.3	100.0%

Source: CoMTrans Study Team

2.2.2 Current Urban Centres and Urbanised Area

Urban structure and characteristics can be understood from the existing structure plan, namely the Colombo Metropolitan Regional Structure Plan (1998) and the Regional Structure Plan of the Western Region Megapolis (2004), and the land use. The result of the land use survey endorses the urban structure pattern more precisely.

(1) Urban Centres

Urban Centres are places where urban activities are concentrated. In other words, they are centres of commercial, business, and other urban related activities which serve residents living in certain areas. The existing urban centres are shown in Figure 2.2.4 which is a map updated by the CoMTrans Study Team based on the Colombo Metropolitan Regional Structure Plan 1998.

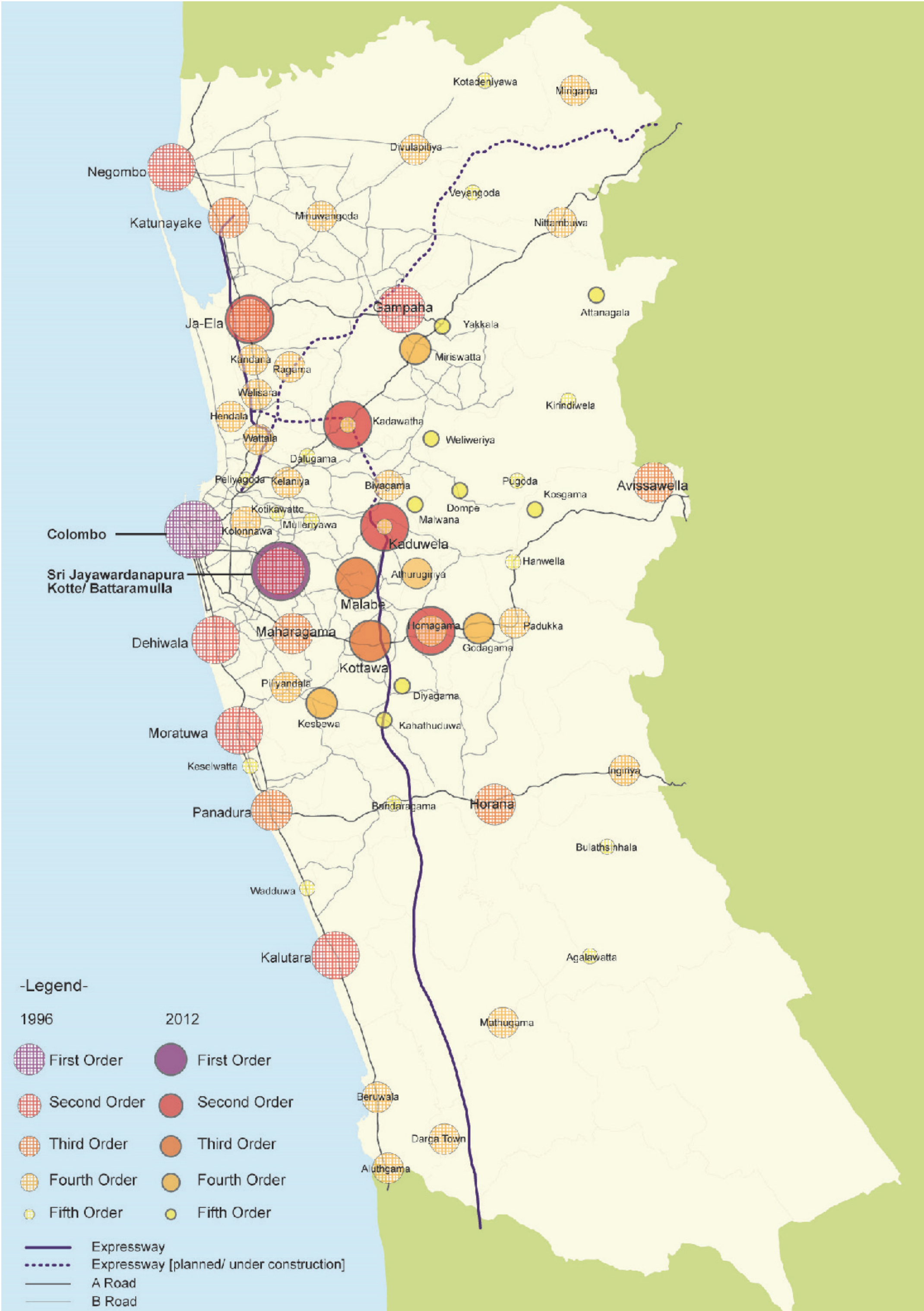
The National Physical Plan 2006 described a clear hierarchy in a structured manner. Urban centres are classified in the following five categories. Each category indicates its extent of the area providing services and ideal population range. At the same time, specific urban facilities are identified. They are shown in Table 2.2.4.

This idea of urban centres in the Sri Lankan urban planning context have been applied to the development plans of the nation as well as each local authority, and is one of the basic concepts to consider regarding urban structures. More specifically, the land use zoning plan which is prepared in the development plans marked the commercial uses of urban centres. This is the major idea to lead the ideal urban structure in a region.

Table 2.2.4 Hierarchical Structure and General Characteristics of Urban Centres

Hierarchy	**First Order** National Urban Centre	**Second Order** Regional Urban Centre	**Third Order** Major Urban Centre	**Fourth Order** Secondary Urban Centre	**Fifth Order** Divisional Urban Centre
Radius of Influence	100-350 km	50-100 km	10-50 km	5-10 km	2-5 km
Population in Service Area	5,000,000-20,000,000	1,000,000-5,000,000	100,000-1,000,000	10,000-100,000	1,000-10,000
Administrative Facilities	Central Government Offices	Prov. Council Offices, Regional Office (Central Gov.)	District Offices (Central and Prov. Gov.)	DSD and Local Authorities offices	PS sub units, and GN Offices
Educational Facilities	University, Polytechnics, Vocational Agencies, etc.	Technical College, Vocational Training Centre, etc.	Senior Secondary School, Technical College, etc.	Junior Secondary School, Vocational School, etc.	Primary Schools, etc.
Health Facilities	Specialised Hospitals, Teaching Hospitals, etc.	Provincial Hospital, Teaching Hospitals, etc.	Base Hospital, District Hospital, etc.	Peripheral Hospital, Rural Hospital, etc.	Dispensary, etc.
Commercial Facilities	Import/Export Centres, Shopping Complexes, etc.	Permanent Markets, Super Markets, etc.	Central Markets, Gov. Stores, Specialised Shops, etc.	Co-operative Shops, General Stores, etc.	Pola (Farmar's/ Weekly Market), and Retail shops
Socio-Cultural Facilities	Art Gallery, Museum, etc.	Public Library, Crematorium, etc.	Cultural Centre, Library, etc.	Community Hall, etc.	Civic Centres, etc.
Recreational Facilities	Central Urban Park, Botanical Gardens, etc.	Urban Park, Zoo, Night Clubs, etc.	Community Park, Cinemas, etc.	Local Parks, Open Space, Cafés, Bars, etc.	Mini Park, Kiosks, etc.
Transport Facilities	International Airport, Railway Terminal, Central Bus Terminal, etc.	Domestic Airport, Railway Station, Bus Terminal, etc.	Railway Station, Bus Stand, etc.	Railway Platforms, Bus Shelters, etc.	Bus Stop
Roads	Expressways, A Class Roads	B & C Class Roads	District Roads (C Class)	D & E Class Roads	Local Roads
Financial Facilities	Stock Exchange, Bank Head Offices, etc.	Regional Bank Offices	Bank Branches	Rural bank	Co-op Credit Society

Note: abr. from National Physical Plan (2006)

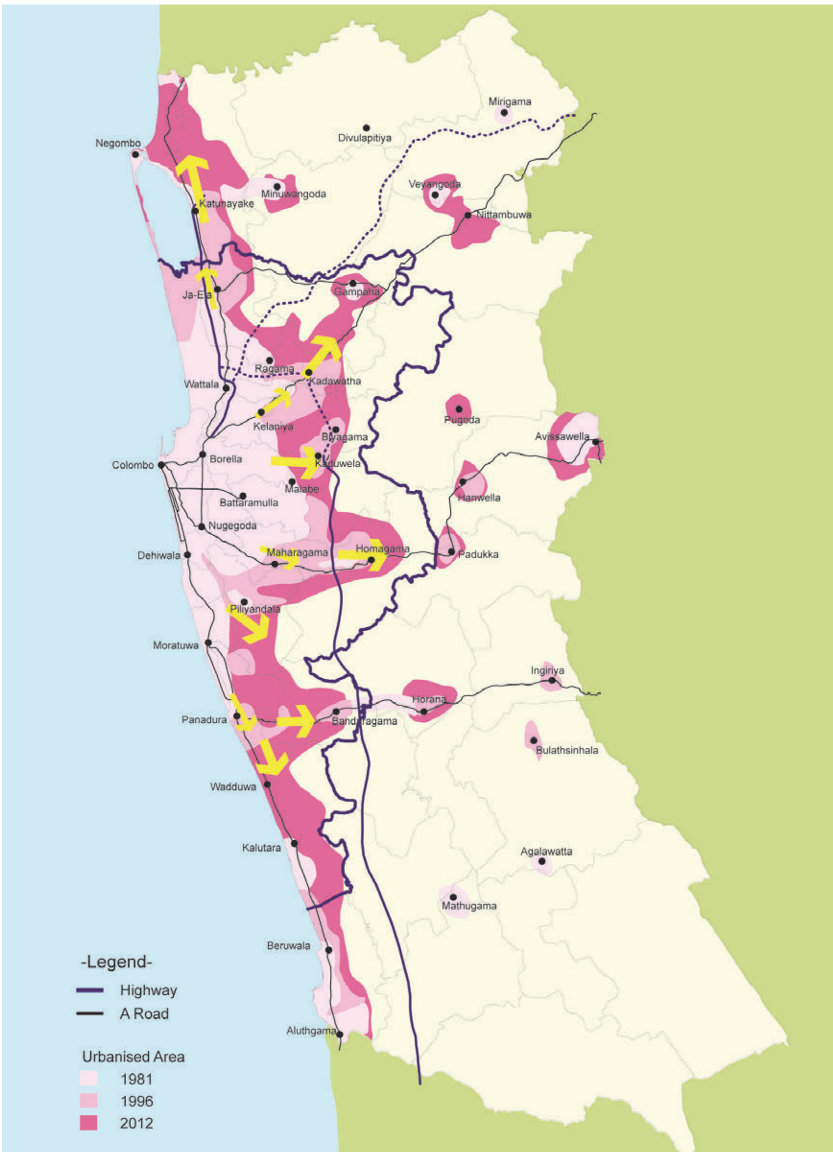


Note: Updated by CoMTrans Study Team based on the map 2.14 "Existing Functional hierarchy of Urban Centres 1996", Colombo Metropolitan Regional Structure Plan 1998

Figure 2.2.4 Functional Hierarchy of Urban Centres

(2) Urbanised Areas

The study of Colombo Metropolitan Regional Structure Plan1998 shows the urbanised areas in 1981and 1996. In addition, present urbanised areas can be found from the current population density and the land use pattern. Figure 2.2.5 shows urbanised areas in 1981, 1996, and 2012.



Note: Updated by the CoMTrans Study Team based on the map 2.12 “Spatial Distribution Pattern of Urban Centres”, Colombo Metropolitan Regional Structure Plan 1998

Figure 2.2.5 Urbanised Areas in 1981, 1996 and 2012

The urban area in 1981 was concentrated in the western part of the Western Province around CMC and surroundings, and some local urban centres such as Katunayake, Gampaha, Mirigama, Avissawella, Homagama, Horana, Kalutara, and Beruwala. By 1996, expansion of the urbanised area was notably observed along Negombo Road, Kadawatha and Nittambuwa on Kandy Road, around Kaduwela, along High Level Road, along Horana Road, and along Galle Road. By 2012, the urbanised areas were extended north to Negombo, and south to Kalutara. The coastal area became continuously urbanised. More expansion towards the east was also observed on High Level Road and Kandy Road, and towards Kaduwela. Urbanisation was also found on Horana Road, and around other local urban centres.

The urbanised areas were formed around CMC and the coast line in a stripe shape. This is considered as the basis of the current basic urban structure.

2.2.3 Urban Development Characteristics

The following are the major urban characteristics. At present, urban development is becoming notable in the Western Province, and the following characteristics are becoming issues for creating effective urban development as well as transport systems.

The urban development characteristics are illustrated in Figure 2.2.6.

(1) Low Density Urban Sprawl and Scattered Residential Development

The current urban settlement pattern, especially in suburbs, is consuming land at a much faster rate than the rate of population growth when compared with other nation's cities. Residential areas cover many parts of the Western Province, which contributes to its low density. The main reasons are mentioned below.

- People tend to build houses with a garden, and this causes the spread of the residential areas.
- Responding to the demand for housing, many housing developments undertaken by the private sector are seen in the suburban areas. Many of them are developed on privately owned coconut fields or forestry tracts in rural areas. These developments are occurring due to land availability without any planning direction. As a result, residential developments are scattered around in the suburban areas. These developments cause inefficient spread of urban areas and become obstacles for future urban development.

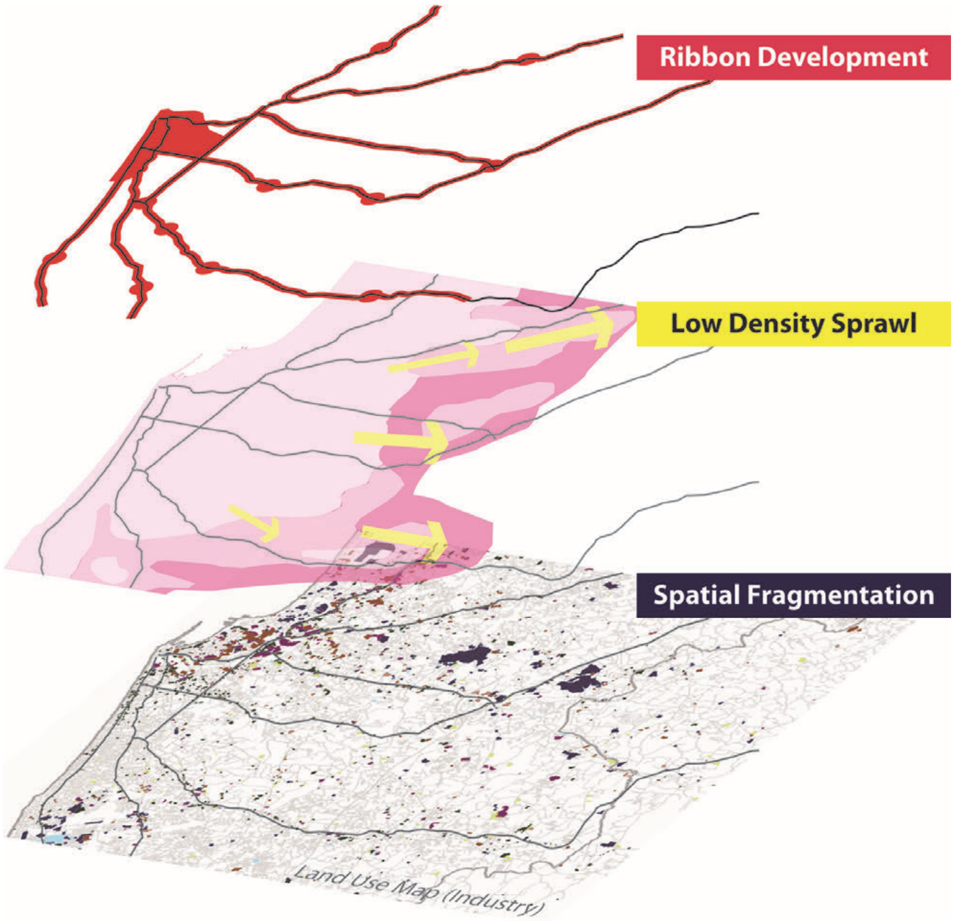
(2) Spatial Fragmentation

Whilst new residents are seeking a better quality of life, bad neighbouring uses such as industrial, logistics and mining uses are also proliferating within the peri-urban residential and agricultural areas. Due to the lack of planning regulations for land use zoning, it is possible that a residential area could be located just next to these undesirable land uses. For instance, some active quarries in the suburban area of Colombo District and some industrial uses along Kelani River are scattered and intermixed with residential areas. This results in undesirable road conditions; heavy vehicles driving through residential areas.

(3) Ribbon Development

The current patterns of business and commercial activities are concentrated along the major roads, such as Galle Road, Kandy Road, Negombo Road, and High Level Road and around the railway stations. Most of the major urban centres in the suburbs of Colombo are also located along the roads and around the railway stations. Especially, urbanised areas are being continuously developed from the centre of Colombo towards suburbs along the major radial roads. In rural areas, towns are located at junctions of regional roads in many cases. The bus network is also intensified on these roads to connect these urbanised areas with the towns. As a result, a great deal of traffic is concentrated on the specific roads and this causes heavy traffic congestion.

In general, low density sprawl and a dispersed pattern of development have resulted in unorganised land use and inefficient public transport systems. Future growth will need to focus on compact town centres with increased residential density to halt the current inefficient uses of land and enable resources to be used in a more efficient and sustainable manner.



Note: Ribbon Development shows the schematic indication of commercial land use, Low Density Sprawl shows the schematic indication of urbanised area, and Spatial Fragmentation shows industrial land use according to the Land Use Survey.

Figure 2.2.6 Urban Development Characteristics

2.3 Economic Activity

2.3.1 GDP and Foundation of Economic Growth

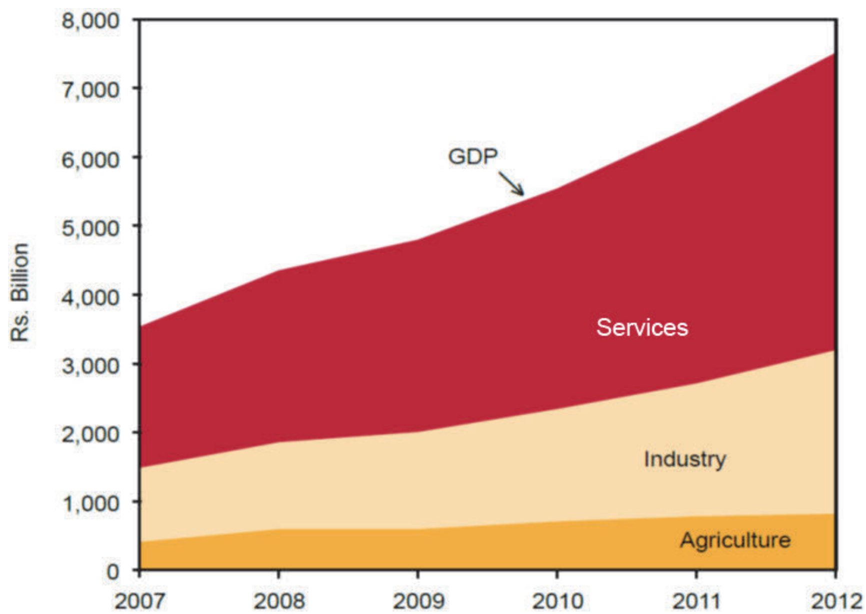
(1) National GDP and Growth

Sri Lanka has continuing high growth of Gross Domestic Product (GDP), especially just after the end of the civil conflict in 2009, it was more than 8% in 2010 and 2011. The Central Bank of Sri Lanka has estimated that GDP growth has dropped down to 6.4% in 2012. Although it is lower than the year before, there is a continuation of the benefits arising from the end of the long-running civil conflict. Table 2.3.1 summarises the National GDP, and Figure 2.3.1 shows the changes in the GDP.

Table 2.3.1 Summary of GDP in Sri Lanka (2006 -2012)

Item	2006	2007	2008	2009	2010	2011	2012*
GDP at Constant (2002) Price (Mil.Rs.)	2,090,564	2,232,656	2,365,501	2,449,214	2,645,542	2,863,715	3,047,277
GDP at Current Market Price (Mil.Rs.)	2,938,680	3,578,688	4,410,682	4,835,293	5,604,104	6,544,009	7,582,376
Growth of GDP	7.7%	6.8%	6.0%	3.5%	8.0%	8.2%	6.4%
GDP per Capita at Current Market Price (Rs.)	147,776	178,845	218,167	236,445	271,346	313,576	373,001

Note: * Provisional
Source: Economic and Social Statistics of Sri Lanka 2013, by Central Bank of Sri Lanka



Source: Central Bank of Sri Lanka

Figure 2.3.1 GDP in Sri Lanka

Table 2.3.2 summarises the GDP by industrial sector. In terms of the share of each industrial sector, the primary industry has slightly declined, the secondary industry is growing, and the tertiary industry has kept at the same level. Key sector growth of the tertiary industry, which accounts for 57.5% of GDP, grew by 8.5% through the expansion of wholesale and retail trade, tourist arrivals (leaped by 31% to 855,975 in 2011), banking, insurance, and real estate.

The forecast growth is seen to continue in the above sectors as well as stimulating, (a) Construction; through continued and planned infrastructure and tourism-related building, and (b) Services; especially hotels and restaurants benefiting from the tourist boom.

Table 2.3.2 GDP by Sector Origin at Current Market Prices of Sri Lanka (2006 – 2012)

Item	2006	2007	2008	2009	2010	2011	2012*
GDP of Primary Industry (Mil.Rs.)	333,137	418,104	590,114	613,694	717,910	792,457	837,883
GDP of Secondary Industry(Mil.Rs.)	900,479	1,070,737	1,295,470	1,434,701	1,649,268	1,956,659	2,387,659
GDP of Tertiary Industry(Mil.Rs.)	1,705,064	2,089,847	2,525,099	2,786,897	3,236,926	3,794,893	4,356,833
Share of Primary Industry	*11.3%*	*11.7%*	*13.4%*	*12.7%*	*12.8%*	*12.1%*	*11.1%*
Share of Secondary Industry	*30.6%*	*29.9%*	*29.4%*	*29.7%*	*29.4%*	*29.9%*	*31.5%*
Share of Tertiary Industry	*58.0%*	*58.4%*	*57.2%*	*57.6%*	*57.8%*	*58.0%*	*57.5%*

Note: * Provisional
Source: Central Bank of Sri Lanka

Growth Forecast by the Sri Lankan Government

The forecast by the Sri Lankan Government is that the economy will continue its trend with high growth and GDP will increase by 8% continuously to 2015. Table 2.3.3 shows the GDP growth forecast by the Central Bank of Sri Lanka.

Table 2.3.3 GDP Forecast to 2015 by the Central Bank of Sri Lanka

Year	2012	2013	2014	2015
GDP Growth Rate (%)	6.5	7.5	8.0	8.3

Source: Central Bank of Sri Lanka

In the view of the Sri Lankan Government, the prime challenge to the continuation of high growth is that currently investment is too low to achieve the national development goals. Private investment, in particular, needs to be substantially scaled up. In this respect there are a number of structural impediments to large-scale private investments identified by the World Bank's "Doing Business 2011 Report" that will have to be addressed, they are; the elimination of red tape, strengthening institutions, building human resources capacity, and simplifying procedures.

Mahinda Chintana, which is a development policy framework of Sri Lanka setting out development visions for a ten year period, emphasises the need to improve the business environment more widely. The intention is to capitalise upon the country's strategic geographical location to develop maritime, aviation, commercial, energy and knowledge hubs as key links between the Eastern and Western global economies.

Growth Forecast by IMF

On the other hand, the International Monetary Fund (IMF) has forecast GDP growth of Sri Lanka in the "World Economic Outlook, April 2013 - Hopes, Realities, Risks". The forecasts are shown in Table 2.3.4. At least till 2018, the GDP growth will stay at a rate of over 6%, which is lower than the forecast by the Central Bank of Sri Lanka.

Table 2.3.4 GDP Forecast to 2018 by IMF

Year	2013	2014	2018
GDP Growth Rate (%)	6.3	6.7	6.5

Source: "World Economic Outlook, April 2013 - Hopes, Realities, Risks", IMF

(2) GRDP of the Western Province

The Western Province is the most developed and urbanised region in Sri Lanka and its Gross Regional Domestic product (GRDP) accounts for nearly 45% of the national GDP in the past five years. The "City Cluster Economic Development – Sri Lanka Case Study" 2010 by the Asian Development Bank, identified the Western Province as the main area in Sri Lanka for accelerated economic growth. The study states that the focus should be on: "developing this region to attract Foreign Direct Investment, promote economic and business activities, and develop internal linkages through trade, create a financial hub and develop information technology together with Business Processing Outsourcing (BPO) etc."

In terms of the share, the tertiary industry has had 64%, which is higher than the rate of the National GDP. Table 2.3.5 summarises GRDP of the Western Province.

Table 2.3.5 GRDP at Current Market Prices of the Western Province (2006 – 2011)

Item	2006	2007	2008	2009	2010	2011*
GDP at Current Price of Sri Lanka (Mil.Rs.)	**2,938,680**	**3,578,688**	**4,410,682**	**4,835,293**	**5,604,104**	**6,544,009**
GRDP at Current Price of Western Province (Mil.Rs.)	**1,472,065**	**1,663,759**	**2,003,055**	**2,216,346**	**2,512,908**	**2,905,159**
Share of Western Prov. to Sri Lanka	50.1%	46.5%	45.4%	45.8%	44.8%	44.4%
GRDP of Primary Industry (Mil.Rs.)	24,730	48,595	62,076	60,955	75,942	93,308
GRDP of Secondary Industry (Mil.Rs.)	488,168	531,248	634,274	732,406	802,790	948,994
GRDP of Tertiary Industry (Mil.Rs.)	959,168	1,083,915	1,306,706	1,422,985	1,634,176	1,862,858
Share of Primary Industry	*1.7%*	*2.9%*	*3.1%*	*2.8%*	*3.0%*	*3.2%*
Share of Secondary Industry	*33.2%*	*31.9%*	*31.7%*	*33.0%*	*31.9%*	*32.7%*
Share of Tertiary Industry	*65.2%*	*65.1%*	*65.2%*	*64.2%*	*65.0%*	*64.1%*

Note: * Provisional
Source: Central Bank of Sri Lanka

The ADB study highlighted the opportunities and benefits to be gained from the competitive advantage of Industry Clusters. The basis for developing and/or consolidating the existing industries into industry clusters are already in evidence within the Transport/Storage and Communication Sectors, the IT Sector, and the Textile & Apparel Sector. At a wider scale the ADB study set out the "Economic Vision" for the Western Province as:

- Financial Hub (Banking/Insurance)
- Rubber City (Rubber Products)
- Apparel Hub (Ready Made Garments)
- Tourism Hub (Travel & Leisure)
- Logistics Hub (Shipping and Aviation)
- Knowledge Hub (IT/Education)

Developing the Knowledge Economy (K Economy)

In addition, the Western Province is experiencing the development of a range of K economy facilities including centres for Nanotechnology, Biotechnology, Tertiary Education, and Sports. This is a Government commitment to investing in knowledge, especially though the medium of high technology, as part of "The National Science and Technology Policy", approved by the Cabinet of Ministers in 2009.

The recent 'Science, Technology & Innovation Strategy for Sri Lanka, 2011-2015' by the Ministry of Technology and Research, defines a clear road map for the development of the K economy sector as a driver of increased GDP per capita, "by increasing high tech value added exports from the (current) 1.5% to 10% by 2015 through the Advanced Technology Initiative". The strategy identifies the establishment of a network of Science Parks, to include:

- Megapolis - central hub for research and development in Colombo,
- Technopolis/Science &Technology corridors at the regional level, and
- Minipolis at the district level.

The initiative also emphasises the need for a highly educated local technical base through training of Research and Development scientists, the establishment of Research Institutes and providing Science Centres to increase science study and career opportunities.

An Equitable Economy

A development strategy based on economic growth by itself is not sustainable. The Sri Lankan New Development Strategy - Framework for Economic Growth and Poverty Reduction (2006) by the Department of National Planning, Ministry of Finance and Planning states: "Higher economic growth alone is not sufficient to reduce poverty; instead it should focus on pro-poor growth strategies. A sustainable 6-8% growth in real income is targeted over the next five years. This in turn requires raising investment to around 35% of Gross Domestic Product (GDP). Such investments include domestic and foreign investment as well as public investment. The ultimate objective is to ensure that Sri Lanka steadily progresses towards an upper middle-income country status within the next ten years".

The following sections describe other economic indicators in Sri Lanka and the Western Province.

2.3.2 Consumer Price Index (CPI) and Inflation

The Consumer Price Index shows inflation clearly. The prices have become almost 2.5 times more expensive in the past ten years and has increased by around 7% in recent years. It was a significant increase from 2007 to 2008; CCPI of Transport rose to 240.3 from 178.1, which is a 35% increase. It is assumed that the reason was the increase in petroleum prices. According to the data from the Central Bank of Sri Lanka, the wholesale price index of petroleum products increased 30% in this period. Table 2.3.6 shows the Consumer Price Index, based on the year of 2002. Rates of annual price increase had been more than 10% a few years ago, which is considered to be galloping inflation, however, the rate has been moderating in the recent years.

As for the sub-indices, except for the communication prices, the index of which was 109.4 in 2012, many indices indicate almost200.

It is noted that the index of Transport prices was 313.4 in 2012compared to a base of 100 in 2002. It was a significant increase from 2007 to 2008; CCPI of Transport rose to 240.3 from 178.1, which is a 35% increase. It is assumed that the reason was the increase in petroleum prices. According to the data from the Central Bank of Sri Lanka, the wholesale price index of petroleum products increased 30% in this period.

Table 2.3.6 Colombo Consumer Price Index (2003 – 2012)

CCPI (2002=100) *		2003	2004	2005	2006	2007	2008	2009	2010	*2011*	*2012*
All Items (Average)		105.8	115.3	128.0	140.8	163.1	199.9	206.8	219.1	*233.9*	*251.5*
Percentage Change		5.8	9.0	11.0	10.0	15.8	22.6	3.4	5.9	*6.7*	*7.6*
Sub-Indices	Food and Non-Alcoholic Beverages	102.6	111.9	124.7	135.8	163.4	213.3	219.2	234.2	*254.7*	*266.8*
	Clothing and Footwear	106.8	112.1	117.9	127.7	140.7	154.8	165.3	176.6	*200.2*	*219.9*
	Housing, Water, Electricity, Gas and Other Fuels	112.0	123.1	146.4	174.2	206.6	226.8	227.5	235.3	*245.6*	*269.3*
	Furnishing, H/H Equipment and Routine Household Maintenance	104.7	109.5	117.6	124.7	134.4	154.1	168.0	176.4	*184.4*	*196.7*
	Health	107.1	107.1	108.0	113.1	115.5	163.2	194.8	227.8	*234.0*	*241.0*
	Transport	106.7	125.4	141.2	156.7	178.1	240.3	238.8	240.7	*257.8*	*313.4*
	Communication	107.8	121.6	121.4	120.5	119.8	100.0	107.0	109.4	*109.4*	*109.4*
	Recreation and Culture	101.7	107.0	113.1	113.6	119.5	128.3	161.8	168.7	*177.9*	*185.1*
	Education	107.9	114.1	119.7	126.3	133.7	141.0	152.0	171.3	*177.2*	*178.0*
	Miscellaneous Goods and Services	111.6	119.3	124.5	131.3	140.5	156.3	168.5	180.7	*187.6*	*195.3*
CCPI (2006/7=100) **							**2008**	**2009**	**2010**	**2011**	**2012**
All Items (Average)							129.2	133.6	141.9	151.5	162.9
Percentage Change								3.5	6.2	6.7	7.6
Sub-Indices	Food and Non-Alcoholic Beverages						144.0	148.5	158.8	172.7	180.9
	Clothing and Footwear						112.5	122.0	130.2	147.6	162.1
	Housing, Water, Electricity, Gas and Other Fuels						114.0	115.1	119.2	124.4	136.4
	Furnishing, H/H Equipment and Routine Household Maintenance						113.0	122.5	128.0	133.8	142.7
	Health						150.4	184.7	233.9	240.3	247.5
	Transport						141.7	138.4	139.7	149.6	181.9
	Communication						82.6	88.2	90.3	90.3	90.3
	Recreation and Culture						116.1	122.7	131.8	139.0	144.6
	Education						110.3	120.7	135.9	140.6	141.2
	Miscellaneous Goods and Services						113.3	122.4	126.3	131.1	136.5

Note: *Colombo Consumer Price Index (2002=100). CCPI at 2011 and 2012 are calculated by the CoMTrans Study Team
** The rebased CCPI (2006/07=100) has replaced CCPI (2002=100) from June 2011.

Source: Central Bank of Sri Lanka

The wage rate indices are also constantly rising. In 2012, there was a 22% rise on average. In the past ten years, the wage almost tripled. Table 2.3.7 summarises the wage rate indices.

Table 2.3.7 Nominal Wage Rate Index (2003 – 2012)

Wage Rate Indices *	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012**
Workers in Agriculture	1,382.2	1,397.7	1,527.4	1,567.1	1,821.4	2,286.6	2,349.4	3,327.6	3,427.2	4,433.0
Percentage Change		*1.1*	*9.3*	*2.6*	*16.2*	*25.5*	*2.7*	*41.6*	*3.0*	*29.3*
Workers in Industry & Commerce	1,009.4	1,044.1	1,078.4	1,090.7	1,522.4	1,877.5	2,054.0	2,199.0	2,402.1	2,402.1
Percentage Change		*3.4*	*3.3*	*1.1*	*39.6*	*23.3*	*9.4*	*7.1*	*9.2*	*0.0*
Workers in Service	678.0	751.0	779.7	779.7	1,057.1	1,370.8	1,545.8	1,673.3	1,851.8	1,851.8
Percentage Change		*10.8*	*3.8*	*0.0*	*35.6*	*29.7*	*12.8*	*8.2*	*10.7*	*0.0*
All Workers	1,205.2	1,233.0	1,329.7	1,358.2	1,648.8	2,070.4	2,171.4	2,865.3	2,996.1	3,662.0
Percentage Change		*2.3*	*7.8*	*2.1*	*21.4*	*25.6*	*4.9*	*32.0*	*4.6*	*22.2*

Note: * Wage Index (1978 December =100), ** Provisional
Source: Central Bank of Sri Lanka

2.3.3 Household Income and Distribution

The median income, which divides the income distribution into two equal sized groups, was 23,746 Rs. per month in 2009/1010, and the mean income, which is the amount obtained by dividing the total aggregate income of a group by the number of units in that group, was 36,451 Rs. per month. Both income levels increased from the year of 2006/2007 to 2009/2010 by around 10% annually. The income of rural areas grew more than urban areas. The household incomes and expenditures in the Western Province were higher but the increase rate was the same as the national level. Similarly, expenditures showed an approximately 10% increase annually. The incomes and expenditures are summarised in Table 2.3.8.

Table 2.3.8 Household Income and Expenditure (2006/07 and 2009/10)

Income / Expenditure per Household (Rs./Month)	2006/07 *			2009/10 **			Annual Increase Rate (06/07-09/10)***		
	Urban	Rural	All Island	Urban	Rural	All Island	Urban	Rural	All Island
Sri Lanka									
Mean Income	41,928	24,039	26,286	47,783	35,228	36,451	4.5%	13.6%	11.5%
Median Income	23,642	16,379	16,735	31,000	23,126	23,746	9.5%	12.2%	12.4%
Expenditure	35,274	21,440	22,952	44,928	29,423	31,331	8.4%	11.1%	10.9%
Western Province									
Mean Income	N/A	N/A	34,282	N/A	N/A	47,118	N/A	N/A	11.2%
Median Income	N/A	N/A	21,686	N/A	N/A	30,600	N/A	N/A	12.2%
Expenditure	N/A	N/A	31,437	N/A	N/A	42,399	N/A	N/A	10.5%

Note: * Excluding the Northern Province and Tricomalee district in the Eastern province, ** Excluding Mannar, Kilinochchi and Mullaitivu districts. *** Calculated by CoMTrans Study Team

Source: Central bank of Sri Lanka

Income distribution and Gini coefficients are shown in Table 2.3.9. Nationwide, the total income share stayed almost the same in the years of 2006/2007 and 2009/2010. The richest 20% of the households shared more than 50% of the total income. In the urban areas, the top decile households together earned 50.3% of the total income.

The Gini coefficient is commonly used as a measure of inequality of income or wealth; a low Gini coefficient indicates a more equal distribution, while higher Gini coefficients indicate more unequal distribution. In the case of Sri Lanka, the Gini Coefficients were around 0.5, which is very high and considered unequal. In the urban areas, it improved to the range of 0.54 to 0.48. The Gini coefficient of the Western Province is almost the same as the National level.

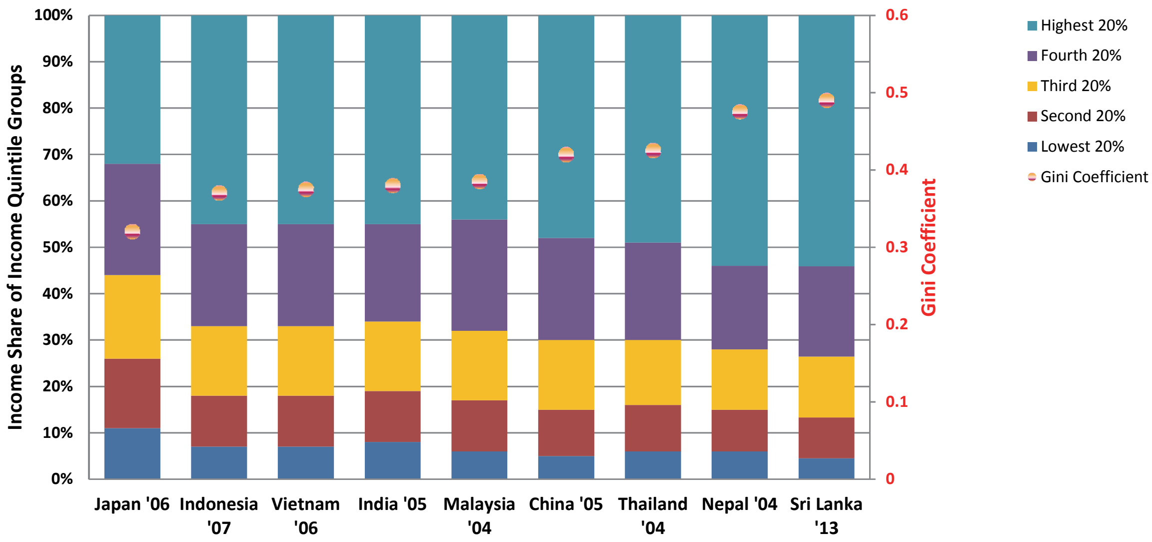
Table 2.3.9 Income Share and Gini Coefficients (2006/07 and 2009/10)

Items	2006/07 *			2009/10 **		
	Urban	Rural	Total	Urban	Rural	Total
Income Share by Decile of Household % (Sri Lanka)						
1st Decile	1.5	1.7	1.6	0.6	1.7	1.6
2nd Decile	2.7	3.1	2.9	1.5	3.1	2.9
3rd Decile	3.5	4.2	3.9	2.0	4.1	3.9
4th Decile	4.2	5.1	4.8	3.0	5.1	4.9
5th Decile	5.1	6.2	5.8	3.7	6.3	6.0
6th Decile	6.3	7.5	7.0	5.7	7.3	7.1
7th Decile	7.4	9.1	8.5	7.7	8.9	8.7
8th Decile	9.7	11.3	10.8	9.9	11.1	10.8
9th Decile	13.2	15.2	14.6	15.7	14.6	14.6
10th Decile	46.2	36.5	40.1	50.3	37.7	39.5
Gini Coefficient (Households), Monthly Income						
Gini Coefficient (Sri Lanka)	0.54	0.46	0.49	0.48	0.49	0.49
Gini Coefficient (Western Province)			0.49			0.47

Note: * Excluding the Northern Province and Tricomalee district in the Eastern province.
** Excluding Mannar, Kilinochchi and Mullaitivu districts.

Source:Central Bank of Sri Lanka

Income distribution of Sri Lanka and other countries are shown in Figure 2.3.2. In Sri Lanka the highest 20 % of households earn 54% of income and the Gini Coefficient is the highest at 49% in the selected countries.



Source: Transport Development in Asian Megacities

Central Bank of Sri Lanka

Figure 2.3.2 Income Distribution and Gini Coefficients in Selected Countries

2.3.4 Unemployment

In the past ten years, unemployment rates have improved from 8.8% in 2002 to 4.2% in 2011. The latest published data is available on the website of the Department of Census and Statistics, the "Labour Force Survey – Quarterly Report 2012 3rd Quarter" shows the latest unemployment rate at 4.1 %.

The unemployment rate for females was 6.8% and it was 2.7% for males. The youth unemployment rate was higher than the other age groups; unemployment of 15-19 year olds was15.4% in 2011.

In terms of level of education, educated labourers have higher unemployment rates. This has also improved from 17% to 8% in the past ten years. On the other hand, unemployment rates of the uneducated population have been very low, less than 2% in the past ten years.

The unemployment rates from 2002 to 2011 are shown in Table 2.3.10.

Table 2.3.10 Unemployment Rate of Sri Lanka (2002 - 2011)

Unemployment Rate (% of Labour Force)	2002 (d)	2003 (a)	2004 (b)	2005 (c)	2006 (d)	2007 (d)	2008 (a)	2009 (a)	2010 (a)	2011 (c)	2012 (c)
Total	8.8	8.4	8.3	7.7	6.5	6.0	5.2	5.8	4.9	4.2	4
Male	6.6	6.0	6.0	5.5	4.7	4.3	3.6	4.3	3.5	2.7	2.8
Female	12.9	13.2	12.8	11.9	9.7	9.0	8.0	8.6	7.7	7.0	6.2
Age Group											
15-19	30.1	30.3	28.3	30.8	23.1	21.6	20.6	20.9	20.3	15.5	18.9
20-29	20.1	19.4	19.2	17.2	15.9	15.0	13.2	15.4	13.8	12.3	11.3
30-39	4.0	3.9	4.0	3.8	3.3	3.3	3.1	3.7	3.1	2.7	2.5
40 and above	1.6	1.1	1.3	1.2	1.4	1.3	1.2	1.4	1.0	0.7	0.8
Level of Education											
No School / Grade 0-4	1.8	1.7	2.0	1.8	Ng	1.3	1.1	Ng	Ng	Ng	Ng
Grade 5-9	7.9	7.4	6.9	6.3	5.8	5.2	4.5	5.0	3.6	3.3	3.2
G.C.E (O/L)	13.3	13.0	12.3	11.5	9.9	8.2	7.4	8.5	6.9	5.2	6
G.C.E (A/L) and above	16.8	16.5	16.8	13.8	11.6	11.8	9.9	11.2	11.6	9.0	7.5
Urban and Rural Sector											
Urban Sector	8.4	8.9	8.4	6.4	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Rural Sector	8.8	8.3	8.3	7.8	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Note: Ng: Negligible, n.a.: Not Available

Unemployed: Persons who are seeking and available for work, but had no employment during the reference period.
Unemployment Rate: The number of unemployed persons as a percentage of the labour force.

(a) Including the Eastern Province but excluding the Northern Province / (b) Excluding the Mullaitivu and Kilinochchi districts / (c) All districts included / (d) Excluding the Northern and Eastern Provinces. / Source: Department of Census and Statistics

2.4 Public Finance

Government Finance is summarised in the following Table 2.4.1 and Figure 2.4.1.

The Central Bank of Sri Lanka estimated the revenue of Sri Lanka in 2012 at 987.8 billion Rs, which was almost 3.5 times that of 2003 (284.4 billion Rs). Grants were also increased from 8 billion to 16 billion. Expenditures have been expanding as well. Current expenditures grew from 334.7 billion to 1,094.2 billion, which was 3.2 times as much.

As the scale of the government finance has been growing, the deficit has been increasing constantly. The overall budget had a 133.3 billion Rs. deficit in 2003 and it increased to 3.7 times as much, or 489.0 billion rupees in 2012. Outstanding government debt greatly increased from 1,864 billion Rs in 2003 to 6,000 billion Rs in 2012.

The share of the revenue to the GDP was around 15%, and this is decreasing in recent years and hit 13.0% in 2012. At the same time, the share of the expenditure had been 22 to 24% but it decreased to 19.7% in 2012.

Since the growth of the expenditure was smaller than that of revenue, the deficit as a percentage of GDP tends to shrink. Government total debt as percentage of GDP was over 100%in 2003 and 2004, but it lowered to less than 80% recently. In terms of percentage to GDP, the finance is being improved.

Table 2.4.1 Government Finance(2003 – 2012)

Item	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Revenue and Grants	**284.4**	**320.2**	**412.4**	**507.9**	**595.6**	**686.5**	**725.6**	**834.2**	**949.9**	**1,003.9**
Revenue	276.5	311.5	379.7	477.8	565.1	655.3	699.6	817.3	934.8	987.8
Grants	8.0	8.7	32.6	30.1	30.5	31.2	25.9	16.9	15.1	16.1
Total Expenditure and Net Lending	**417.7**	**476.9**	**584.8**	**713.6**	**841.6**	**996.1**	**1,201.9**	**1,280.2**	**1,400.1**	**1,492.9**
Current Expenditure	334.7	389.7	443.4	548.0	622.8	743.7	879.6	937.1	1,006.6	1,094.2
Capital Expenditure and Net Lending	83.0	87.2	141.4	165.7	218.8	252.4	322.4	343.1	393.5	398.6
Current Account Surplus(+)/Deficit(-)	**-58.2**	**-78.2**	**-63.6**	**-70.1**	**-57.7**	**-88.5**	**-179.9**	**-119.8**	**-71.9**	**-106.4**
Overall Budget Surplus(+)/Deficit(-)	**-133.3**	**-156.8**	**-172.4**	**-205.7**	**-246.0**	**-309.6**	**-476.4**	**-446.0**	**-450.2**	**-489.0**
Total Financing	**133.3**	**156.8**	**172.4**	**205.7**	**246.0**	**309.6**	**476.4**	**446.0**	**450.2**	**489.0**
Foreign	43.1	37.1	47.8	41.9	100.9	-4.6	230.8	243.8	219.0	286.5
Domestic	79.9	117.2	123.6	163.8	145.1	314.3	245.6	202.2	231.2	202.5
Privatization Proceeds	10.2	2.4	1.0	–	–	–	–	–	–	-
Outstanding Government Debt	**1,863.9**	**2,139.5**	**2,222.3**	**2,582.6**	**3,041.7**	**3,589.0**	**4,161.4**	**4,590.2**	**5,133.4**	**6,000.1**
GDP at Current Price	*1,822.5*	*2,090.8*	*2,452.8*	*2,938.7*	*3,578.7*	*4,410.7*	*4,835.3*	*5,604.1*	*6,544.0*	*7,582.4*
Revenue, excluding grants as % of GDP	*15.2%*	*14.9%*	*15.5%*	*16.3%*	*15.8%*	*14.9%*	*14.5%*	*14.6%*	*14.3%*	*13.0%*
Total Expenditure and Net Lending as % of GDP	*22.9%*	*22.8%*	*23.8%*	*24.3%*	*23.5%*	*22.6%*	*24.9%*	*22.8%*	*21.4%*	*19.7%*
Overall Budget as % of GDP	*-7.3%*	*-7.5%*	*-7.0%*	*-7.0%*	*-6.9%*	*-7.0%*	*-9.9%*	*-8.0%*	*-6.9%*	*-6.4%*
Government Debt as % of GDP	*102.3%*	*102.3%*	*90.6%*	*87.9%*	*85.0%*	*81.4%*	*86.1%*	*81.9%*	*78.4%*	*79.1%*

Note: Billions of Sri Lankan Rupees
* Provisional
Source:Central bank of Sri Lanka

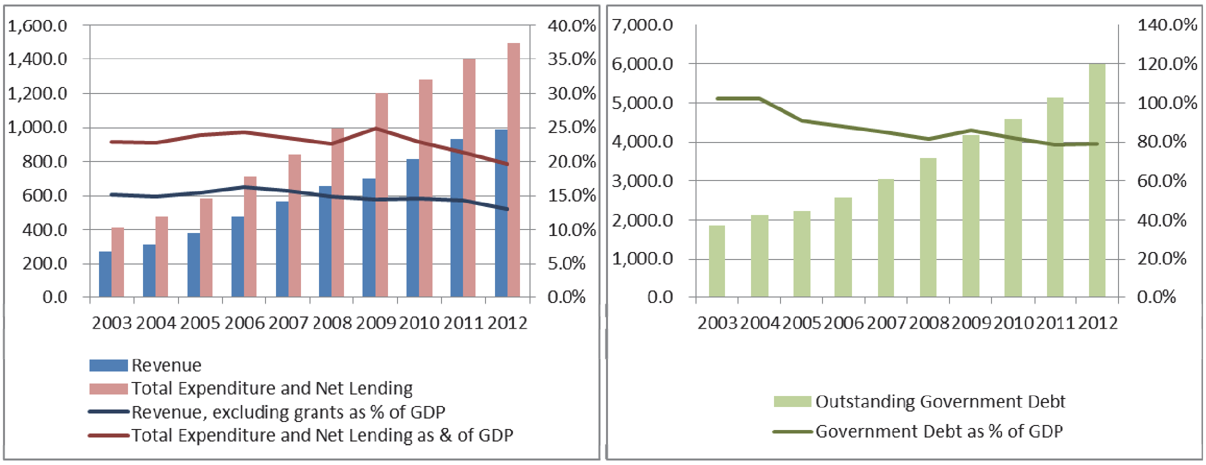


Figure 2.4.1 Revenue and Expenditure in Sri Lanka (2003-2012)

<u>Expenditure on Transport Sector</u>

Based on the Annual Report by the Ministry of Finance and Planning, expenditures on the transport and communication sector are shown in Table 2.4.2. In this data, the figures of the transport and communication sectors are added up.

Both the current and capital expenditures have increased in accordance with the rise of total expenditures. In recent years, more than 15% has been shared by the transport and communication sector in total. Whilst share of current expenditure on the transport and communication sector has been around 3%, the share of capital expenditure has been high. More than 40% is delegated to the transport and communication sector.

Table 2.4.2 Government Expenditure on Transport and Communication Sector

Item	2007	2008	2009	2010	2011	2012*
Current Expenditure on All Sectors (Mil.Rs.)	622,758	743,710	879,575	937,094	1,008,244	1,093,192
Transport and Communication Sector (Mil.Rs.)	18,983	29,587	31,068	31,246	31,823	34,995
Share of Transport and Communication sector to All (%)	3.0%	4.0%	3.5%	3.3%	3.2%	3.2%
Capital Expenditure and Lending on All Sectors (Mil.Rs.)	229,273	263,859	330,448	356,519	438,962	481,804
Transport and Communication Sector (Mil.Rs.)	50,995	82,916	139,104	165,505	190,026	204,539
Share of Transport and Communication sector to All (%)	22.2%	31.4%	42.1%	46.4%	43.3%	42.5%
Total Expenditure and Lending on All Sectors (Mil.Rs.)	852,031	1,007,569	1,210,023	1,293,613	1,447,206	1,574,996
Transport and Communication Sector Mil.Rs.)	69,978	112,503	170,172	196,751	221,849	239,534
Share of Transport and Communication sector to All (%)	8.2%	11.2%	14.1%	15.2%	15.3%	15.2%

Note: *Provisional
Sectorial Classification by the Ministry of Finance and Planning is; 1.General Public Services – 1.1.Civil Administration, 1.2.Defence, 1.3.Public Order and Safety / 2.Social Services – 2.1.Education, 2.2.Health, 2.3.Welfare, 2.4.Community Services / 3.Economic Services – 3.1.Agriculture & Irrigation, 3.2.Energy and Water Supply, 3.3.Transport & Communication / 4.Other

Source: Annual Report 2012, Ministry of Finance and Planning, Sri Lanka

Recurrent and capital expenditures of the major agencies under the Ministry of Transport and Ministry of Private Transport Services, and the Ministry of Highways, Ports and Shipping are shown in Table 2.4.3.

The Department of Sri Lanka Railways, Department of Motor Traffic, Sri Lanka Transport Board, National Transport Medical Institute, Lakdiva Engineering Company (Pvt) Ltd, and National Council for Road Safety are under the Ministry of Transport, and the National Transport Commission is under the Ministry of Private Transport Services. The expenditures have been increasing drastically since 2005, especially the capital expenditure. The expenditure of the Department of Motor Traffic has stayed the same in the recent years, but the expenditures of the other agencies have been increasing.

Expenditure of the Ministry of Highways, Ports, and Shipping was also drastically increased from the level of 2005. In recent years, the capital expenditure is more than 130 billion Sri Lankan Rupees, which is nearly four times larger than the capital expenditure of Ministry of Transport.

Table 2.4.3 Recurrent and Capital Expenditure of Ministries and Agencies of Transport and Highway Sector (2005, 2010-2014)

Ministries / Agencies	Expenditure	Actual Allocation (Mil.Rs.)					Revised Budget (Mil. Rs.)	Estimated Budget (Mil.Rs.)
		2005		2010	2011	2012	2013	2014
Ministry of Transport	**Recurrent**	**7,609**		**11,871**	**14,173**	**15,844**	**18,781**	**20,066**
	Capital	**6,981**		**14,407**	**33,850**	**32,010**	**29,200**	**39,298**
Department of Sri Lanka Railways	Recurrent	5,512		7,191	8,295	8,648	10,791	11,197
	Capital	2,902		12,164	31,337	30,260	22,151	26,950
Department of Motor Traffic	Recurrent	507		716	1,789	1,529	1,448	1,446
	Capital	21		1,044	1,055	1,020	1,051	1,049
Sri Lanka Transport Board	Recurrent	1,337		3,827	3,938	5,516	6,365	7,245
	Capital	3,993		849	1,243	579	1,920	2,197
Ministry of Private Transport Services *	**Recurrent**	**NA**		**351**	**325**	**235**	**560**	**566**
	Capital	**NA**		**79**	**82**	**66**	**207**	**178**
National Transport Commission **	Recurrent	103		351	281	** 419	** 501	NA
	Capital	39		79	39	** 54	** 147	NA
Ministry of Highways, Ports, and Shipping ***	**Recurrent**	**587**		**254**	**196**	**196**	**217**	**229**
	Capital	**13,960**		**111,831**	**127,470**	**146,682**	**133,016**	**144,770**

Note: * Ministry of Private Transport Services was established in 2010
** Expenditure of National Transport Commission in 2012 is revised budget allocation, 2013 is estimated budget allocation, and 2014 is not available.
*** Name of the Ministry changed from "Ministry of Highways and Ports" in 2013.
Source:National Budget Department

2.5 Motor Vehicle Registrations and Ownership

2.5.1 Vehicle Population based on Revenue Licences

The total number of vehicles based on the revenue licences in the Western Province was 1,279,616 in 2012 according to the Motor Traffic Department of the Western Provincial Council. This number is the number of vehicles with a valid vehicle licence which is revised annually. It has grown continuously, and was 2.3 times larger than the revenue licences issued ten years ago. Annually, it increased 8.5% on average. Compared to the population growth, which showed a 0.7% increase annually, the increase rate of vehicle population is much higher.

Based on the revenue licence data, vehicles are classified into ten categories, Motor cars, Three Wheelers (Motor Tricycles), Motor Cycles, Mini Buses, Motor Couches, Dual purpose vehicles, Motor Lorries, Land vehicles, Ambulances, and Others. The number of motor cars increased as well, from 110,799 in 2002 to 244,636 in 2012. The number of motor cars per 100 people also doubled, from 2.0 in 2002 to 4.2 in 2012.

The number of three-wheelers has increased at a very high pace, almost 3.5 times in the past ten years. These remarkable increases in the number of vehicles are causing more and more severe traffic congestion in urban areas.

Vehicle populations from 2002 to 2012 are shown in Table 2.5.1 and Figure 2.5.1.

Table 2.5.1 Total Vehicle Population in Western Province 2002, 2008-2012

Vehicle Type	2002		2008	2009	2010	2011	2012	AAGR*
Motor Cars	110,799		183,687	182,078	200,986	237,233	244,636	8.2%
Three Wheelers	67,591		148,183	154,888	179,124	212,349	237,473	13.4%
Motor Cycles	208,685		421,324	416,527	464,405	508,828	542,858	10.0%
Mini Buses	7,028		6,493	6,461	6,916	6,658	6,530	-0.7%
Motor Coaches	9,296		11,290	10,920	12,090	12,698	13,421	3.7%
Dual Purpose Vehicles	81,720		102,613	100,840	105,831	117,332	125,642	4.4%
Motor Lorries	55,836		82,254	81,866	88,570	92,254	92,355	5.2%
Land Vehicles	11,827		14,969	14,300	14,902	14,922	14,367	2.0%
Ambulances	104		526	445	502	514	487	16.7%
Other	11,610		1,448	1,395	1,743	2,920	1,847	-16.8%
Total Revenue Licence	**564,496**		**972,787**	**969,720**	**1,075,069**	**1,205,708**	**1,279,616**	**8.5%**

Note: *AAGR: Average Annual Growth Rate from 2002 to 2012, calculated by CoMTrans Study Team
Source: Motor Traffic Department of the Western Provincial Council

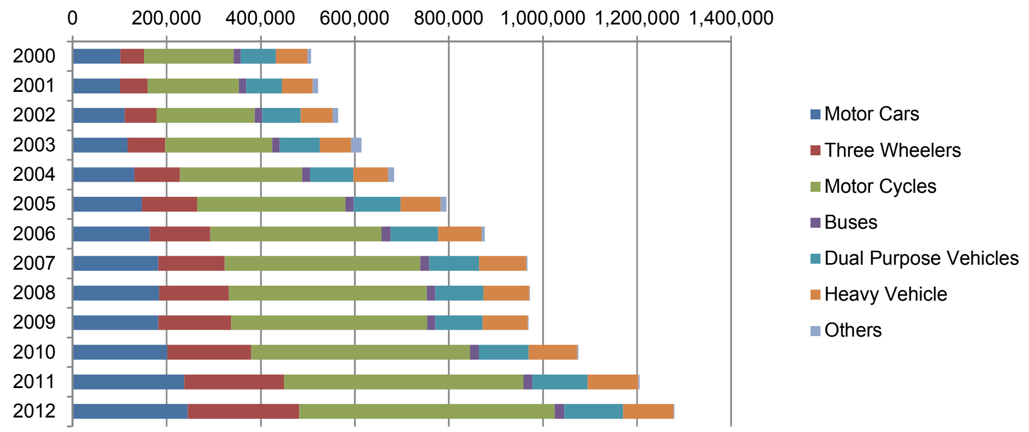
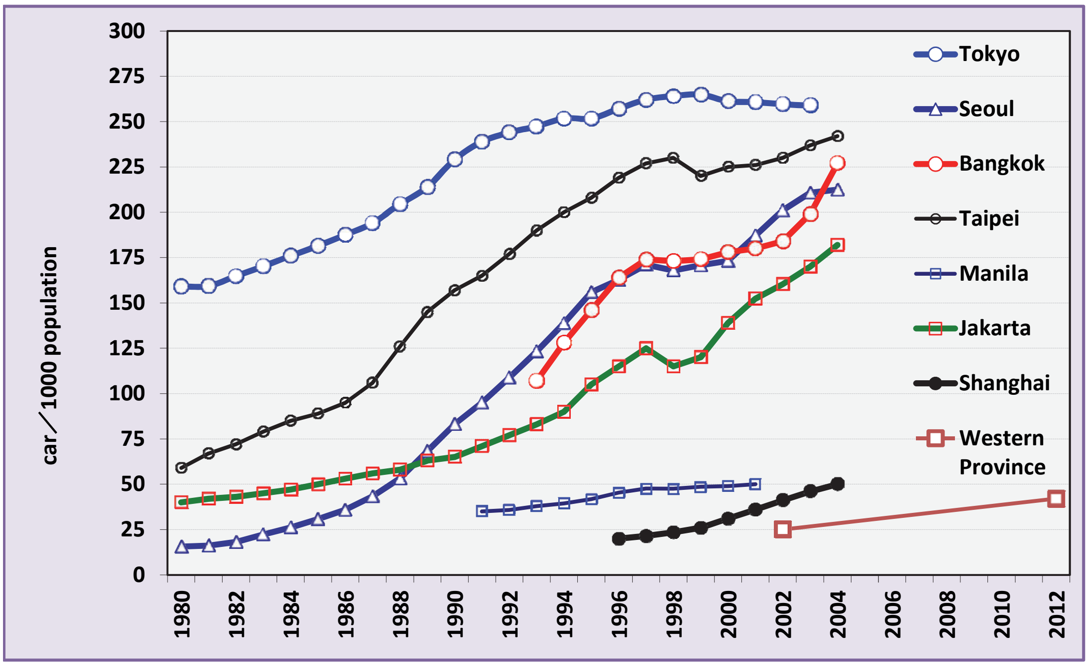


Figure 2.5.1 Vehicle Population in the Western Province

Many large Asian cities have experienced the rapid motorisation as depicted in Figure 2.5.2. Car ownership in the Western Province was 20 cars per 1000 people and it increased to 42 cars per 1000 people in 2012. However the car ownership in the Western Province is still low compared the other large cities. It might increase as GRDP per capita increases in the future.



Source: Transport Development in Asian Megacities

Economic and Social Statistics of Sri Lanka 2013, Central Bank of Sri Lanka

Figure 2.5.2 Past Trend of Car Ownership in Selected Cities

2.5.2 Vehicle Registration in Sri Lanka and Western Province

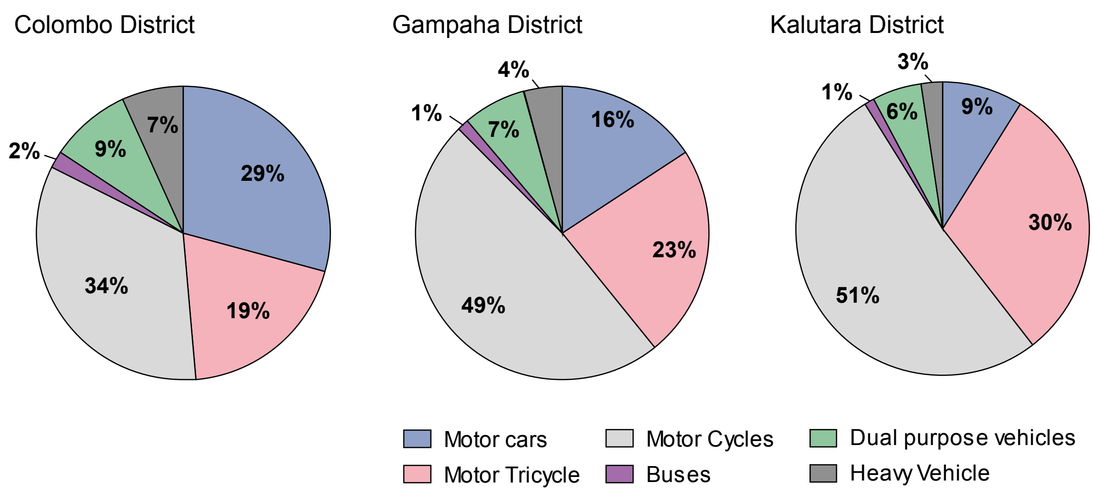
Vehicle registration depends largely on the government tax policy. Although the number of registered vehicles is increasing generally, there were low numbers registered in 2009, and the numbers significantly increased to 525,421 in 2011. Again, it dropped to 397,295 in 2012. More specifically, diesel vehicles were increasing but petrol vehicles were decreasing in this year. Around 30% of the total number of vehicles were registered in the Western Province, and of these, around half were in the Colombo District. The registered numbers of vehicles are listed in Table 2.5.2.

Approximately 29% of motor cars are in the Colombo District, but fewer motor cycles are registered. On the contrary, almost 50% of registered vehicles in Gampaha and Kalutara District are motor cycles and in these districts there are more tricycles than motor cars. The shares of registered vehicles in the Districts in the Western Province are shown in Figure 2.5.3.

Table 2.5.2 New Registration of Motor Vehicles 2005-2012

Class of Vehicle	2005	2006	2007	2008	2009	2010	2011	2012
Motor Cars	17,283	27,578	22,603	20,237	5,762	23,072	59,090	32,685
Motor Tricycles	41,085	64,466	43,068	44,804	37,364	85,648	138,446	98,819
Motor Cycles	130,696	156,626	182,508	155,952	135,421	204,811	253,331	192,283
Buses	2,069	3,346	2,637	1,180	739	2,491	4,248	3,095
Dual Purpose Vehicles	6,851	7,245	5,193	2,856	1,280	11,712	33,518	37,398
Lorries	14,262	20,436	18,408	14,038	8,225	11,845	13,594	11,123
Land Vehicles-Tractors	15,597	19,040	21,346	24,357	13,951	17,363	20,073	18,450
Land Vehicles-Trailers	1,826	1,785	2,129	1,775	1,333	2,301	3,121	3,442
TOTAL in Sri Lanka	**229,669**	**300,522**	**297,892**	**265,199**	**204,075**	**359,243**	**525,421**	**397,295**
Total in Western Province			111,090	86,996	54,044	108,517	182,622	
Total in Colombo District			58,345	45,355	25,575	52,142	90,479	
Total in Gampaha District			36,056	27,988	19,287	38,358	63,389	
Total in Kalutara District			16,689	13,653	9,182	18,017	28,754	

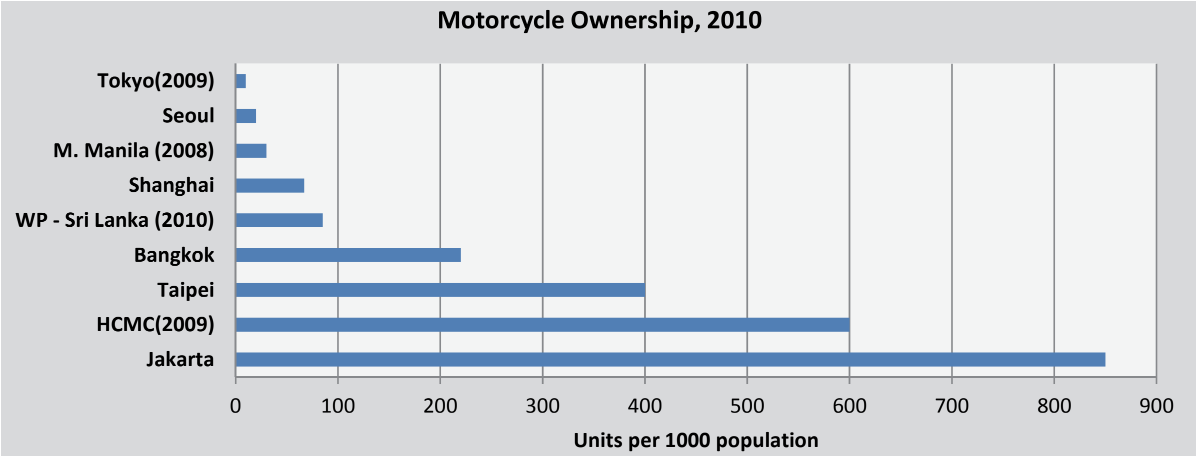
Source: Department of Motor Traffic



Note: Heavy Vehicles includes Lorries, Land-Vehicle Tractors, and Land-Vehicle Trailers
Source: Department of Motor Traffic

Figure 2.5.3 Share of Registered Vehicles in 2011

It is widely known that motorcycle ownership in Jakarta has been increasing remarkably. During the period from 2000 to 2010, the total number of motorcycles has grown by five times. At present the average number of motorcycles is 0.85 motorcycles per person in Jakarta as shown in Figure 2.5.3. Motorcycle ownership in the Western Province is still low at 0.8 but the growth rate of motorcycle ownership is high in the Western Province. It implies that the motorcycle ownership would continue to increase over the short-term.

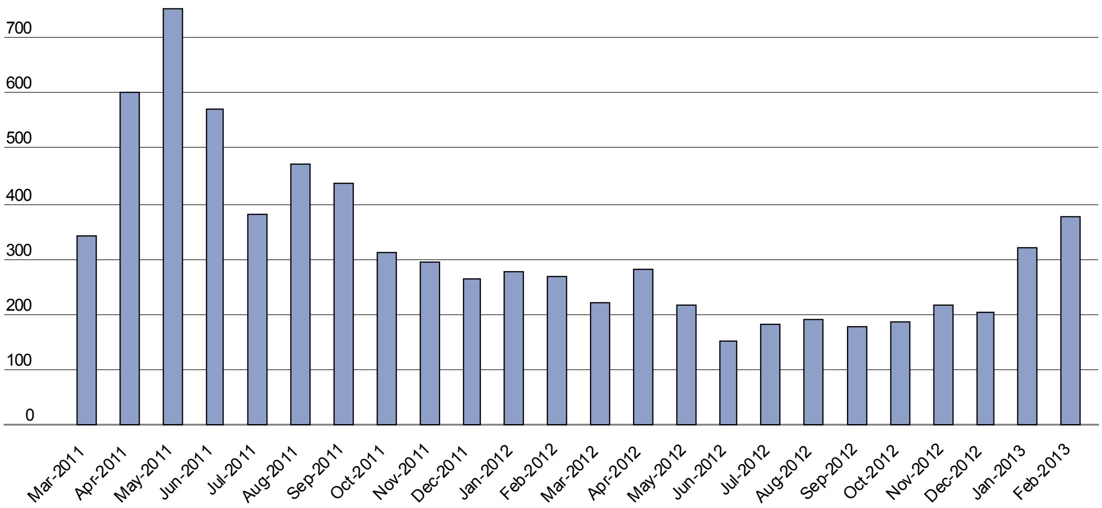


Source: Transport Development in Asian Megacities
Economic and Social Statistics of Sri Lanka 2013, Central Bank of Sri Lanka
Census of Population and Housing 2012, Department of Census and Statistics

Figure 2.5.4 Motorcycle Ownership in Selected Cities

Hybrid Cars

Hybrid cars were introduced in Sri Lanka in March 2011, and soon the registration per month hit 751 in May 2011. Then, the registration pace slowed to 200. Recently, over 300 hybrid vehicles have been registered. By the end of 2012, there were approximately 7,000 hybrid cars registered, which is some 1.4 % of the total motor vehicles. The registration number of hybrid cars also depends on government tax policy. The registration numbers of Hybrid Cars are shown in Figure 2.5.5.



Note: Number of new registered hybrid cars per month
Source: Department of Motor Traffic

Figure 2.5.5 New Registration of Hybrid Cars

2.5.3 Vehicle Ownership in the Western Province

According to the HVS, vehicle ownership by the categories of passenger car, motor cycle, and three wheeler is estimated as follows:

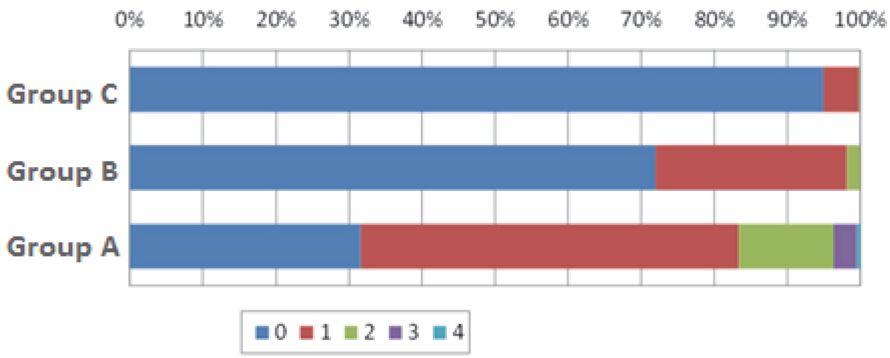
(1) Passenger Car Ownership

Table 2.5.3 and Figure 2.5.6 show the distribution of passenger car ownership by income levels. Clearly, the passenger car ownership grows as income level goes up. The average number of passenger cars owned per household of Group C is 0.05. Meanwhile that of Group A is 0.89.

Table 2.5.3 Passenger Car Ownership by Household Income Level

Passenger Car Ownership	Group C	Group B	Group A	All
Number of Households Not Owning Cars	976,391	230,669	32,779	1,239,840
Number of Households Owning 1 Car	50,512	83,757	53,753	188,022
Number of Households Owning 2 Cars	1,386	5,722	13,449	20,556
Number of Households Owning 3 or 4 Cars	137	156	3,786	4,078
Total Households	1,028,426	320,304	103,767	1,452,497
Total Number of Cars	53,727	95,668	92,500	241,895
Average Number of Cars per Household	0.05	0.30	0.89	0.17
Average Number of Cars per Total Number of Household Owning Cars	1.03	1.07	1.30	1.14

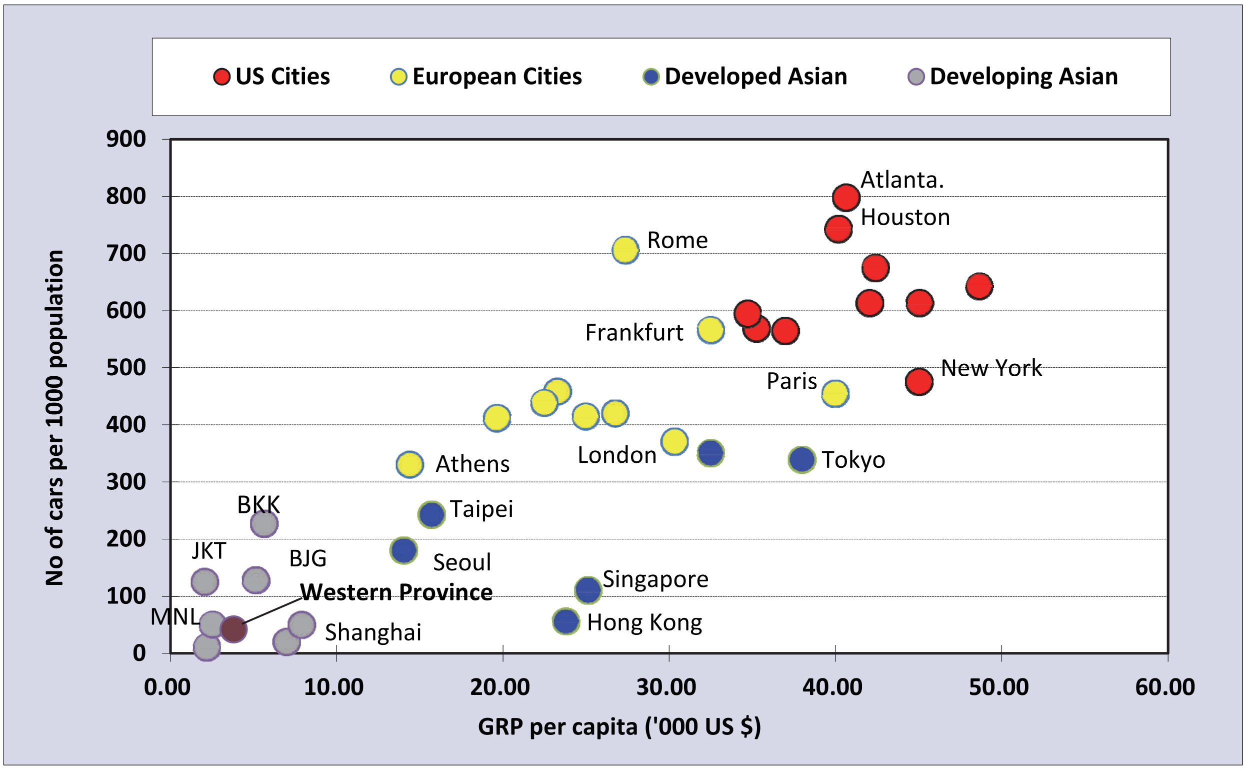
Note: Group C: Less than Rs. 40,000 / Group B: Rs.40,000 – Rs. 79,999 / Group A: Rs. 80,000 and above
Source:CoMTrans Home Visit Survey 2013



Source: CoMTrans Study Team

Figure 2.5.6 Passenger Car Ownership by Household Income Level

Metropolitan areas in USA and those in EU countries have different characteristics. Many US metropolitan areas indicate high car ownership while European metropolitan areas show lower car ownership than the USA. Compared to the US metropolitan areas and EU metropolitan areas, Asian metropolitan areas have lower car ownership. The car ownership in the Western Province is still low which is similar to that in Metro Manila. The future car ownership in the Western Province depends on urban transport policies such as the promotion of a public transport network and the restriction of private car use and so forth.



Source: Transport Development in Asian Megacities
Economic and Social Statistics of Sri Lanka 2013, Central Bank of Sri Lanka
Census of Population and Housing 2012, Department of Census and Statistics

Figure 2.5.7 Car Ownership and GRDP per Capita for Selected Metropolitan Area

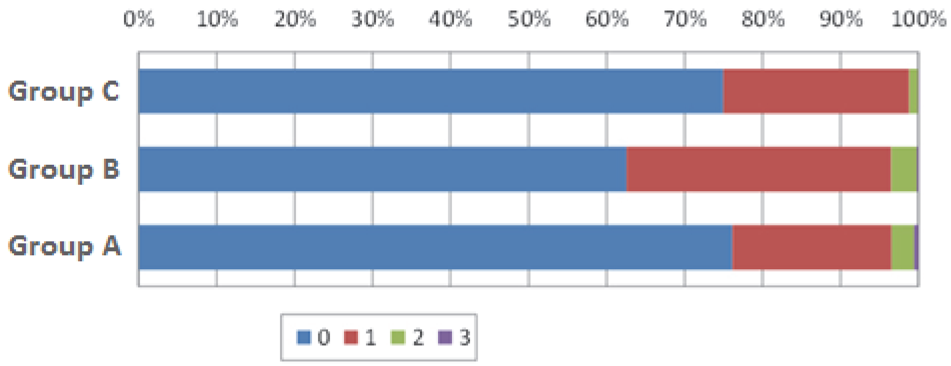
(2) Motorcycle Ownership

Table 2.5.4 and Figure 2.5.8 show the distribution of motorcycle ownership by income levels. Motorcycle ownership grows as income level goes up from Group C to Group B. However, if monthly household income goes up from the Group B to the Group A, motorcycle ownership conversely decreases. This is because if they become rich enough to allow them to purchase a car, they shift to that instead of a motorcycle.

Table 2.5.4 Motorcycle Ownership by Household Income Level

Motorcycle Ownership	Group C	Group B	Group A	All
Number of Households Not Owning Motorcycles	770,797	200,266	78,990	1,050,054
Number of Households Owning 1 Motorcycle	245,617	109,023	21,239	375,879
Number of Households Owning 2 Motorcycles	11,414	10,365	2,978	24,757
Number of Households Owning 3 Motorcycles	598	650	559	1,807
Total Households	1,028,426	320,304	103,767	1,452,497
Total Number of Motorcycles	270,239	131,703	28,872	430,814
Average Number of Motorcycles per Household	0.26	0.41	0.28	0.30
Average Number of Motorcycles per Total Number of Household Owning Motorcycles	1.05	1.10	1.17	1.07

Note: Group C: Less than Rs. 40,000 / Group B: Rs.40,000 – Rs. 79,999 / Group A: Rs. 80,000 and above
Source:CoMTrans Home Visit Survey 2013



Source: CoMTrans Study Team

Figure 2.5.8 Motorcycle Ownership by Household Income Level

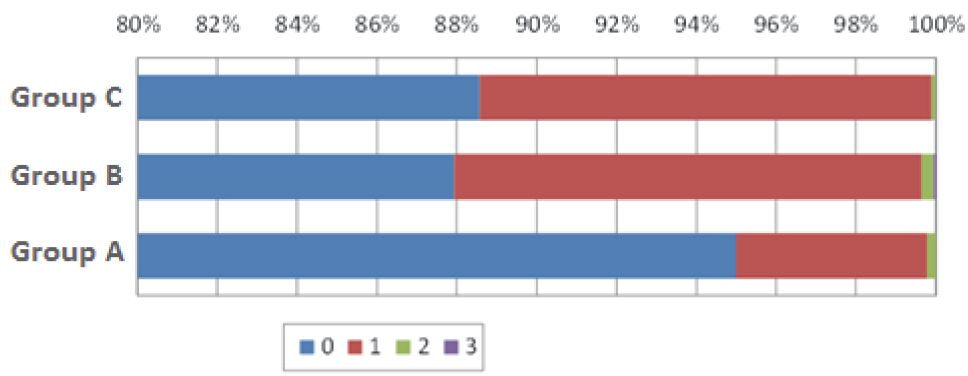
(3) Three Wheeler Ownership

Table 2.5.5 and Figure 2.5.9 show the distribution of three wheeler ownership by income levels. Three wheeler ownership decreases as income level goes up.

Table 2.5.5 Three Wheeler Ownership by Household Income Level

Three Wheeler Ownership	Group C	Group B	Group A	All
Number of Households Not Owning 3-wheelers	910,992	281,669	98,567	1,291,228
Number of Households Owning 1 3-wheeler	116,277	37,487	4,975	158,738
Number of Households Owning 2 3-wheelers	1,127	950	225	2,303
Number of Households Owning 3 3-wheelers	30	198	0	228
Total Households	1,028,426	320,304	103,767	1,452,497
Total Number of 3-wheelers	118,622	39,982	5,425	164,028
Average Number of 3-wheelers per Household	0.12	0.12	0.05	0.11
Average Number of 3-wheelers per Total Number of Household Owning 3-wheelers	1.01	1.03	1.04	1.02

Note: Group C: Less than Rs. 40,000 / Group B: Rs.40,000 – Rs. 79,999 / Group A: Rs. 80,000 and above
Source:CoMTrans Home Visit Survey 2013



Source: CoMTrans Study Team

Figure 2.5.9 Three Wheeler Ownership by Household Income Level

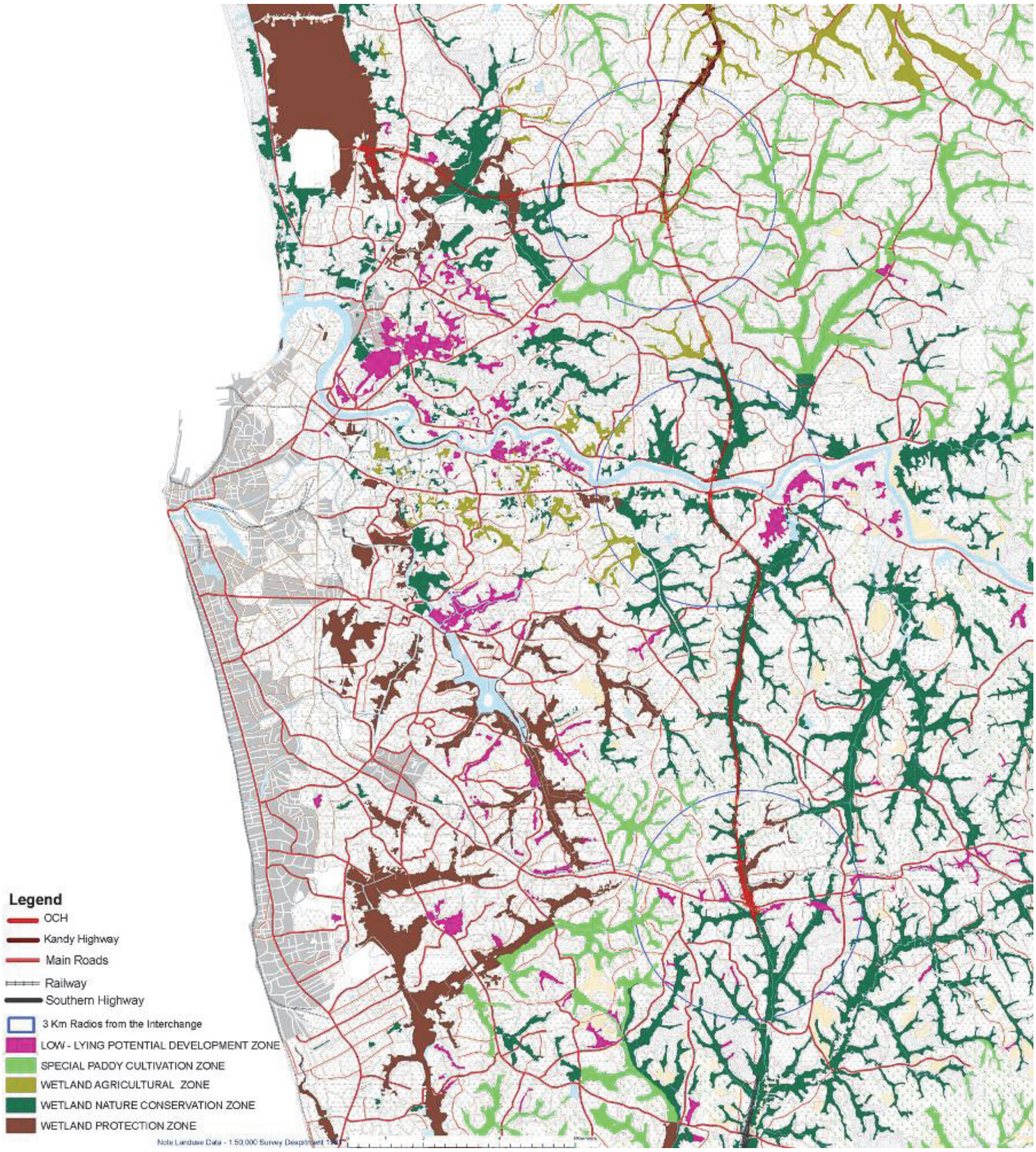
2.6 Environmental Issues

(1) Characteristics of Natural Land

One of the geographical characteristics of the Western Province is low-lying lands, or wetlands. The finger shaped wetlands and higher ground areas in between create an undulating landscape. Although many parts of the lands around CMC are already urbanised, wetlands still remain and preserve the original natural structure. The wetlands have been used as paddy fields, and rice cultivation is still active in many parts of the Western Province, except around Colombo's urbanised areas. Except for nationally important projects such as the Outer Circular Highway, development of wetlands is statutorily controlled because wetlands play a very important role to maintain biodiversity and water retention function for flood control.

These wetland areas in the Western Province have been assessed by UDA, SLLRDC and CEA for their importance in terms of environmental protection and development potential, and the "Guidelines for the Western Province Wetland Zoning" was formulated in 2006, and the wetlands are designated into the following zones; (1) Wetland Protection Zone, (2) Wetland Nature Conservation Zone, (3) Wetland Agriculture Zone, (4) Special Paddy Cultivation Zone, and (5) Low-lying Potential development Zone. The Wetland Zoning Map of Colombo suburb is shown in Figure 2.6.1. The map shows the intricate structure of the wetlands.

Additionally, it should be noted that there are regular flood risks, especially in the Kelani River Basin and Kalu River Basin. The effect of flooding must be considered for future land use patterns.



Source: UDA, manipulated by CoMTrans Study Team

Figure 2.6.1 Wetland Zoning in Colombo Suburbs

2.6.1 Major Contributors for Air Pollution

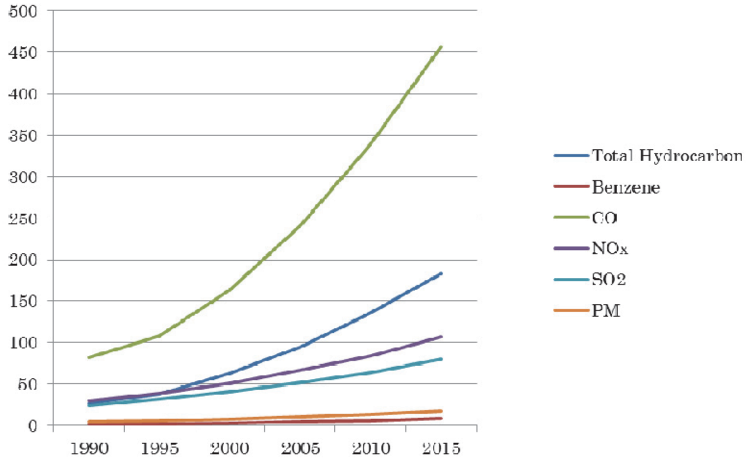
Rapid urbanisation and industrial development are the main factors responsible for air pollution; the major contributors for this pollution are the industries and vehicle fleets. The emission from the motor vehicles is one of the most air polluting sources in Sri Lanka. Ever increasing use of vehicles in the transport sector without proper monitoring, controlling and regulation of emissions together with lack of standards and national interest has resulted in substandard air quality in Sri Lanka, and especially in the main urban areas of Colombo, this has resulted in adverse health conditions.

(1) Air Polluting Emissions from Transport Sector

It is estimated that around 60% of the vehicle fleet is concentrated in the Western Province. The atmospheric environments in Colombo and its suburbs are deteriorating due to a flow of motor vehicles into the city and its traffic congestion on the roads such as Kandy Road. Especially, heavy traffic jams occur within a radius of 10 to 15 km, from the Colombo core area extending towards its surroundings. According to an investigation, the density of pollutants such as NO_2, SO_2, and CO is in an increasing trend during the peak period. Thus, it is inferred that the atmospheric conditions along the roads are even worse.

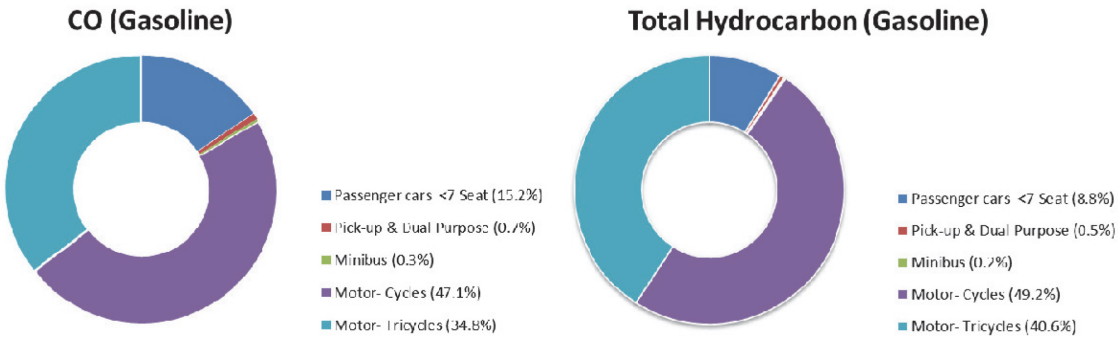
The Air Resource Management Center (AirMac) has calculated the base case emissions from the transport sector, the “Do Nothing Scenario”, for the period between 1990 and 2015 as shown in Figure 2.6.2. The emissions are calculated using an emission inventory model. This model, originally developed for IPIECA (International Petroleum Industry Environmental Conservation Association) by Enstrat International Ltd., has the flexibility to be locally customised and accepts local vehicle populations, vehicle field use data inputs (annual mileage, average traffic speeds, local emission factors when they exist, etc.), and typical local fuel qualities. It is estimated that each pollutant from the transport sector has increased.

In addition, a breakdown of each pollutant by vehicle type in 2000 is calculated for major emitters such as gasoline engine vehicles (Figure 2.6.3) and diesel engine vehicles (Figure 2.6.4). Among these, gasoline engines are bigger emitters of CO and Hydrocarbon, while NOx and PM are mostly emitted from diesel engines.



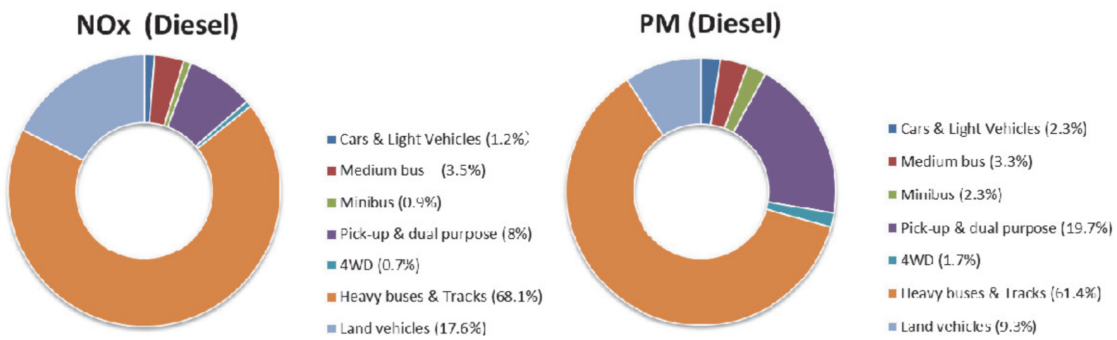
Source: Urban Air Quality Management in Sri Lanka

Figure 2.6.2 Estimated Air Emissions from Transport Sector in Sri Lanka (kt/year)



Source: Urban Air Quality Management in Sri Lanka

Figure 2.6.3 Percentage of Emission by Type of Gasoline Vehicles



Source: Urban Air Quality Management in Sri Lanka

Figure 2.6.4 Percentage of Emission by Type of Diesel Vehicles

The main findings from the emission calculations of the study show:

- Hydro Carbon (HC) emissions have more than doubled between 1990 and 2000, and by 2015 are expected to grow by a factor of 6 to 7 versus 1990.
- The motorcycles and the motortricycles together contribute about 90% of the HC of gasoline engine vehicles.
- Heavy buses and trucks together contribute to 60 - 70% of the NOx and PM emissions of the diesel engine vehicles.

(2) Ambient Air Quality

Continuous Air Quality Monitoring is currently in operation at the Colombo Fort Station of the Western Province. Until 2008, the monitoring had been carried out for CO, SO_2, NO_2, O_3 and PM10. However, at present the Air Quality monitoring is confined to PM10 only. It is learned that, from 2013 onwards, the Air Quality level determination for SO_2, NO_2, CO, PM10, PM2.5 and O_3 will be measured by the Passive Sampling method, which is expected to be monitored for the next ten years in two sites namely, Colombo and Gampaha.

Table 2.6.1 shows the maximum concentration observed in the measured data in 2008. CO and NO_2 were within local standards, however, SO_2 and PM10 were occasionally observed to exceed the standard. Further, there are a few industrial zones in Colombo and Gampaha area which eventually aggravate the pollution levels of the surrounding environment.

Table 2.6.1 Result of Maximum Concentration in Colombo in 2008

Emission Factors	Maximum Concentration	CEA Standards	Measured Date
CO	2.86 ppm	26.0	January 4th
SO2	0.104 ppm	0.08	January 2nd
NO2	0.10295 ppm	0.13	November 20th
PM10	146 microg/m3	100	November 7th

Source: CoMTrans Study Team

There is a lack of data availability for PM2.5 in the Western Province, which causes greater health risk due to its fine size. In typical cities, PM2.5 accounts for 50 – 60% of the total PM10. However, it is discussed that PM2.5 concentration in the central area of Colombo and along major roads are high enough to present a significant risk to public health based on the data of other similar cities (Bangkok and Santo Domingo).

In order to address the increasing air pollution, Air Mac was launched in 2002 and several major activities were implemented by Air Mac including

- Amendment of the air emission standard for mobile vehicles
- The development of the “Clean Air 2007 Action Plan”
- Implementation of Vehicle Emission Testing.

2.6.2 Climatic Factors

(1) Climate

The climate of Sri Lanka is categorised as tropical monsoon, having a wet season and short dry seasons. There are four seasons in Sri Lanka namely, 1) First Inter Monsoon season (March – April), 2) Southwest Monsoon season (May – September), 3) Second Inter Monsoon season (October – brought by the Northeast Monsoon season) and wet season due to the Southwest Monsoon. The southwestern part of Sri Lanka, including the Study Area, is influenced by the Southwest Monsoon and is classified as a wet area with annual rainfall of around 2,000 mm – 3,000 mm. According to monthly average rainfall records for Colombo for 50 years from 1961 to 2010 (Department of Meteorology), May, October and November are observed to be rainy months with around 330 – 350 mm rainfall each, while January and February is observed to be a dry period with around 50mm rainfall. The mean daily maximum temperature in the study area ranges around 29 – 31℃ while the mean daily minimum temperature ranges around 22 - 25 ℃.

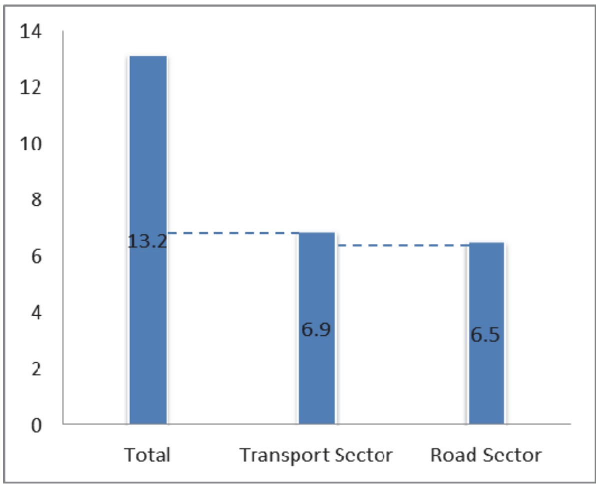
(2) Climate Change

In a global context, the mean air temperature and sea level has increased by about 0.6℃ and 0.1m respectively over the 20th century. These phenomena are defined as Climate Change considered to be caused by natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere, or in land use, which the emission of GHG contributes to (IPCC 2001). In Sri Lanka, there is a trend that annual mean air temperature anomalies have been increasing significantly during the last few decades (Basnayake et al 2002) and the rate of increase of the mean air temperature for the 1961 – 90 period was at a level of 0.016℃ per year (Fernando &Chandrapala 1995). It has been discussed that the increase in temperature is caused by enhanced greenhouse effect as well as rapid urbanisation generating a heat island effect.

(3) Green House Gas (GHG)

GHG are the main contributors to Global Warming. Emissions from transport represented 22% of global CO_2 emissions in 2010 (including emissions from non-fuel combustion) and almost three-quarters of the emissions from transport is from the road sector. According to the International Energy Agency (IEA) report[1], total $CO2_2$ emission from fuel combustion in Sri Lanka in 2010 was 13.2million tonnes and a little higher than half of total CO_2 emission (6.9 million tonnes), was from the transport system, of which the road sector contributes the most (approximately 94%) of CO_2 emission of 6.5 million tonnes (Figure 2.6.5). Although Sri Lanka`s contribution of GHG is very minor at the global level, the portion of CO_2 emission from the road sector in the western part of Sri Lanka is very high, especially in the Western Province where 28% of the total population lives.

[1] CO_2 Emissions from Fuel Combustion highlights 2012 edition, International Energy Agency(2012)



Source: CoMTrans Study Team

Figure 2.6.5 CO_2 Emission from Fuel Combustion (million ton)

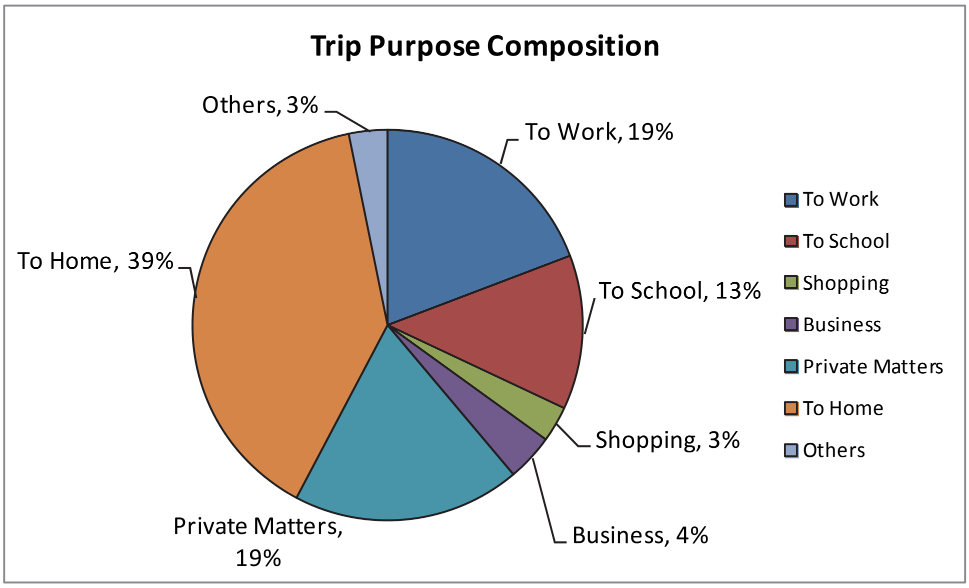
CHAPTER 3 Current Urban Transport System and Transport Demand

3.1 Person Travel Demand and Characteristics

3.1.1 Trip Purpose Composition

A trip is defined as the movement of a person from an origin to a destination with a purpose. Detailed explanations of trips, including special cases and exceptions, are given in Technical Report No. 3.

Trip purpose composition of the residents in the Western province is shown in Figure 3.1.1. Aside from “To Home” trips, the “To Work”, “Private Matters” and “To School” trips are the three major trip purposes and the share of these three trips are 19%, 19% and 13% percent respectively. Compared to the three major trip purposes, “Business”, “Shopping”, and “Others” trips represent 4%, 3% and 3%.



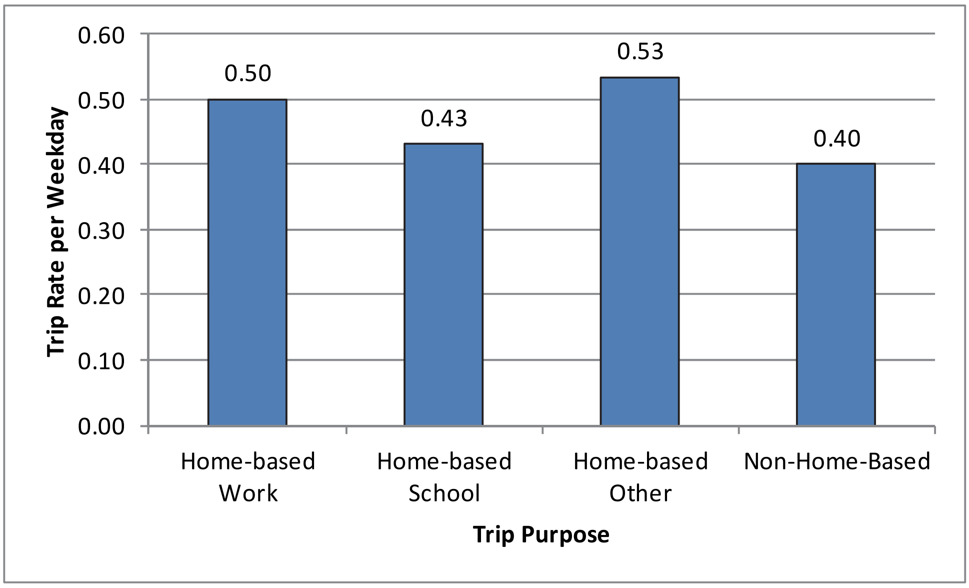
Source: CoMTrans Home Visit Survey 2013

Figure 3.1.1 Trip Purpose Composition

3.1.2 Trip Production Rate

Trip production rate is an important indicator to understand trip making behaviour of the residents. An average trip per person per weekday, calculated by dividing the total number of trips by the population aged five years and above, is referred to as gross trip rate.

The overall gross trip production rate in the province is 1.87. Based on the breakdown of this trip rate by purpose is shown in Figure 3.1.2 "Home-based Other" purpose has the highest trip rate. The next one is "Home-based Work", which is followed by "Home-based School" and "Non-Home-Based".



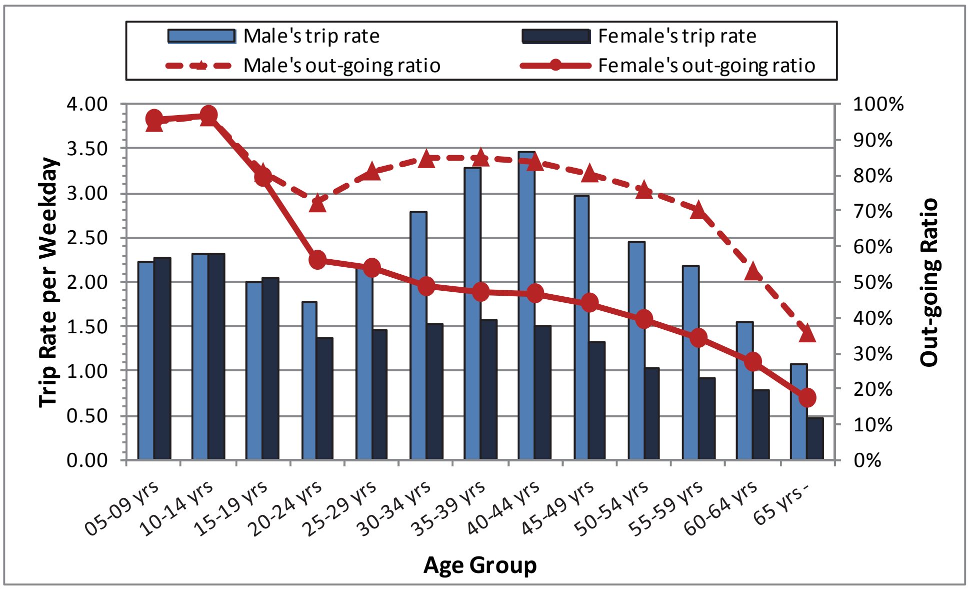
Source: CoMTrans Home Visit Survey 2013

Figure 3.1.2 Trip Rate by Trip Purpose

3.1.3 Trip Patterns by Socio-economic Group

Trip rate is one of the most important indicators to understand trip making patterns and it is also used for measuring future trip generation.

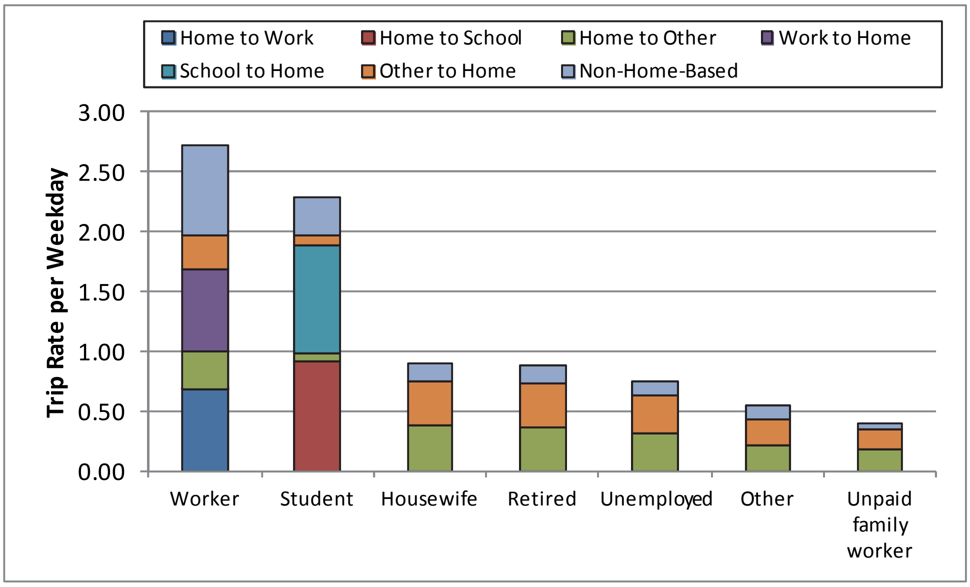
Trip making behaviour of males and females in the Western Province differ significantly. On average, out-going ratio and trip rate per weekday of males are 77% and 2.35, while that of females are 53% and 1.43 respectively. The following figure reveals the decline of out-going ratio and trip rate of females as age increases. It is interesting to note that both males and females have equally high out-going ratios and trip rates when the age is below 20 years, the school-attending age.



Source: CoMTrans Home Visit Survey 2013

Figure 3.1.3 Trip Rate and Out-going Ratio by Gender and Age Group

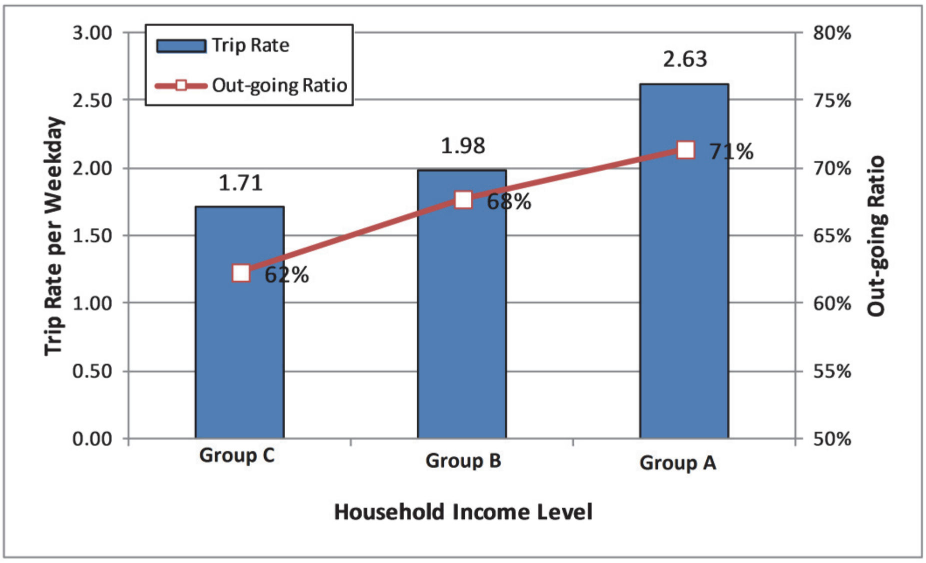
The trip rate varies according to social group and trip purpose as shown in Figure 3.2.4. For workers, higher trip rates are for "Home to Work", "Work to Home" and "Non-Home-Based", while for students, higher trip rates are "Home to School" and "School to Home". For the remaining social groups, trip rate consists mainly of "Home to Other", "Other to Home", and "Non-Home-Based" purposes.



Source: CoMTrans Home Visit Survey 2013

Figure 3.1.4 Trip Rate by Social Group by Trip Purpose

It is estimated that around 10 million trips are generated every day from 1.46 million households in the Western Province in which 71%, 22% and 7% belong to Group C, Group B and Group A households respectively. Trip making behaviours, which are characterised by trip production rate and choice of transport mode, are significantly influenced by levels of income. From Figure 3.1.5, it is observed that trip rate and out-going ratio increase proportionately with the household income level.



Note: 1) Classification of income - Group C: <40,000Rs./HH/Month; Group B: 40,000-79,999Rs./HH/Month; Group A: 80,000 Rs/HH/Month and over

Source: CoMTrans Home Visit Survey 2013

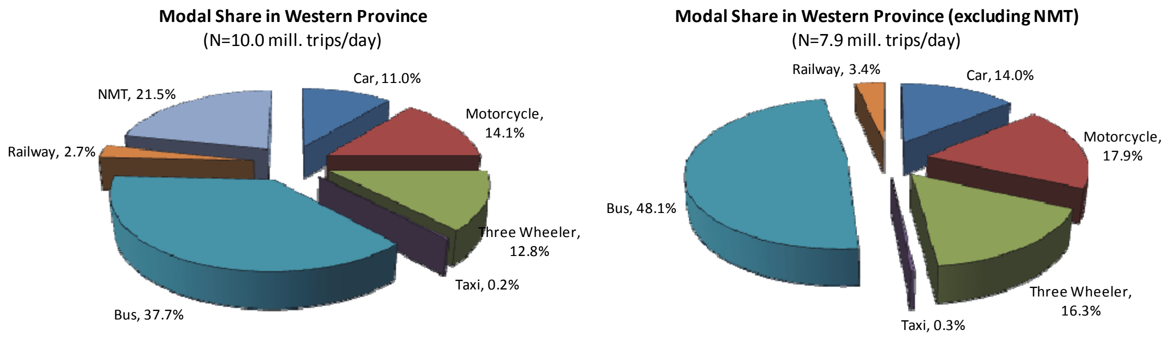
Figure 3.1.5 Trip Rate and Outgoing Rate by Income Group in the Western Province

3.1.4 Modal Share

Figure 3.1.6 shows the modal share with and without non-motorised transport. Around 38% of trips are made by private modes of transport, including cars, taxis, three wheelers and motorcycles while approximately 40% are made by buses and railway. The remaining 21.6 percent of the trips are made by non-motorised modes of transport including walk, bicycle, and others.

In general, transfers reduce ridership of public transport. Figure 3.1.10 shows that while 74% of bus trips do not require any transfer between transport modes, only 26% of railway trips have this pattern. On average, bus users make 0.31 transfers per trip whereas railway users make 1.06 transfers per trip, more than three times higher. Furthermore, bus service is highly accessible by foot as walking accounts for more than 90% of access and egress modes of bus trips. Accessibility of railway, however, relies not only on walking but also on other modes, particularly bus. Figure 3.1.11 reveals that walking and taking the bus constitutes 49% and 38% of access mode and 51% and 40% of egress mode respectively.

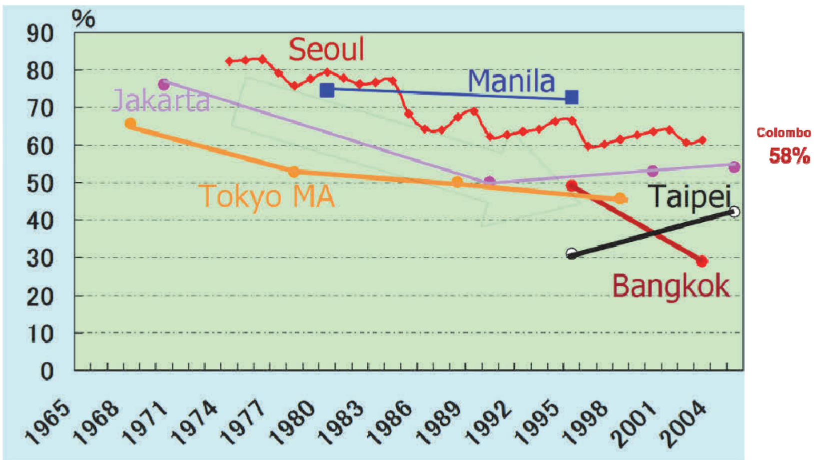
This analysis gives an implication that buses not only widely cover the study area, but also operate as trunk lines. Moreover, as long as connections between bus and railway are not well organised, the issue of transferring remains strong impedance for travelling by train.



Source: CoMTrans Home Visit Survey 2013

Figure 3.1.6 Modal Share of Person Trips made by Residents in the Western Province

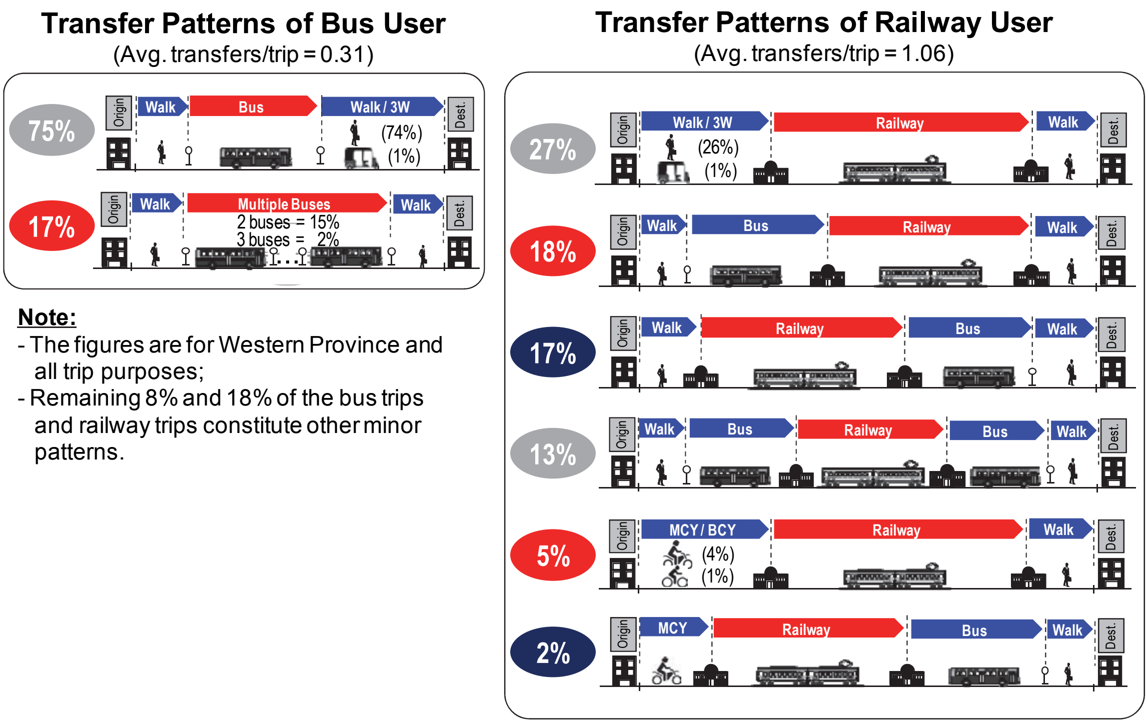
Figure 3.1.7 depicts the trends of public transport mode share. In general, the share of public mode of transport in the metropolitan areas tends to be declining due to several reasons such as rapid motorisation and insufficient public transport service. It should be noted that the change of modal share cannot be explained by one factor but may be attributable to various factors. Tendency of a decreasing share of public transport is a lesson from international experiences.



Note: Walking and bicycles are not included.

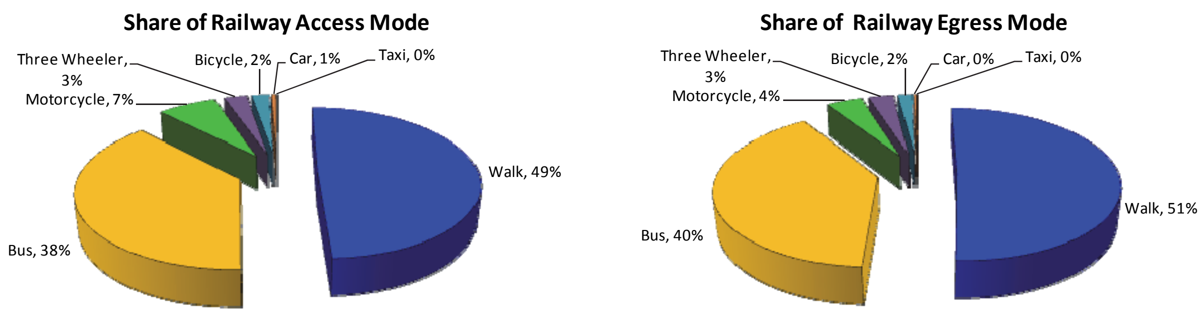
Source: Presentation prepared by Prof. Dr. Shigeru Morichi (2003), GRIPS

Figure 3.1.7 Trend of Public Transport Mode Share



Source: CoMTrans Home Visit Survey 2013

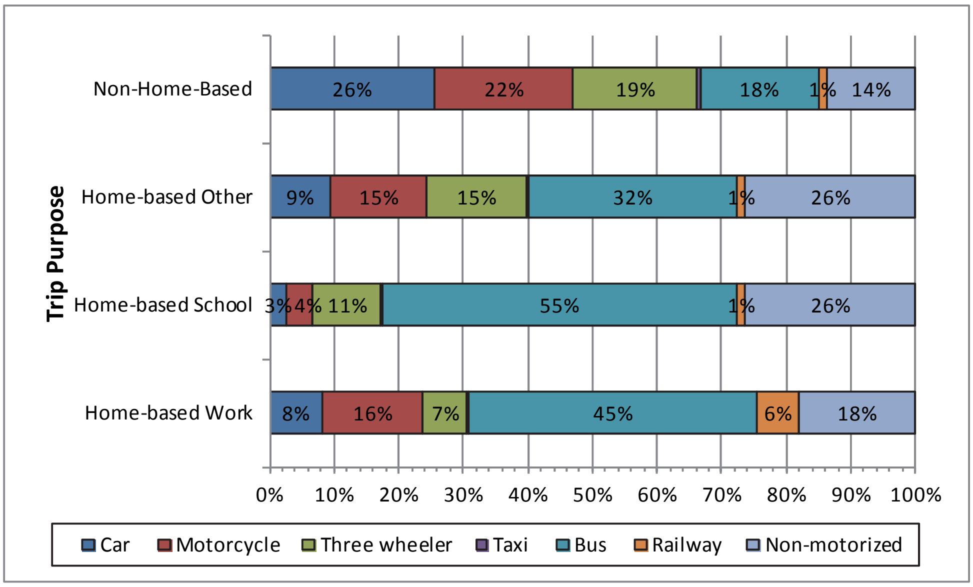
Figure 3.1.8 Major Patterns of Mode Transfer for Bus Users and Railway Users



Source: CoMTrans Home Visit Survey 2013

Figure 3.1.9 Access and Egress Modal Share for Railway

Modal share also varies according to trip purpose. Figure 3.1.10 indicates that for almost all trip purposes, bus is always the dominant mode. More than half of the home-based school trips and almost half of home-based work trips are made by bus. Modal share of three-wheelers and motorcycles is about the same for home-based other trips. For non-home-based trips, private modes, including cars and motorcycles, are the leading modes of transportation.

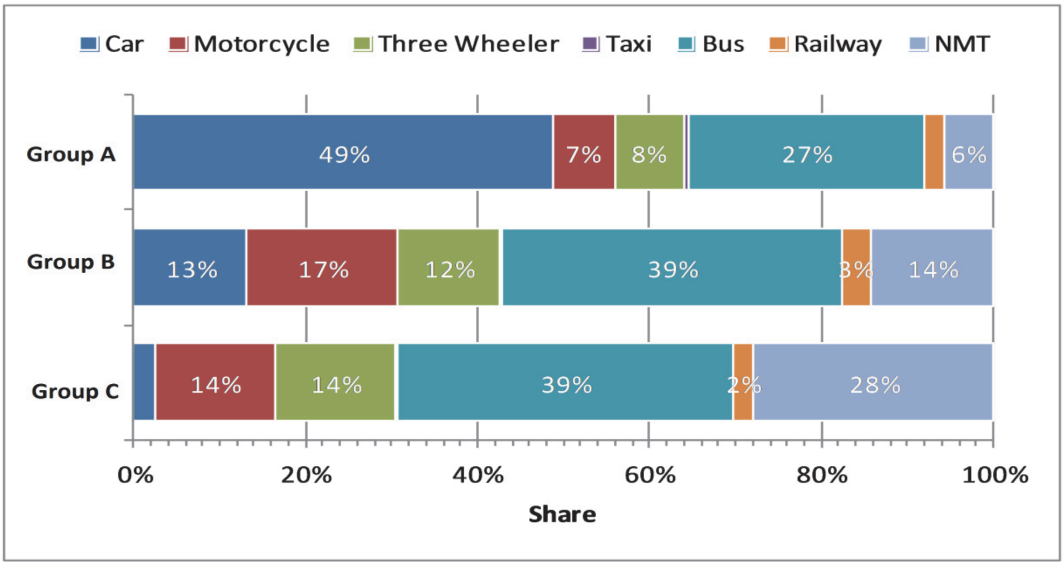


Source: CoMTrans Home Visit Survey 2013

Figure 3.1.10 Modal Share by Trip Purpose in the Western Province

Residents of Group A are more car dependent as the modal share accounts for 47.6% as shown in Figure 3.1.11. Only a few of them use non-motorised transport (6.3%) as compared to Group C. On the other hand, it is noteworthy that the modal shares of bus transport are considerably high in all income groups, while that of railways is extremely low. One of the reasons is that the area covered by the railway network is limited compared to the bus network, or in other words, the accessibility to railways is low.

Given the limited coverage of the railway network, railways users make more transfers than bus users.



Note: 1) Classification of income - Group C: <40,000Rs./HH/Month; Group B: 40,000-79,999Rs./HH/Month; Group A: 80,000 Rs/HH/Month and over

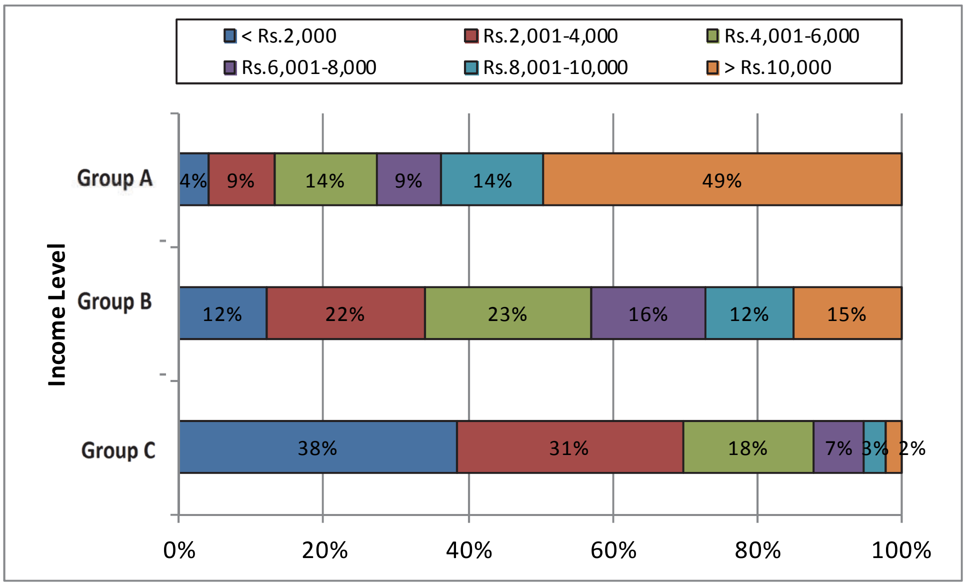
2) NMT includes walk, bicycle, and others.

Source: CoMTrans Home Visit Survey 2013

Figure 3.1.11 Modal Share by Household Income in the Western Province

3.1.5 Transport Expenditure

Figure 3.1.12 depicts the composition of monthly household transport expenditure by income group. As expected, the general trend is that Group C households spend less and Group A households spend more on monthly transport. As much as 69% of Group C households (i.e. households with income less than Rs. 40,000) spend no more than Rs. 4,000 on transport, while only 34% and 13% of Group B (Rs. 40,000 – Rs. 79,999) and Group A households (Rs. 80,000 and above), respectively, spend Rs 4,000 or less on transport. It is interesting to note that for Group C, 27% of the households spend more than Rs. 8,000 which is more than 10% of their household income. For the Group A, almost 50% spend over Rs. 10,000 for transport.



Source: CoMTrans Home Visit Survey 2013

Figure 3.1.12 Distribution of Household Monthly Transport Cost by Income Group

As given in Table 3.1.1, the average monthly transport cost of Group C, Group B and Group A are Rs. 3,584, Rs. 6,998 and Rs. 14,929 respectively. The transport cost of the Group B households is almost double that of Group C; transport cost of Group A households is as high as 4 times that of the Group C. On average, 14%, 16%, and 17% of the total household expenditure of Group C, B, and A income respectively are spent on the transport cost.

Table 3.1.1 Average Household Transport Cost and its Ratio to Total Expenditure

Household Income Group	Average Household Monthly Expenditures (Rs./month)	Average Household Monthly Transport Cost (Rs./month)	Ratio of Transport Cost to Total Expenditures
Group C	26,307	3,584	14%
Group B	43,303	6,998	16%
Group A	88,432	14,929	17%

Source: CoMTrans Home Visit Survey 2013

3.1.6 Trip Generation and Trip Distribution

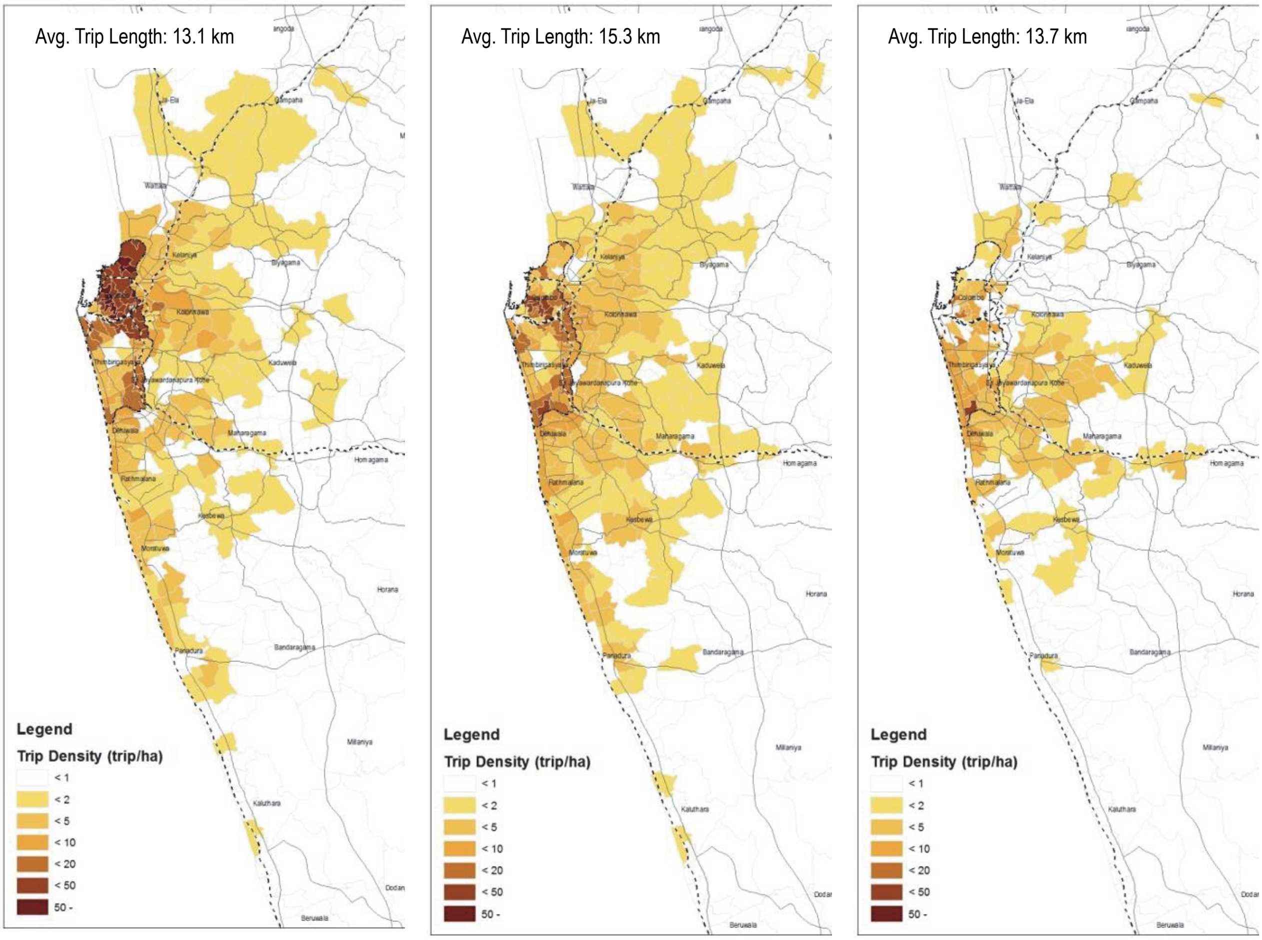
Generated and attracted trips are observed in terms of trip density. Trip density is calculated by dividing the number of trips by the area of each Traffic Analysis Zone (TAZ)[1] where the trips are produced or attracted.

[1] Traffic Analysis Zone (TAZ): a unit of geography which varies in size and is commonly used in conventional transport planning models. In this study, the Western Province is divided into 462TAZs, in which 59 TAZs are in CMC and 403TAZs are in the rest of the province based on the boundary of GN Division.

(1) Generated and Attracted Trips by Purpose

To Work Trip

The number of trips for commuting to work in CMC is around 400 thousand trips per day, in which more than 70% come from outside of CMC. Trip origin distribution of workers commuting to work in CMC depicted in Figure 3.1.2 indicates that most of the Group C workers commute at relatively shorter distances, that is, they live relatively closer to their workplace, particularly in the Northern part of CMC. Despite their short commuting trip distance, almost 15% of their household expenditure is spent on the transport cost alone.



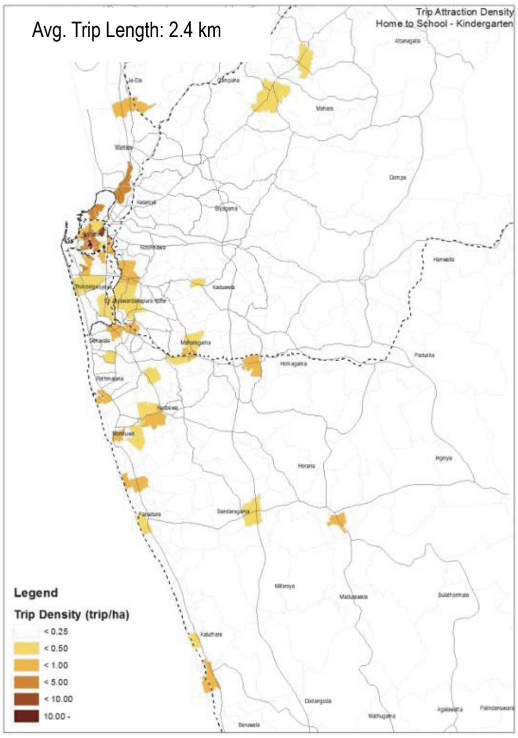
a) Group C b) Group B c) Group A

Source: CoMTrans Home Visit Survey 2013

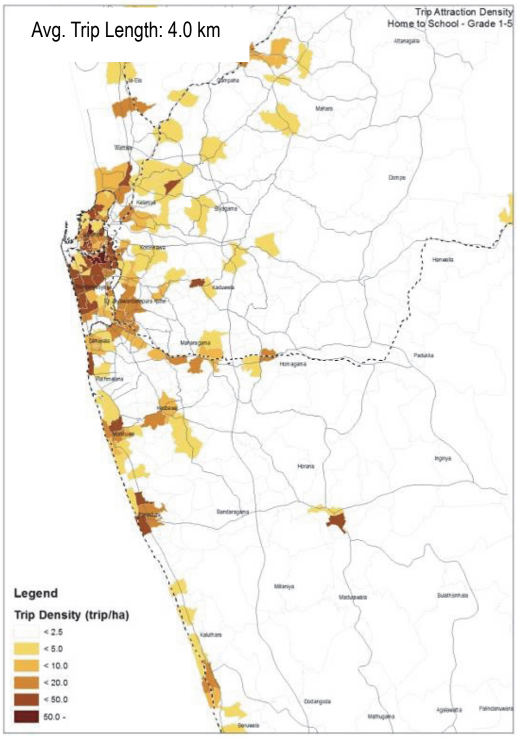
Figure 3.1.13 Trip Generation Density of Workers Commuting to CMC

Educational Trips

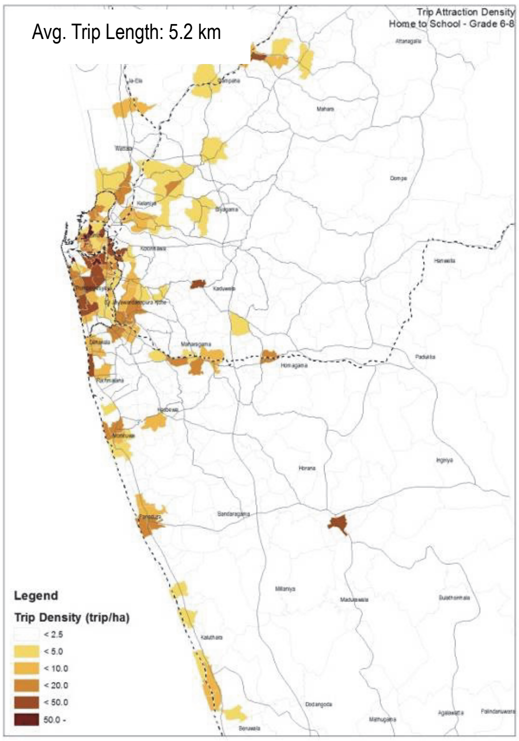
In general, high trip attraction for educational trips is observed in CMC where education facilities are concentrated (see Figure 3.1.16). For students who attend G.C.E A-Level or lower grades, their average trip length below 7.0 km suggests that they go to school close to their residential location. Once admitted to universities, their average travel distance significantly increases to as much as 17 km since many tertiary educational institutions (including state and private universities or institutions) are located within CMC and its surrounding urbanised areas such as Kelaniya, Malabe, Nugegoda and Moratuwa. Those who attend non-university tertiary education also have to travel 14.7 km for educational purpose.



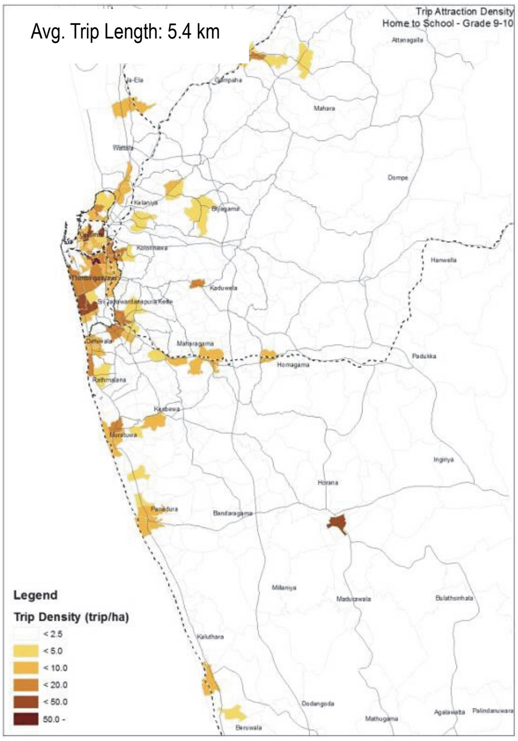
a) Kindergarten



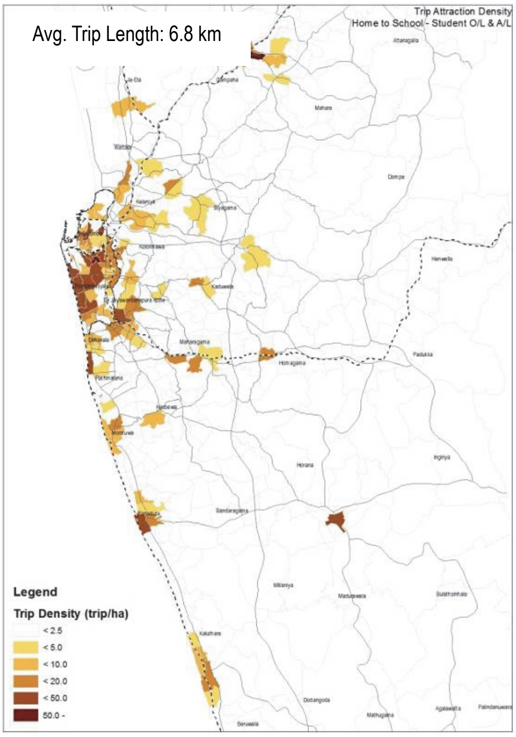
b) Students Grade 1-5



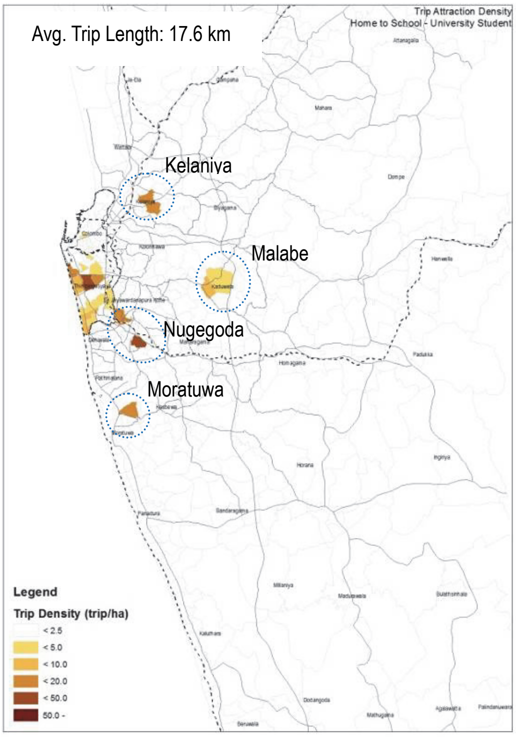
c) Students Grade 6-8



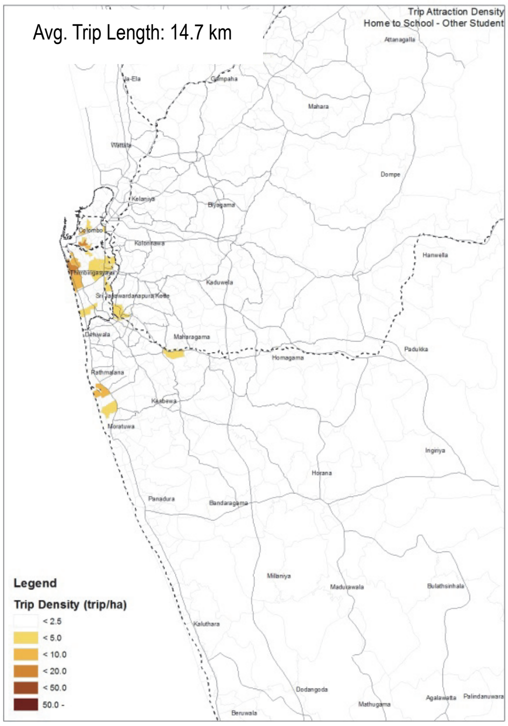
d) Students Grade 9-10



e) Students G.C.E. O/L and A/L



f) Students Graduate & Above



g) Other Types of Students

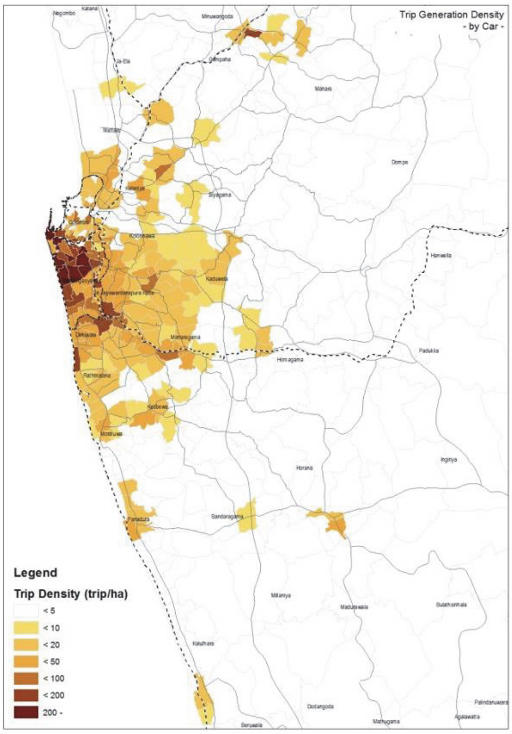
Source: CoMTrans Home Visit Survey 2013

Figure 3.1.14 Trip Attraction Density of Educational Trips

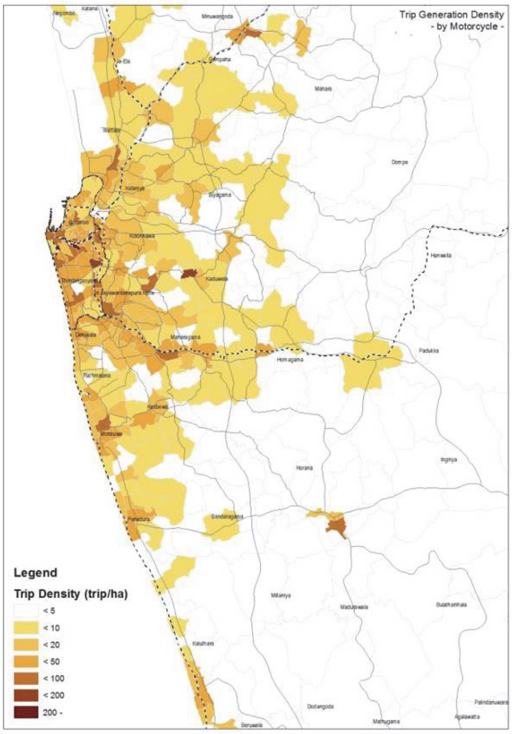
(2) Generated Trips by Mode of Transport

For all purposes, trip generations are high in CMC where the majority of workplaces, educational institutions as well as facilities for social and economic activities are located (see Figure 3.1.15).

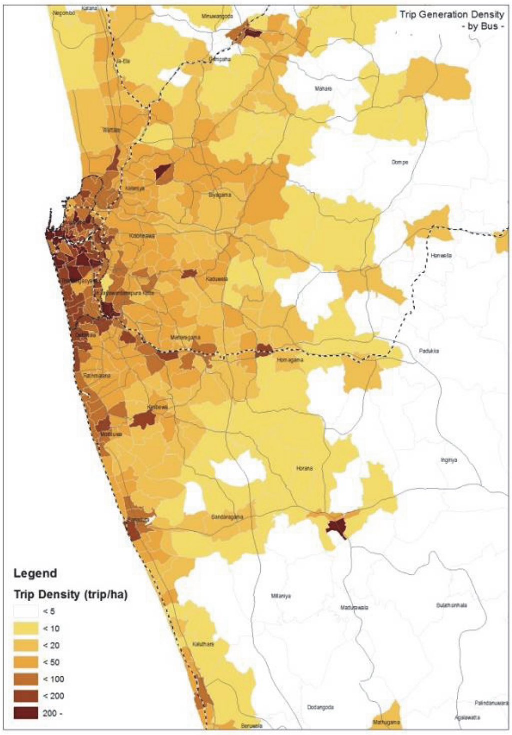
Outside of CMC, trip generation by car is notably high in the area to the East of CMC (up to Malabe) and to the South of CMC (up to Moratuwa), whereas trip generation by motorcycle spreads widely across the surrounding areas of CMC. As for public transport, trip generation by bus is widespread and the use of buses is even higher along the transport corridors. In contrast, trips by the railways are only observed along the railway line which underlines the low accessibility to the railways.



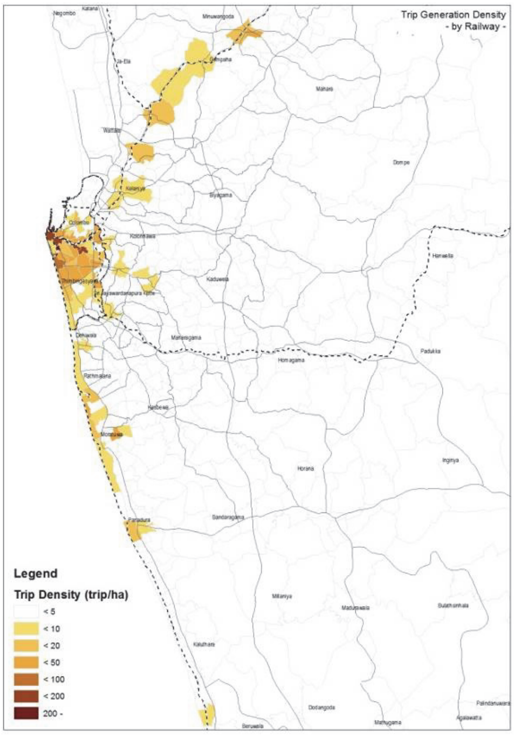
a) Car



b) Motorcycle



c) Bus



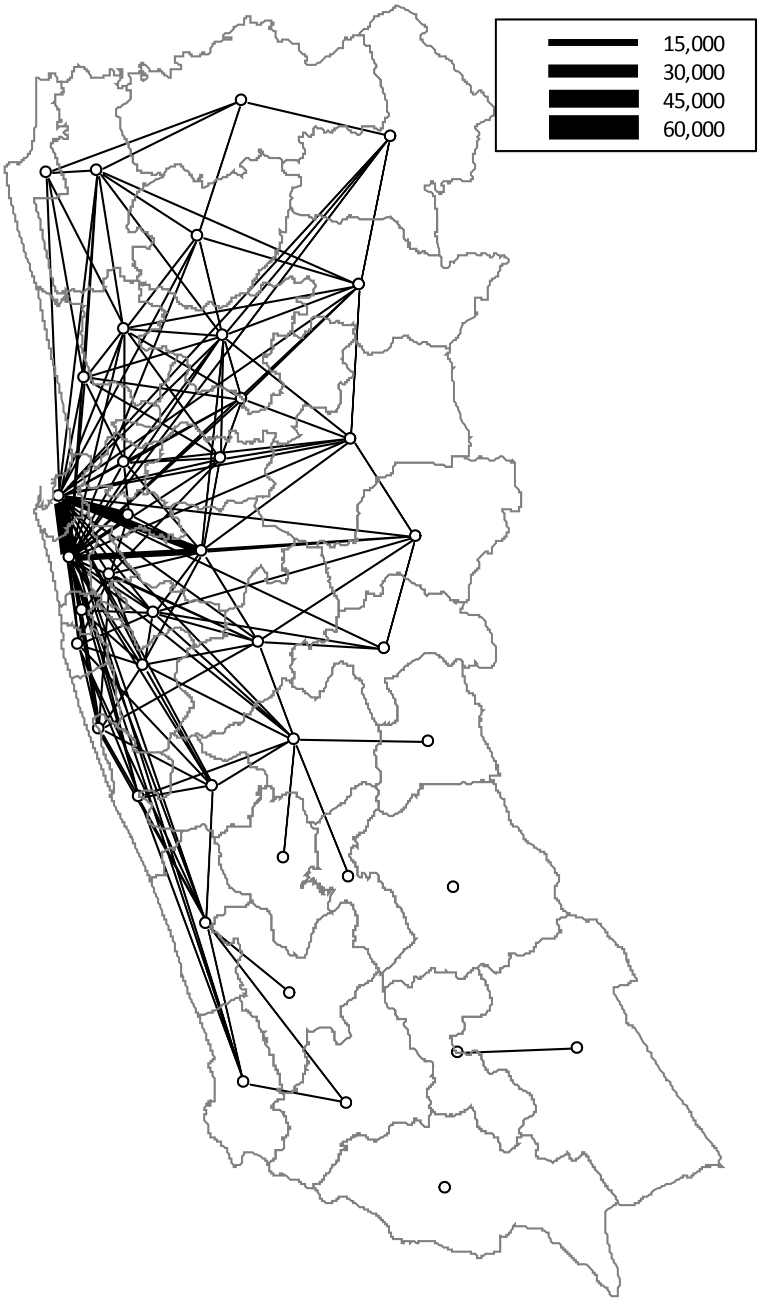
d) Railway

Source: CoMTrans Home Visit Survey 2013

Figure 3.1.15 Trip Generation Density by Transport Mode

(3) Trip Distribution of Home-based to Work Trips

Heavy flows are observed within CMC as well as between CMC and surrounding DS divisions such as Kaduwela, Sri Jayawardenepura Kotte, Dehiwala, and Moratuwa.



Source: CoMTrans Study Team

Figure 3.1.16 Home-based Work Trips (>=2000 trips only)

(4) Characteristics of Trips Entering CMC

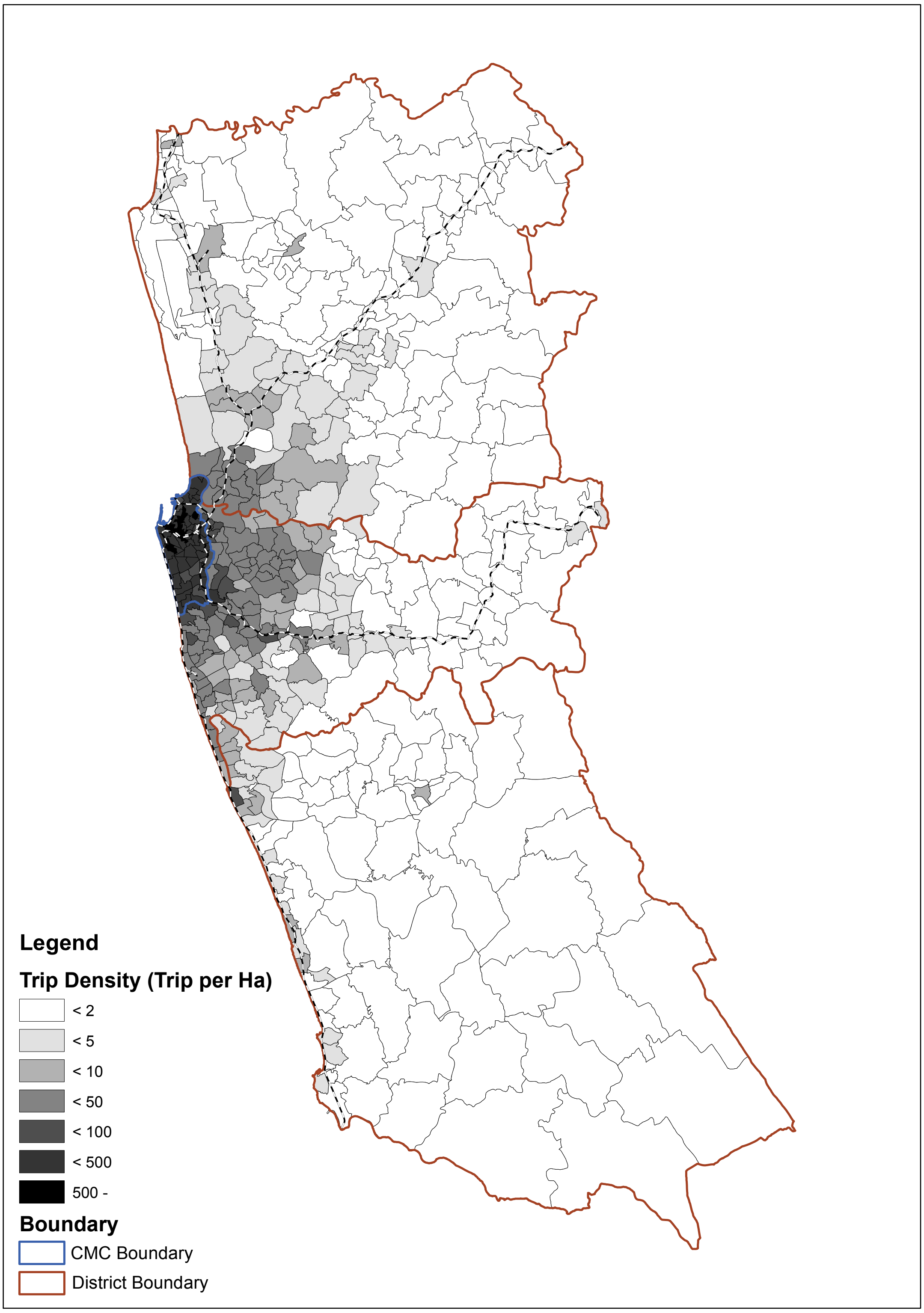
As shown in earlier sections, a considerable number of trips are made within CMC as well as between CMC and surrounding DS divisions. As calculated from OD matrices, approximately 705 thousand trips per day are from outside of CMC ending inside this city. As much as 20% of these trips are made within one hour of the busiest morning peak period (07:00-07:59),

Table 3.1.2 Trips Attracted to CMC from Outside per Day and per Peak Hour

Items	Transport Mode			Total
	Private	Public	NMT	
Daily trip (‘000 trips/day)	256	443	6	705
Peak hour trips (07:00-08:00) (‘000 trips/hour)	61	81	2	145
Peak Hour Ratio	24%	18%	36%	20%

Source: CoMTrans Home Visit Survey 2013

Figure 3.1.17 shows the generation density of trips ending in CMC observed at the Traffic Analysis Zone (TAZ) level. This figure also includes the trips produced in CMC where the highest trip attraction density is observed indicating that a significant number of trips are made within the city boundary. For trips from outside CMC, their origins are mainly located in the area surrounding CMC and along the major corridors. Figure 3.1.19 also implies that where public transport, especially railway service, is better, the travel distances seem higher and in the areas far from the city higher trip densities are also generated.



Source: CoMTrans Home Visit Survey 2013

Figure 3.1.17 Trip Generation Density of Trips Attracted to CMC

3.1.7 Passenger Volume Crossing the Provincial Borders

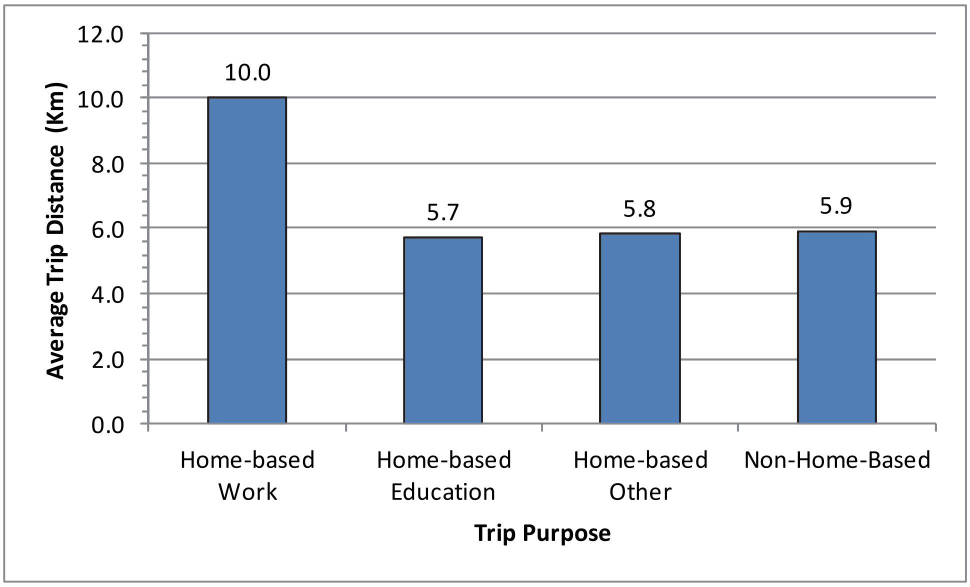
From the result of the Cordon Line Survey (CLS), the CoMTrans Study Team estimated the number of passengers travelling to/from the outside of the Western Province. Preliminary results of the passenger demand at each border by all modes (railways, buses, motorcycles, three-wheelers and cars) are summarised as follows:

- About 584,000 passengers in both directions cross the provincial border daily.
- 61% of the passengers use buses, 8% use railways and 11% use motorcycles/three-wheelers.
- There are four major corridors for inter-provincial movement such as Negombo, Kandy, Avissawella and Galle roads with more than 100,000 passengers per day.

More detailed analyses and findings are presented in Technical Report No. 3.

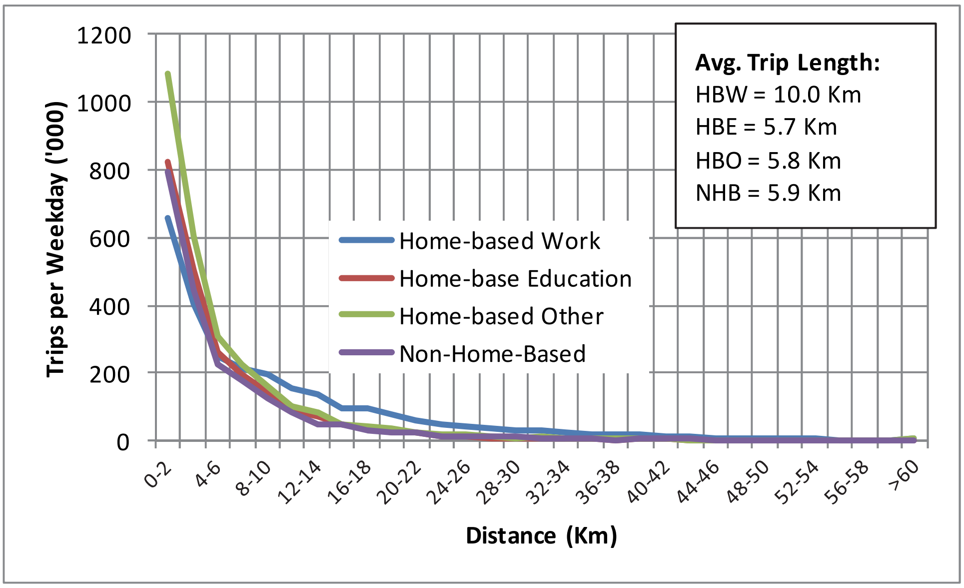
3.1.8 Travel Distance

Travel distance by trip purpose is illustrated below. Home-based work has the largest average of distance travelled, which is 10 km. The distribution of the travel distance by purpose reveals that for the travel distance beyond 8 km, home-based work trip is the highest category.



Source: CoMTrans Home Visit Survey 2013

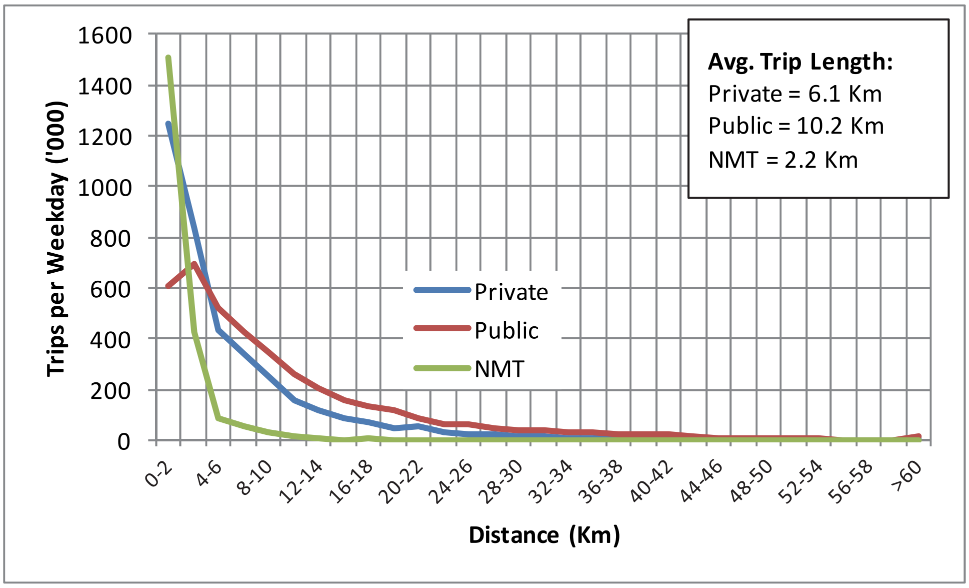
Figure 3.1.18 Average Travel Distance by Trip Purpose in the Western Province



Source: CoMTrans Home Visit Survey 2013

Figure 3.1.19 Distribution of Trips by Purpose by Travel Distance in the Western Province

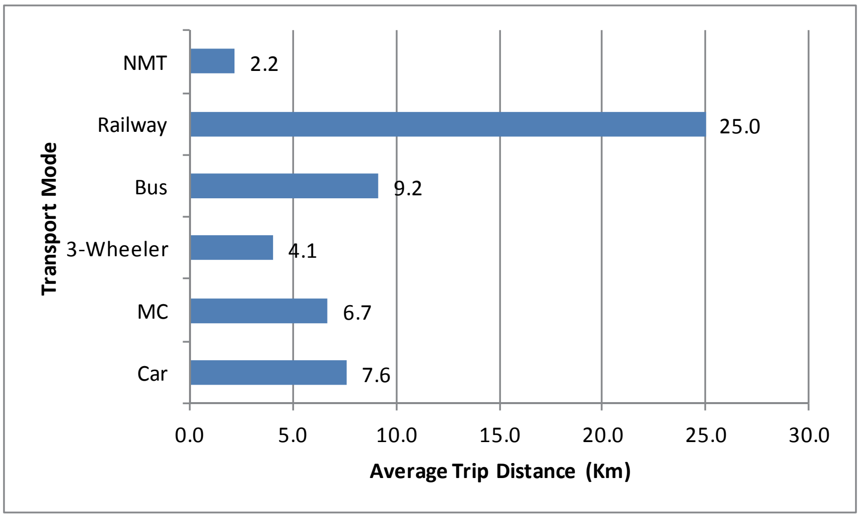
The analysis result also indicates that those who travel by public transport (including buses and the railways) travel further than those who use a private mode. The distribution of travel distance by transport mode depicts that when the distance is 4 km or longer, the number of trips by public transport becomes the highest.



Source: CoMTrans Home Visit Survey 2013

Figure 3.1.20 Distribution of Trips by Mode by Travel Distance in the Western Province

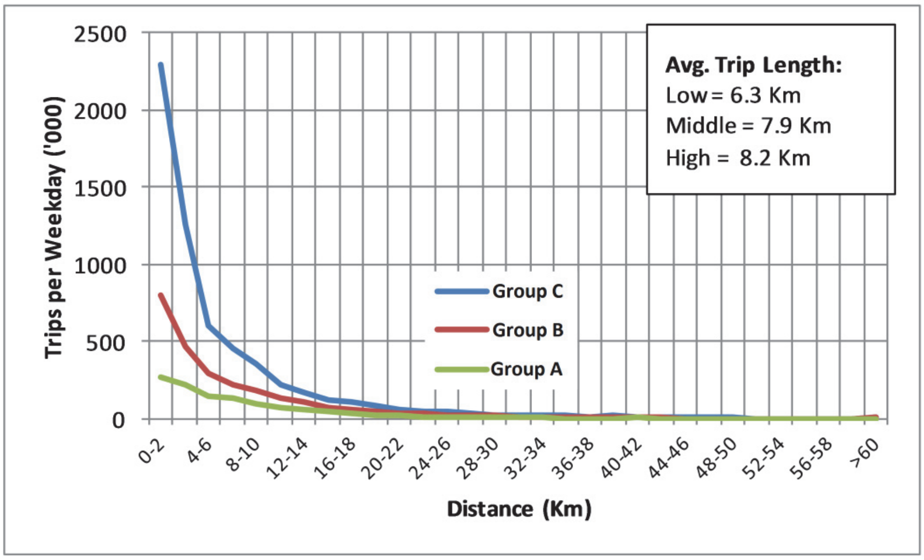
Further detail of trip distance by mode indicates that railway users have the longest trips in which the average distance is about 25 km. Bus users and car users have average travel distances of 9 km and 8 km respectively.



Source: CoMTrans Home Visit Survey 2013

Figure 3.1.21 Average Travel Distance by Mode of Transport

As income increases, the average travel distance also slightly increases. The larger average distance of the Group A is attributed to their higher ownership of vehicles. In contrast, it also signifies that Group C people are constrained in travelling long distances.



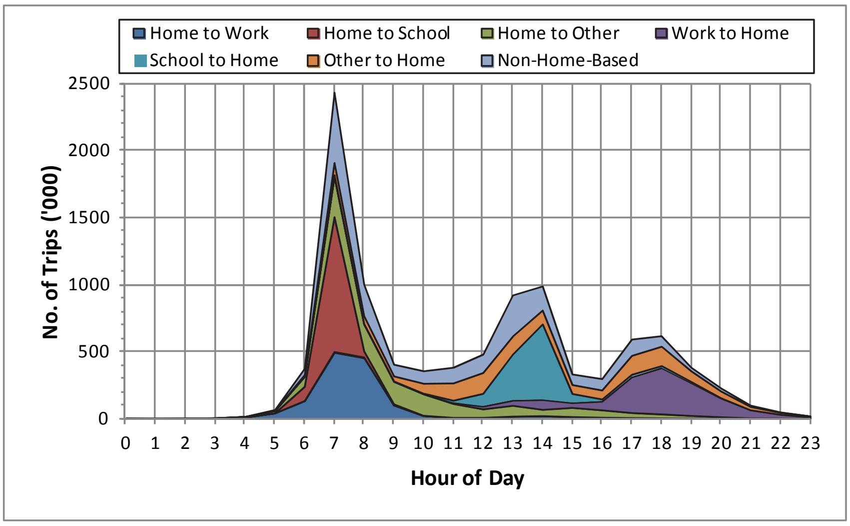
Source: CoMTrans Home Visit Survey 2013

Figure 3.1.22 Distribution of Trips by Income Group by Travel Distance in the Western Province

3.1.9 Hourly Fluctuation of Trips Generated and Attracted

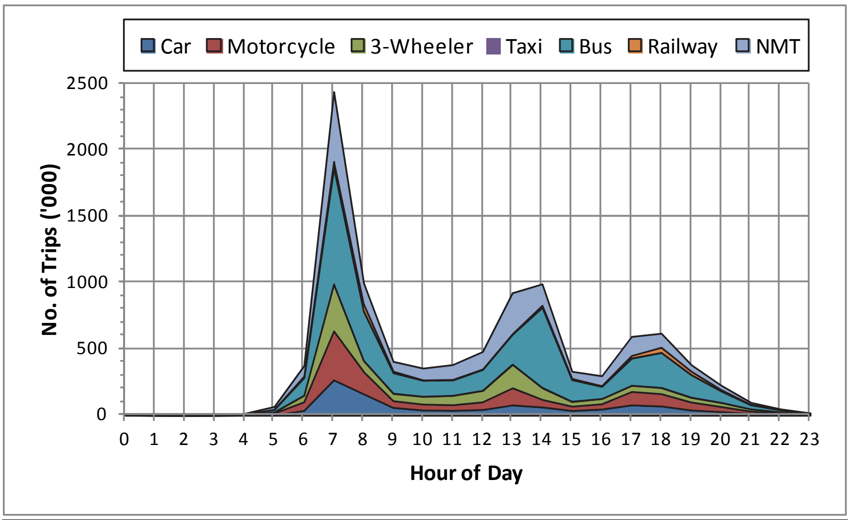
Analysis of hourly fluctuations of trips shows that there are three peaks within a day. The morning peak period is sharply seen within one hour between 7 A.M. and 8 A.M. while the afternoon and evening peak periods extend for about two hours from 1 P.M. to 3 P.M. and from 5 P.M. to 7 P.M. respectively. Accordingly, the shares of these peak hour trips to the daily trips are 24%, 19% and 12%.

The morning peak hour is dominated by home to work and home to school purposes, whereas afternoon peak hour and evening peak hours are dominated by school to home and work to home respectively. The analysis also indicates that buses have the highest share during the three peak periods. Further details are presented in Technical Report No. 3.



Source: CoMTrans Home Visit Survey 2013

Figure 3.1.23 Hourly Fluctuations by Purpose at Trip Destination in the Western Province



Source: CoMTrans Home Visit Survey 2013

Figure 3.1.24 Hourly Fluctuations by Mode at Trip Destination in the Western Province

3.2 Railways

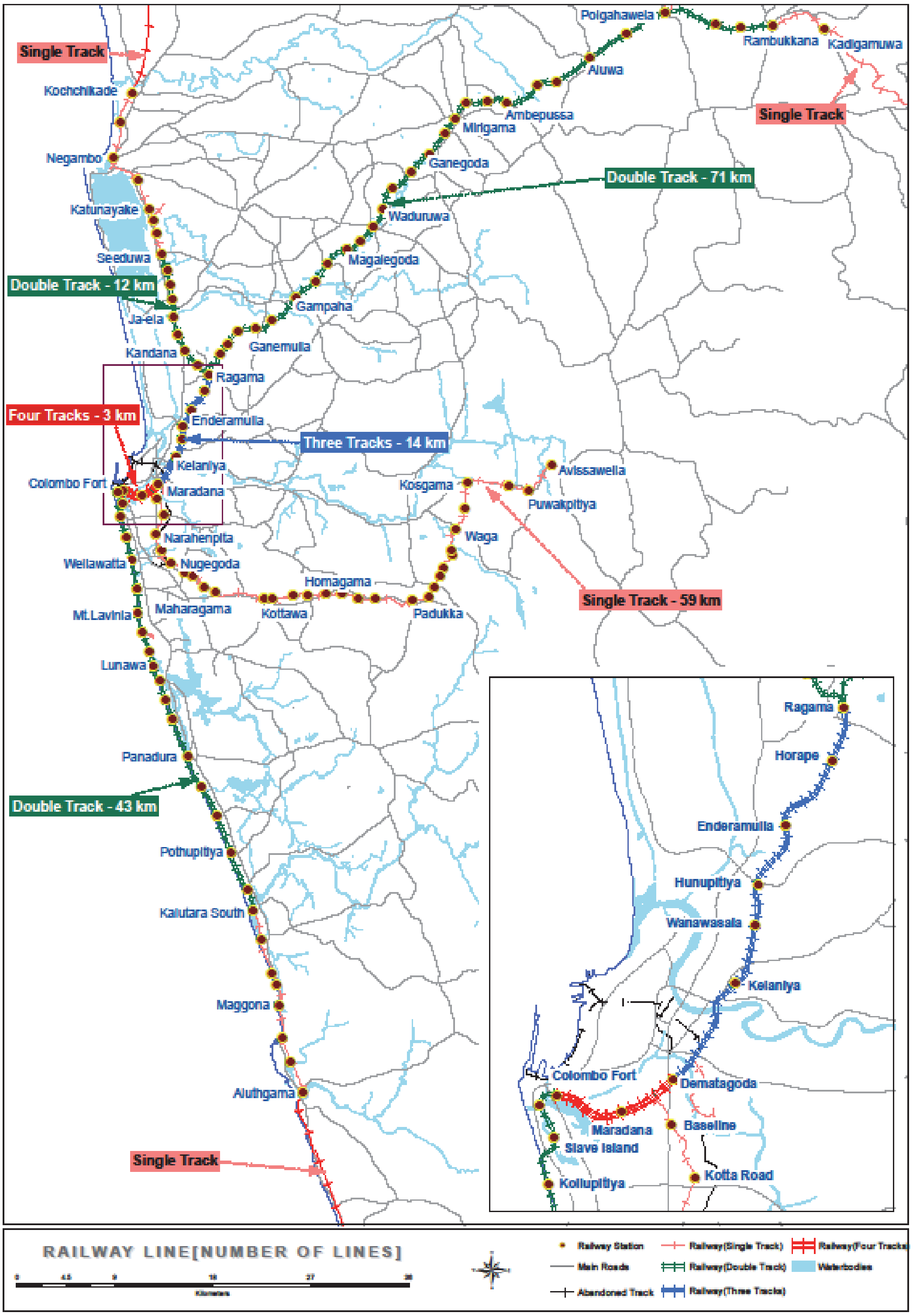
3.2.1 Railway Lines in the Western Province

In the Western Province, the Main Line, the Coastal Line, the Puttalam Line and the Kelani Valley Line are currently operated. The main line has double tracks for the whole section. The Coastal line has a double track section from Colombo Fort station to Kalutara. The Sri Lanka Railways (SLR) is extending its double track section further south. A part of the Puttalam line from Ja-ela to Seeduwa was improved to double track recently, and the double track section reached from Ragama to Seeduwa. However, no line is electrified. The Kelani Valley Line was built as a narrow gauge for rubber plantations in 1902. Although the line was upgraded to a broad gauge in 1996, the line has a number of sharp curves with radius less than 200m.

Figure 3.2.1 shows the number of tracks in railway lines of The Western Province. Details of the railway in Sri Lanka, history and trend of pax-km and Freight-ton-km in Sri Lanka are described in the Technical Report.

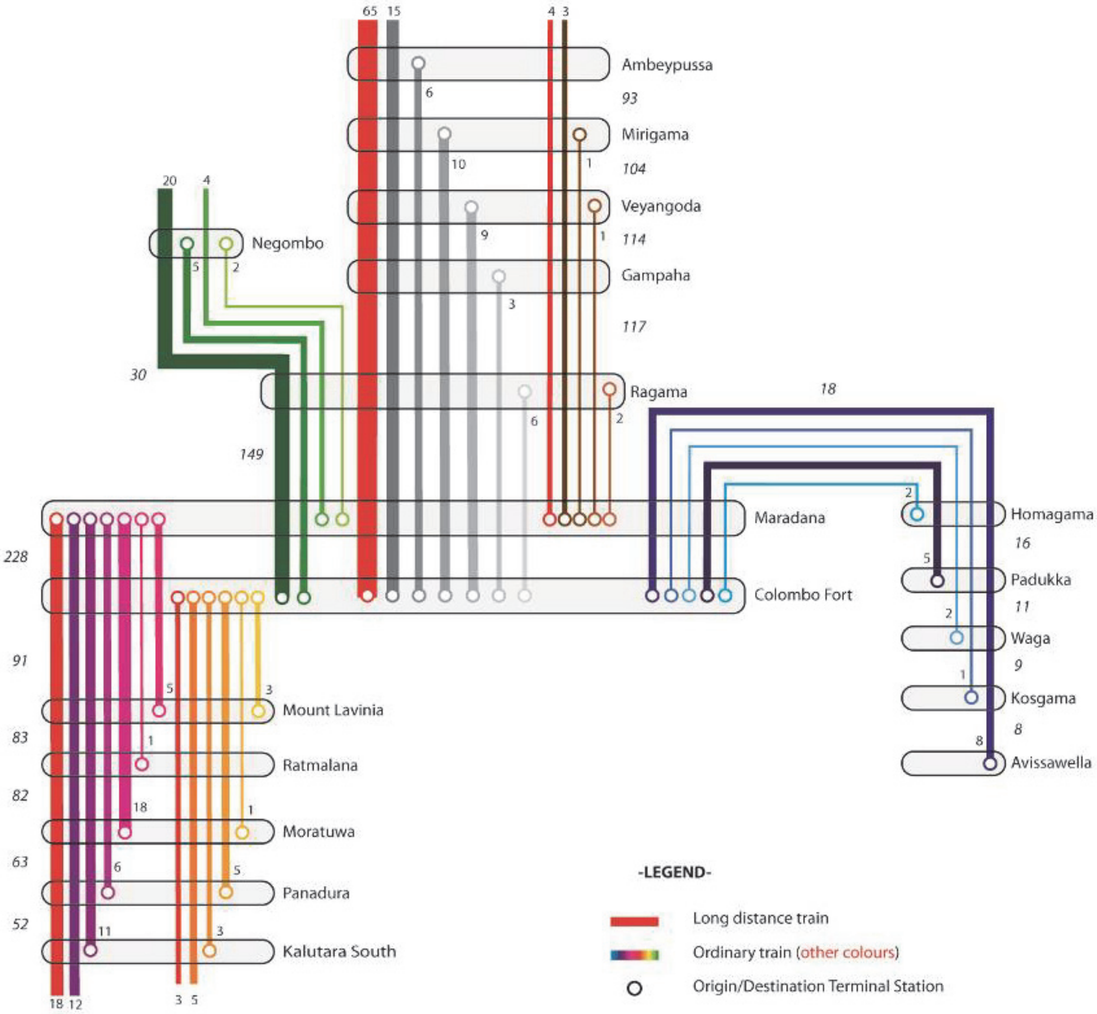
3.2.2 Train Operation

There are long distance trains and commuter trains operated in the Western Province area of Sri Lanka Railway for passenger service. Trains of the Coastal line start from Maradana station while most of the trains going north and east start from Fort station. Figure 3.2.2 indicates the train network of this area, number of trains running in each section, and scheduled speed.



Source: CoMTrans Study Team arranged from SLR data

Figure 3.2.1 Number of Tracks on Railways in the Western Province



Source: CoMTrans Study Team

Figure 3.2.2 Train Distribution Diagram of the Western Province

Trains going north start from Fort station and trains going south start from Maradana station. The number of tracks between Fort and Maradana is four but one track is designed for the KV line, therefore, the effective number tracks for the Main line and Coastal line is three. However, the number of trains operating between Fort and Maradana is about twice as many as the number of trains between Maradana and Ragama. Also, trains from the depot to Fort station or Maradana station run this section crossing the revenue line. Therefore, trains have to wait to pass this section until the track becomes clear.

Although no train is operated, there is a railway track from Katunayaka South station to a station roughly one kilometre from departure gate of the Bandaranayake International Airport. According to the CoMTrans cordon line survey at the airport, 38% of airport passengers access to airport by passenger cars followed by taxi which is 32% of passengers. Other access modes are bus, 16%, tourist bus, 5%, and three wheelers, 5%. 61% of airport passengers are from the

Western Province.

Average scheduled train speeds in the Western Province are in the range between 27 and 33 km per hour as listed in Table 3.2.1. However the average speeds in the sections between Fort – Ratmalana and Ratmalana – Panadura are 24 km/hour and 18 km/hour respectively. These speeds are low for railway operation. On the other hand the average speed of the Kelani Valley Line is 24 km per hour due to many sharp curves.

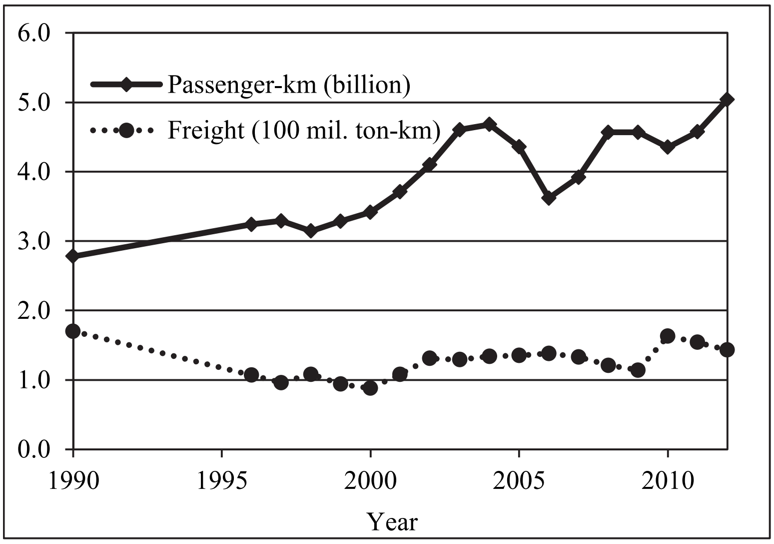
Table 3.2.1 Average Scheduled Train Operation Speed

Line	Section	Average Speed	Remarks
Main Line	Fort- Maradana	29 km/hr	Quadruple track
	Maradana – Ragama	32 km/hr	Triple track
	Ragama – Gampaha	33 km/hr	Triple track
	Gampaha – Ambepussa	35 km/hr	Double track
Puttalam Line	Ragama – Ja Ela	30 km/hr	Double track
	Ja Ela – Negombo	29 km/hr	Mainly single track (Seeduwa – Ja Ela is double track)
	Negombo – Kochchikade	27 km/hr	Single track
Coastal Line	Fort – Ratmalana	24 km/hr	Double track
	Ratmalana – Panadura	18 km/hr	Double track
	Panadura – Kalutara South	35 km/hr	Double track
	Kalutara South – Althugama	34 km/hr	Single track
Kelani Valley Line	Maradana – Padukka	25 km/hr	Single track, a number of sharp curve sections
	Padukka - Avissawella	25 km/hr	Single track, a number of sharp curve sections

Source: Calculated based on Time Table of Sri Lanka Railways

3.2.3 Railway Passengers

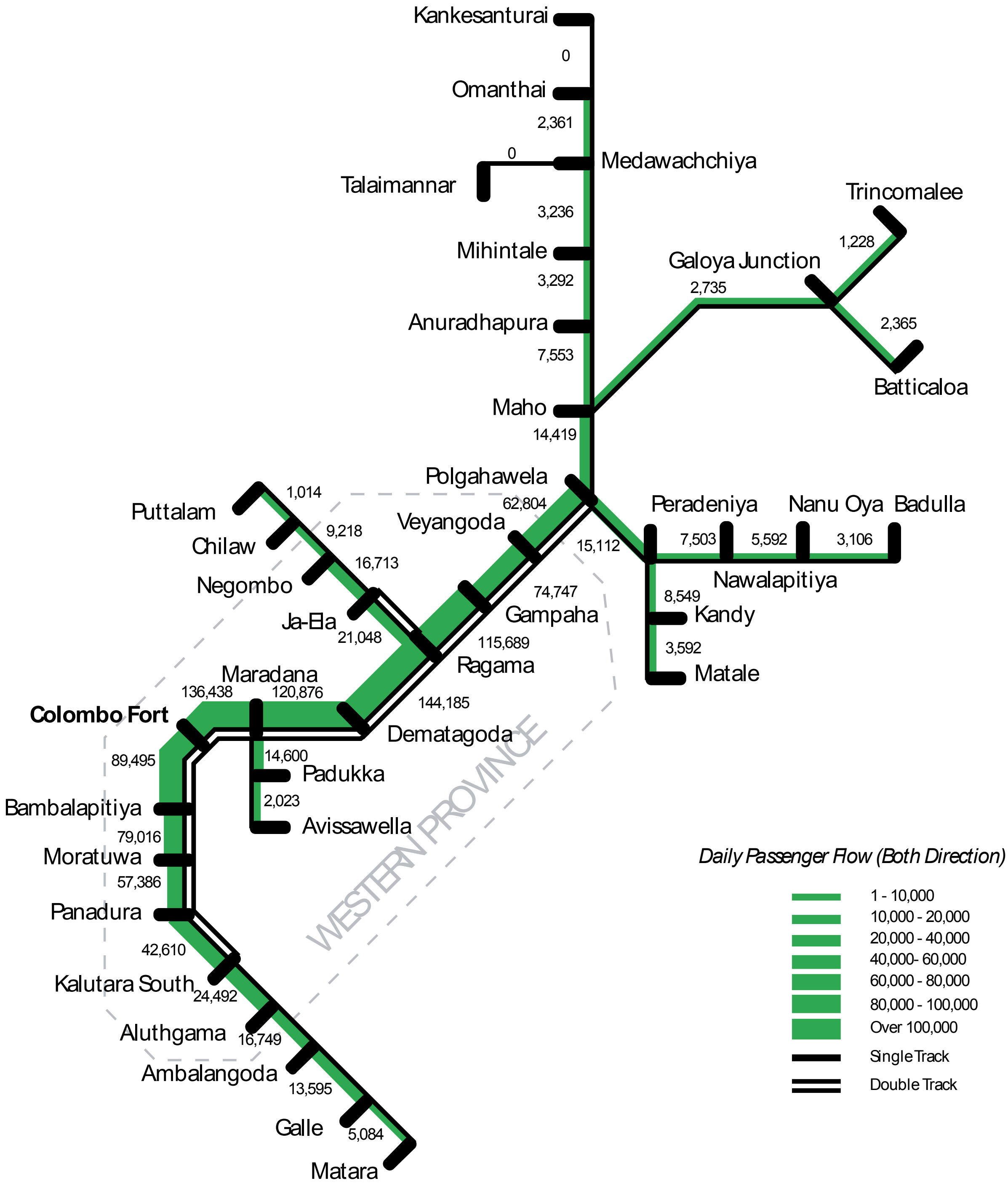
Railway passenger-kilometres and freight tonnage-kilometres in the Western Province for the last decade demonstrate an upward trend in general while annual fluctuations are observed. The passenger-kilometres of the Western Province accounted for approximately 64% of all passenger-kilometres in Sri Lanka in 2010. The passenger volume the Sri Lanka Railways is increasing trend in general since 2006.



Source: Economic and Social Statistics of Sri Lanka 2006-2013, Central Bank of Sri Lanka

Figure 3.2.3 Historical Trend of Passenger-Kilometres and Freight Tonnage-Kilometres in Sri Lanka

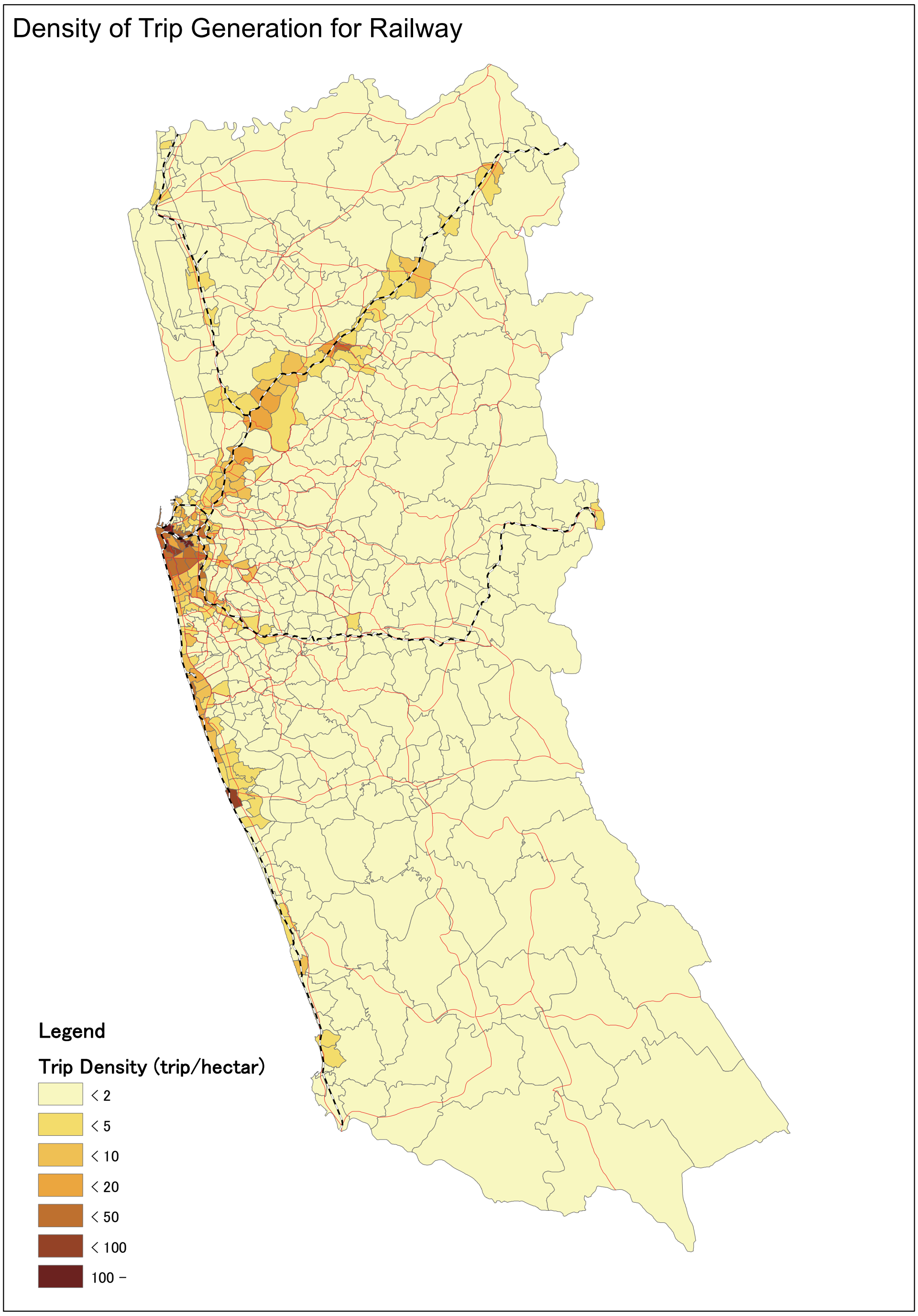
The daily sectional passenger volume is one of the key indicators to determine whether or not to improve the railway capacity. The estimated sectional daily passenger volume as determined by the University of Moratuwa based on the ticket sale data is shown in Figure 3.2.4. The highest sectional passenger volume for both directions of roughly 152,000 daily passengers is observed in the section between Dematagoda and Ragama, where the Main Line and the Puttalam Line merge, followed by the Fort – Maradana section with 136,000 passengers, Maradana – Dematagoda section with 121,000 passengers and Ragama – Gampaha section with 116,000 passengers. Other higher volume sections are on the double track sections of the Main Line and the Coastal Line. Some single track sections exceeded 15,000 passengers per day in the Western Province such as Kalutara South – Aluthgama and Seeduwa – Negombo.



Source: University of Moratuwa

Figure 3.2.4 Daily Average Sectional Passenger Volume of Railway Network in 2009 in Sri Lanka

The trip density by railway is shown in Figure 3.2.5. It is evident that railway passengers are from zones close to a railway line. It is also noteworthy that average travel distance of railway, 25.5 km, is the longest among all public transport modes according to the CoMTrans Home Visit Survey. These imply that the railway is mainly catering for medium to long distance passengers along railway corridors.



Source: CoMTrans Home Visit Survey 2013

Figure 3.2.5 Trip Generation Density for Railways

3.2.4 Railway Fares and Financial Conditions

The following table summarises railway fares of the Sri Lanka Railways. While there are three classes of trains in operation, stations where a train with an upper class coach stops within the Colombo Metropolitan Area (CMA) are limited such as Gampaha, Kalutara South, Panadura, Moratuwa and Mount Lavinia. These trains do not function as an urban railway service for daily commuters.

Table 3.2.2 Railway Fares of Sri Lanka Railways

Class	Minimum Fare	10 km	20 km
First Class, with A/C	Rs. 40.0	Rs. 40.0	Rs. 80.0
Second Class, Non A/C	Rs. 20.0	Rs. 20.0	Rs. 40.0
Third Class, Non A/C	Rs. 10.0	Rs. 10.0	Rs. 20.0

Source: Sri Lanka Railways

Additionally, discounts are applied for school children and students as a public service obligation. Government officers and workers are also eligible to purchase a season ticket for less than half of the price of a one month commuter's ticket for other adult passengers.

Table 3.2.3 Fare for Monthly Commuter's Ticket

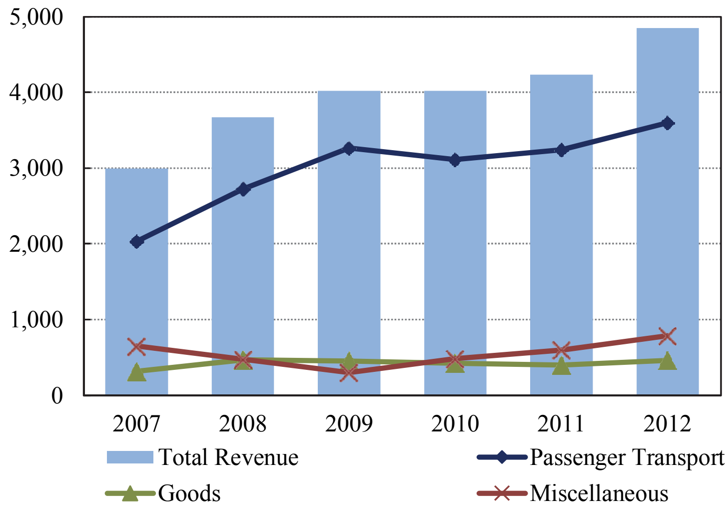
Category of Ticket	Fare
School Children below 12 years	5% of 30-day fare
All Other Students above 12 years	10% of 30-day fare
Government Officers / Workers*	15% of 30-day fare
All Other Adults (Private)	40% of 30-day fare

Note: * Government institutions have to reimburse the Sri Lanka Railways the difference of the fare with other adult private passengers.
Source: Commercial Department, Sri Lanka Railways

Although more than half of the railway passengers use bus as an access and/or egress mode of transport, fare schemes are independent. This means that majority of railway passenger has to pay a minimum fare twice or more.

Figure 3.2.6 shows the annual revenue of SLR. From 2007 to 2012, the total revenue has increased 61%. Most part of the growth was the revenue from passenger transport (77% increase). The number of ordinary ticket holders was 62 million (revenue: 2,806 million Rs.) and the number of season ticket holders was 43.7 million (revenue: 793 million Rs.) in 2012.

Roughly 10% of the revenue is from freight transport, and the amount of the freight is 2.06 million tons (143 million tons-km) in 2012.

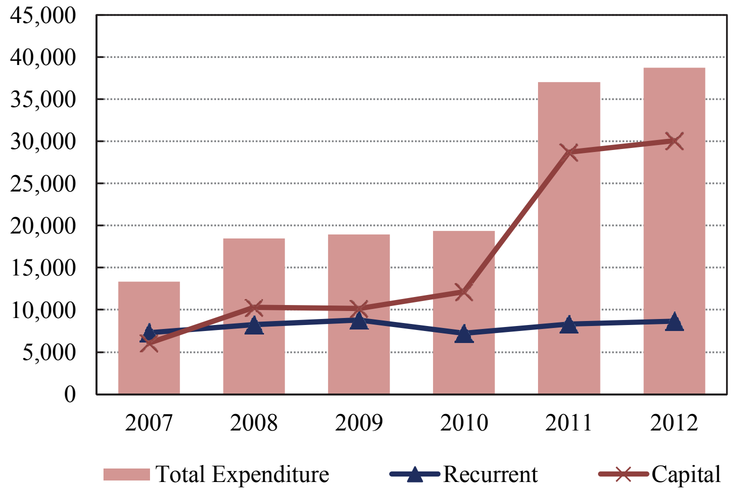


Source: Annual Report of Sri Lanka Railways (unit: Rs. Mn.)

Figure 3.2.6 Annual Revenue of Sri Lanka Railways 2007-2012

Figure 3.2.7 shows the annual expenditure of SLR. The expenditure consists of recurrent and capital expenditure. The recurrent expenditure has hovered around 7 to 9 billion Rs.

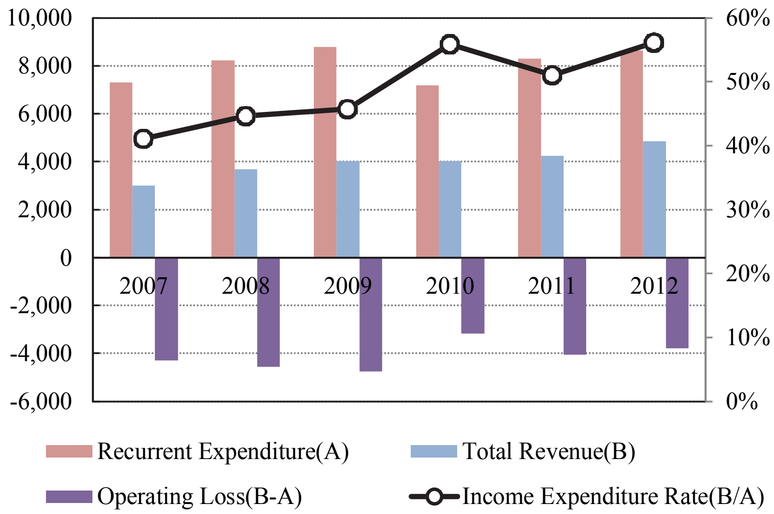
The capital expenditure has varied considerably from year to year, and it has large impact on the total amount of annual expenditure. In 2011 and 2012, the capital expenditure was roughly three times higher than that in other years. This is mainly because a large amount was invested in maintenance of permanent way and building.



Source: Annual Report of Sri Lanka Railways (unit: Rs. Mn.)

Figure 3.2.7 Annual Expenditure of Sri Lanka Railways 2007-2012

The SLR has continuously posted losses. Figure 3.2.8 depicts the revenue, expenditures, and profit/loss of the SLR in the last six years. The revenue could cover approximately only half of the expenditures. While the revenues are relatively level, there are some fluctuations in the expenditures.



Source: Sri Lanka Railways (unit: Rs. Mn.)

Figure 3.2.8 Revenue, Expenditure and Profit/Loss of the Sri Lanka Railways

3.2.5 Rolling Stock and Railway Facilities

(1) Railway Rolling Stock

There are 1777 units of rolling stock in Sri Lanka Railways. They are categorised as shown in Table 3.2.4.

Table 3.2.4 Number of Rolling Stock

Type of Rolling Stock	Number	unit
Diesel Electric Locomotive	60	car
Diesel Hydraulic Locomotive	10	car
Diesel Multiple Unit	55	unit
Carriage (Passenger Coach)	900	car
Goods Wagon	600	car
Oil Tanker	152	car

Source: Sri Lanka Railways

Passenger trains consist of a locomotive and passenger coaches or diesel multiple units (DMU).

A locomotive and passenger coaches is the conventional train system and one locomotive pulls many passenger coaches where a DMU has no locomotive but some cars have a diesel engine and push/pull the train. In a DMU each end car has a drivers cab, therefore the train can operate either direction without shunting the locomotive. The ratio of wheels with traction on a DMU is higher than on a locomotive pulled train. Generally, acceleration and deceleration are higher than that of a locomotive pulled train therefore DMU is suitable for commuter trains.

A DMU of Sri Lanka Railway consists of one motor car at one end and five trailer cars. Approximately two thirds of the space in the motor car is the machine room and the other one third is a passenger saloon. The engine and generator are installed in the machine room. Mostly two units are coupled to make one train to provide enough passenger capacity.

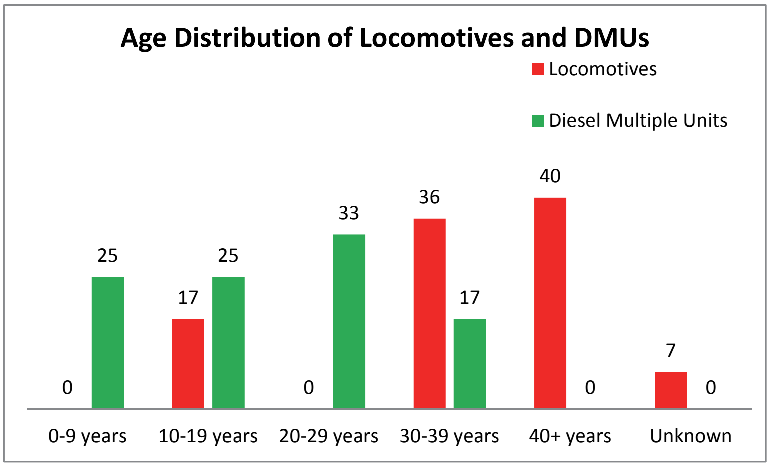
Locomotive and Passenger Coach DMU

Source: CoMTrans Study Team

Figure 3.2.9 Trains of Sri Lanka Railway

The SLR possesses a variety of railway rolling stock. Most of the locomotives of the SLR were purchased more than 30 years ago and 40% of the locomotives are more than 40 years old as shown in Figure 3.2.10. On the other hand, diesel multiple units (DMU) are relatively new. A half of the DMUs were purchased within the last two decades.

During the period from the 50's to the early 80's, the SLR imported mainly from developed countries such as Canada, Japan, Germany and England. After the 90's, the SLR imported mainly from China and India except for 10 locomotives from France. Recently, the SLR is shifting to a DMU rather than a locomotive-coach system. China is a key provider of DMUs. In addition to a total of 30 DMUs in 2000 and 2008, the SLR is planning to purchase 13 DMUs from China as a part of the Southern Railway Upgrading Project and 20 DMUs from India for the Coastal Line.



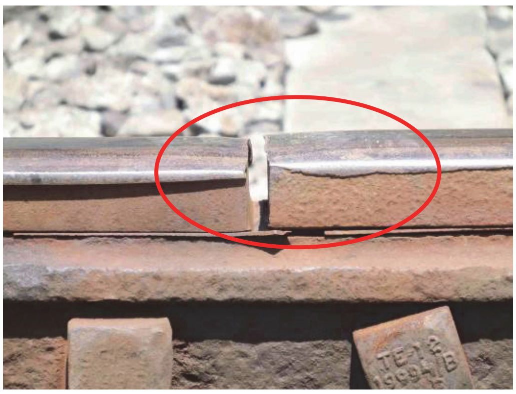
Source: Ministry of Transport

Figure 3.2.10 Age of Locomotives and DMUs of Sri Lanka Railways

(2) Track

Sri Lanka Railways uses ballasted track mostly with concrete sleepers. Wooden sleepers are used in some areas. Tracks have many joints because of the use of short rails. Deformation of rails and installation of rails with insufficient width at the heads are seen at joints. (Figure 3.2.11)

In addition, significant irregularities in rail standards, alignments, and heights are observed because of low precision at rail joints and insufficient maintenance of track beds as shown in Figure 3.2.12. Therefore, trains rattle badly while running. These aspects become great obstacles when increasing the speed of the trains.



Source: CoMTrans Study Team

Figure 3.2.11 Deformation of Rail

Source: CoMTrans Study Team

Figure 3.2.12 Irregularity of Alignment

The noteworthy point is the Coastal Line. The Coastal Line is literary installed along the coast, and some sections of the line are constantly exposed to wave splashes which are resulting in significant corrosion caused by rust on the rails and fasteners. This creates the possibility that designated track gauges cannot be maintained, or the breakdown of rails may occur. Ballasts have been washed away toward the ocean due to wave motions in some areas, and sleepers are completely exposed from ballasts in such areas. (Figure 3.2.13) In the worst case scenario, these conditions may cause derailing or overturning of trains.

Source: CoMTrans Study Team

Figure 3.2.13 Exposed Sleepers

(3) Signalling System

The SLR has a variety of signalling systems as well. The Main Line is still using the 50-year old Colour Light Signalling and it will be replaced by a new colour light system including a Centralised Traffic Control (CTC) System and a telecommunication system. The 25-year old CTC system of the Coastal Line will also be replaced. These signalling systems are in the following condition:

- Lack of maintenance (Figure 3.2.14)
- Significant age-related deterioration
- Difficult to receive support from manufacturers
- Difficult to obtain replacement parts
- Unable to work with high speed and high frequency train operations

Source: CoMTrans Study Team

Figure 3.2.14 Broken Signal

Source: CoMTrans Study Team

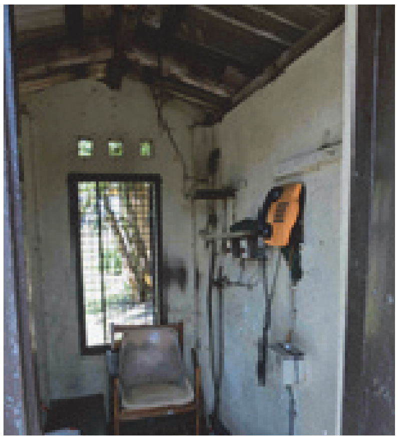
Figure 3.2.15 Exposed Terminal Box

These conditions indicate that signalling devices are not functioning as intended, and malfunctions and damages cannot be quickly repaired. Delays and cancellation of trains frequently occur as a result. In addition, since these old signalling systems do not have features to protect trains automatically, there is a high risk that minor mistakes and a misunderstanding between train drivers and station officers could result in collisions of trains.

(4) Telecommunication Systems

For the Telecommunication system, a 155 Mbps ATM (Asynchronous Transfer Mode) System through optical fibre is applied in the Coastal Line while the other lines are Radio Telecommunication through UHF/VHF. Sri Lanka Railways is using a radio system using the UHF/VHF radio waves and the communication system using optical cables in the south as the backbone of its communication system.

Sri Lanka Railways have established communication methods as backbones, but age-related deteriorations are seen in some of the terminal devices.



Source: CoMTrans Study Team

Figure 3.2.16 Terminal Device

(5) Station Facilities

Railway station buildings are generally old fashioned. Some stations are still using buildings constructed during the colonial period. Unlike railways in developing Asian countries, the majority of SLR stations are equipped with a station square. Some bus terminals such as Moratuwa and Gampaha are just in front of the railway station. However, access roads to some stations in suburban areas do not have sidewalks.

Electronic signboards for passengers are also installed in some major stations such as Colombo Fort, Moratuwa and Negombo while small stations only have billboards.

Source: CoMTrans Study Team

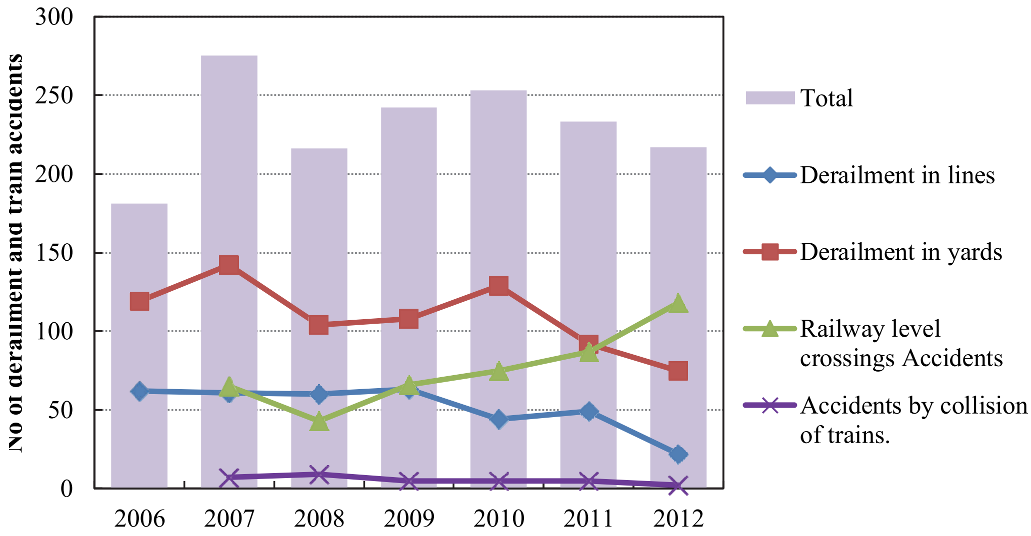
Figure 3.2.17
Colonial Station Facilities of Egoda Uyana Station

Source: CoMTrans Study Team

Figure 3.2.18 Station Square of Negombo Station

3.2.6 Railway Accidents and Derailments

As shown in Figure 3.2.19 the number of total derailments and accidents has hovered around 200 to 250 in the recent years. Both the numbers of derailments in lines and in yards have decreasing trends in the figure. Especially, the number of the derailments in lines has decreased 65 percent in the last seven years. Instead, the number of accidents at the railway level crossings has increased 81% and became the main factor.



Source: Sri Lanka Railways

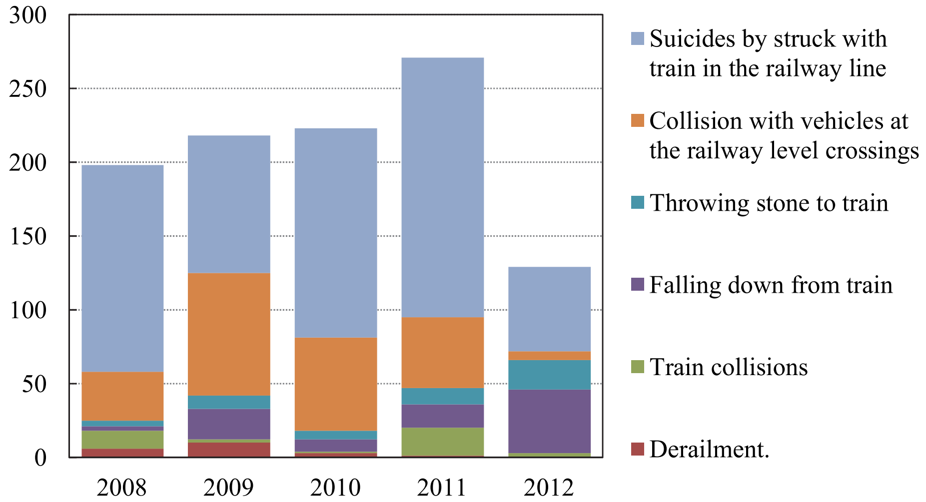
Figure 3.2.19 Number of Derailments and Train Accidents

Figure 3.2.20 and Figure 3.2.21 show the reported number of fatalities and injuries due to the train accidents in the last 5 years. The total number of the fatalities had increased during 2008 to 2011. However it dramatically decreased from 141 to 38 between 2011 and 2012. The main factor of the fatalities was suicide struck with train in the railway line, and its ratio was 84% in the last five years. The second leading factor of the fatalities was collisions with vehicles at the railway level crossings and its ratio was 14%.

As shown in Figure 3.2.21, the number of injuries shows a similar trend with the number of fatalities. The total number of injured people had increased up to 271 from 2008 to 2011, and dropped down to 129 in 2012. The main factor of the injuries was suicide struck by a train in the railway line, and its ratio was 59% in the last five years. The second most cause of injuries was collisions with vehicles at the railway level crossings (22%) and the third was falling down from the train (9%) in the last five years.

Source: Sri Lanka Railways

Figure 3.2.20 Number Fatalities due to Train Accidents



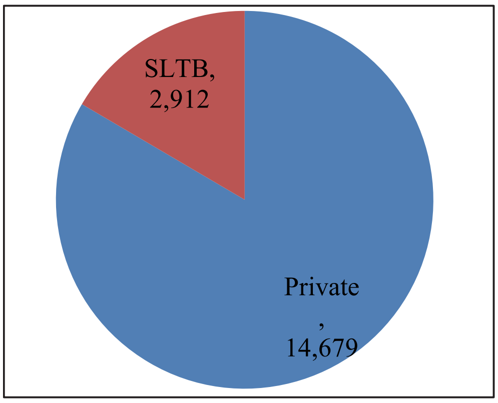
Source: Sri Lanka Railways

Figure 3.2.21 Number Injured due to Train Accidents

3.3 Bus Transport

3.3.1 Bus Routes and Operations

The Sri Lanka Transport Board (SLTB) and private bus operators have roughly 680 intra-provincial bus routes and 400 inter-provincial bus routes in the Western Province according to the bus route information from the National Transport Commission (NTC). Bus passenger kilometres of the SLTB and private buses are shown in Figure 3.3.1. While the share of kilometres of private buses is approximately 78%, the share of passenger kilometres of private buses is roughly 83%. This means that load factors of private buses are generally higher than that of SLTB.



Unit: Million Passenger Kilometres in 2011

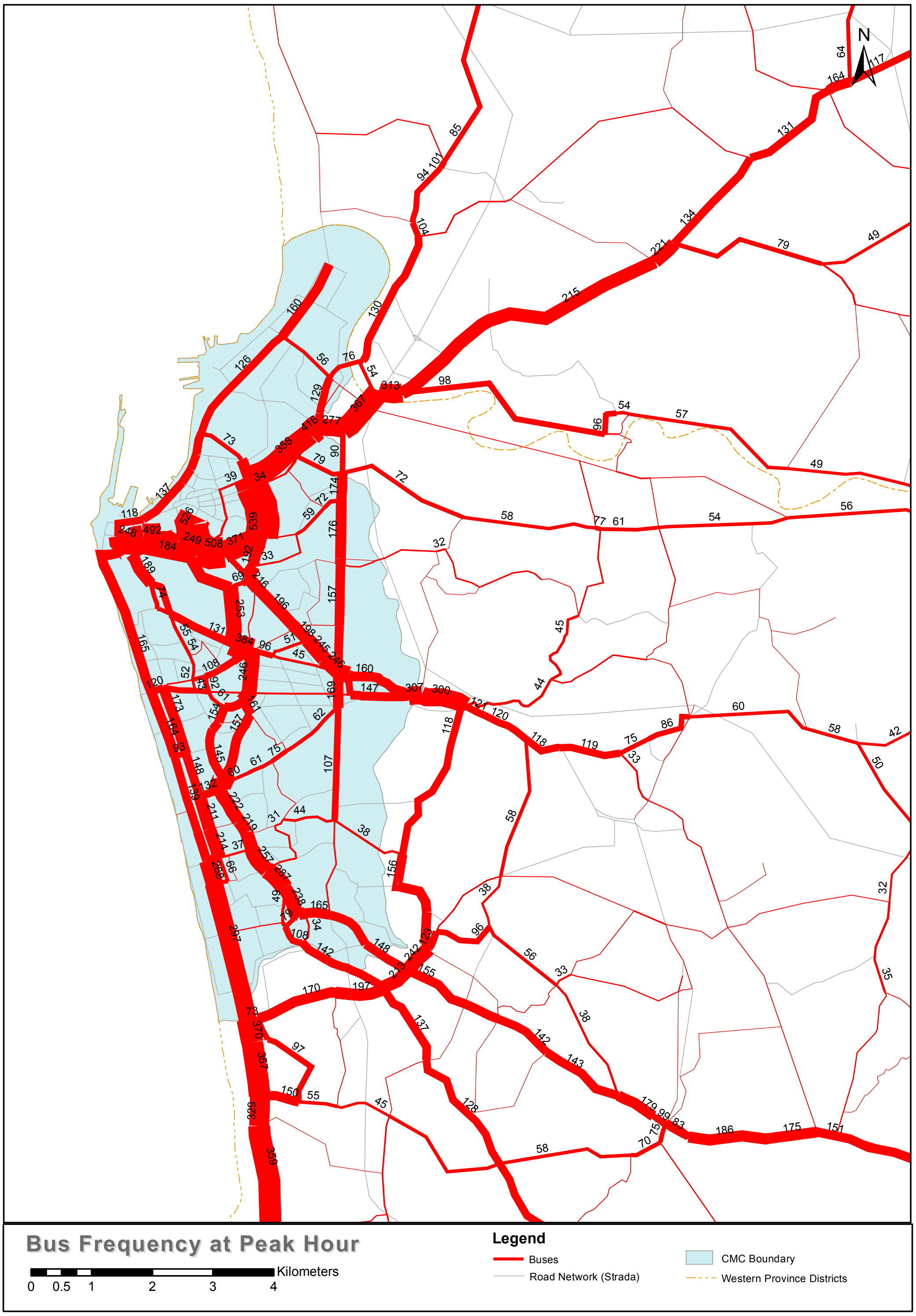
Source: Economic and Social Statistics of Sri Lanka 2013

Figure 3.3.1 Passenger Kilometres of Bus Transport in the Western Province

It is evident that one third of intra-province bus routes operated in the Western Province have one of their ends in the Pettah area of Colombo where three bus terminals are located. Although it is complicated for passengers to find the routes appropriate for their origin and destination, no maps for passengers are available at this moment.

There are also several initiatives to improve bus services of the region. The SLTB has started to procure 100 luxury low floor buses equipped with air conditioners for the routes in the Western Province. Routes to suburban cities located around 20-40km from Colombo Municipality such as Moratuwa, Kesbawa, Homagama, Kaduwela, Gampaha and Negombo were selected. Export credit from the Bank of Sweden is being utilised.

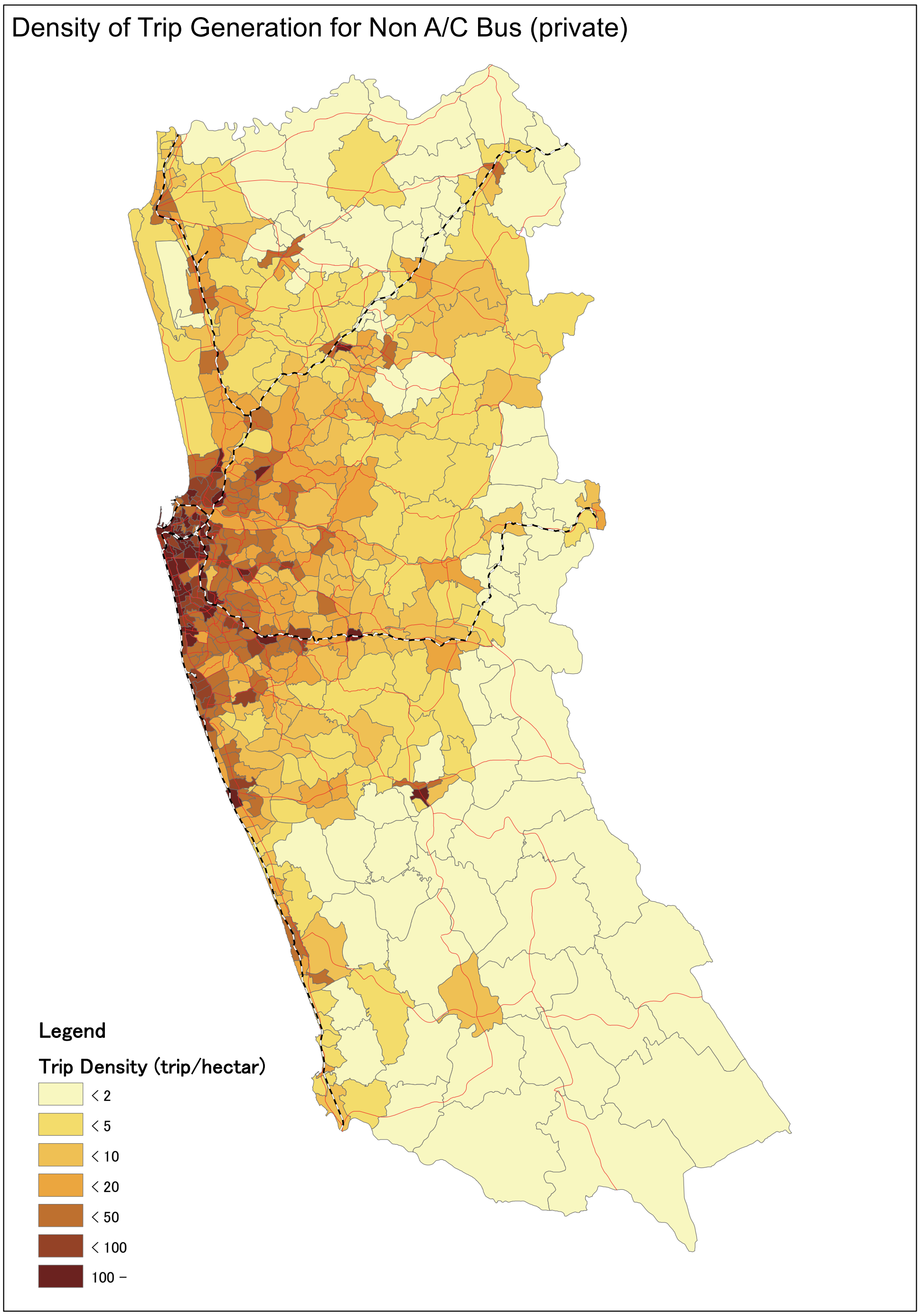
Based on the bus route information from the SLTB and the Western Province Road and Passenger Transport Authority (WPRPTA), buses that are operated during peak hour are shown in Figure 3.3.2. The number of buses on the seven major radial corridors outnumbers other roads. Kandy, Galle and Malabe corridors are the highest followed by High Level, Negombo, Horana and Low level corridors. A number of buses are operated around Pettah bus terminals.



Source: Time tables and bus operational information from the Western Province Road and Passenger Transport Authority (WPRPT), the Srl Lanka Transport Board (SLTB) and the National Transport Commission (NTC). Time tables and bus operational information was summarised and visualised by the CoMTrans Study Team.

Figure 3.3.2 Bus Operation during 7 – 8 AM in the CMC and Surroundings

The trip density by non-air-conditioned private bus is shown in Figure 3.3.3. Compared with the trip density map of railways in Figure 3.2.5, trips are scattered around the Colombo Metropolitan Area (CMA). Trip density is much higher than railway even in cities along the railway lines.



Source: CoMTrans Home Visit Survey 2013

Figure 3.3.3 Trip Generation Density for Buses

3.3.2 Load Factors of Bus Transport

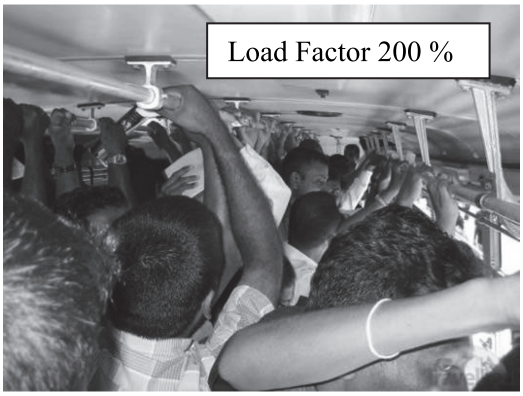
Buses are the major public mode of transport in Colombo. In the morning period buses are over-crowded on the inbound direction on almost all major corridors according to the Screen Line survey. The load factors on the all corridors indicate more than 100%. In particular on Kandy, Low Level Road and Horana road, the load factors are more than 150%. In the evening peak period, buses are crowded on the all corridors except Sri Jayawardenepura Mawatha of which the load factor was 87%.

Table 3.3.1 Bus Load Factor of Major Transport Corridors

Corridor	Road	Morning Peak Period (Inbound)			Evening Peak Period (Outbound)		
		CMC Boundary	5 km	10 km	CMC Boundary	5 km	10 km
Negombo Road		142	122	117	115	120	133
Kandy Road		116	142	171	120	108	143
Low Level Road	Avissawella Road	171	-	-	143	-	-
	Kolonnawa Road	127	-	-	127	-	-
Malabe	Kotte Road	130	126	127	111	123	156
	Sri Jayawarde-nepura Mawatha	138	-	-	87	-	-
High Level Road		106	121	134	124	133	108
Horana Road		166	174	-	147	169	-
Galle Road		101	-	-	102	110	-

(Unit: per cent) Bus load factor is estimated by dividing loading passenger by seating capacity. Cells of tables are coloured by load factor. Green is less than 120%. Yellow is 120-149%, and, pink is 150% or more.

Source: CoMTrans Screen Line Survey, 2012



Source: CoMTrans Study Team

Figure 3.3.4 Images of Load Factors

3.3.3 Bus Fares and Financial Conditions

(1) Bus Fares

The National Transport Commission defines service standards by classes. There are three classes of buses services. The luxury class buses are equipped with air-conditioners. The semi-luxury buses are seat-allocated. The fare of luxury buses is two times the normal bus fare, and, that of semi-luxury buses is 1.5 times the normal bus fare. Bus fares are collected on board and by cash by a bus conductor while the SLTB started trial is on a pre-paid card system. The SLTB and some private operators are using portable ticketing machines with global positioning system (GPS). Bus conductors are collecting fares manually.

Table 3.3.2 Bus Fare System

Bus Type	Minimum Fare	10 km	20 km
Luxury	Rs. 18	Rs. 56	Rs. 82
Semi Luxury	Rs. 14.	Rs. 42.	Rs. 62
Normal, Non-Air-Conditioned	Rs. 9	Rs. 28	Rs. 41

Source: National Transport Commission, Revised Fare of 1 November, 2013

(2) Bus Fares Discount System

A governmental bus operator, the Sri Lanka Transport Board (SLTB), has a 10% fare commuter's ticket for school children, 30% for students of educational institutions and 65% for adult commuters as a public service obligation. However, there is limited discount ticket for private buses except for several schemes assisted by the government such as school bus service, night bus service and rural bus service. As frequency of the SLTB buses is low for some routes, a commuter's ticket holder cannot avoid waiting for a long time. Special passes are issued to members of the armed forces and police officers, where the cost of such passes is completely paid to the SLTB by the Police and the respective force. Trips made by these passes should be within 50km from the work place. Also SLTB provides a special pass service for employees of media and other government organisations on requests made through the ministry of transport. In this case the organisation pays the complete amount to the SLTB. SLTB has also recently launched a pilot project to issue new electronic prepaid cards and has already issued around 500 passes to travel from Mattegoda to Maharagama.

Table 3.3.3 Monthly Commuter's Ticket Fare of the SLTB

Category of Season Ticket	Fare
School Children	10% of 21-day fare
Students of Other Educational Institutions	30% of 26-day fare
All Other Adults	65% of 26-day fare

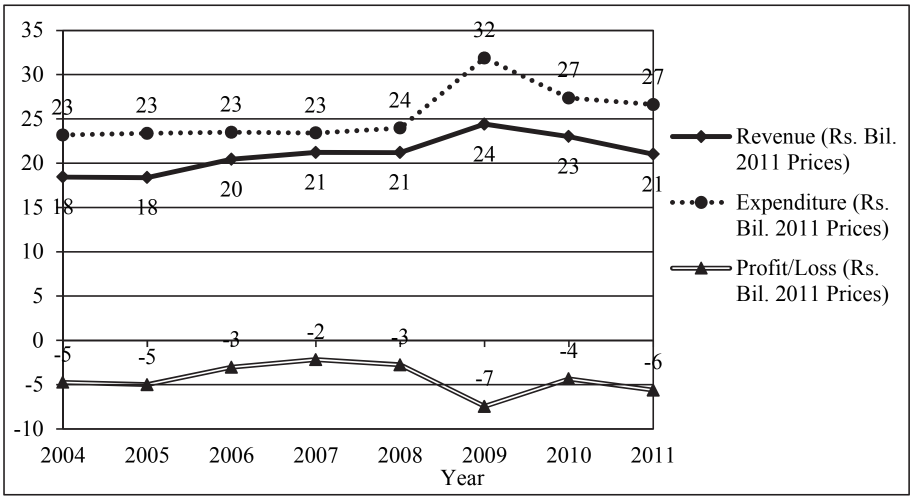
Source: Sri Lanka Transport Board

(3) Government Assistance on Bus Transport

Currently the Government supports three types of bus transport services; 1) *Sisu Seriya* school bus for school students to provide safe and affordable bus transport, 2) *Gemi Seriya* service to provide a reliable and economical transport service for villagers to reach the city centres for their daily requirements, and 3) *Nisi Seriya* Service to provide night time bus service. The details of these services are described in the Technical Report.

(4) Financial Condition of the SLTB

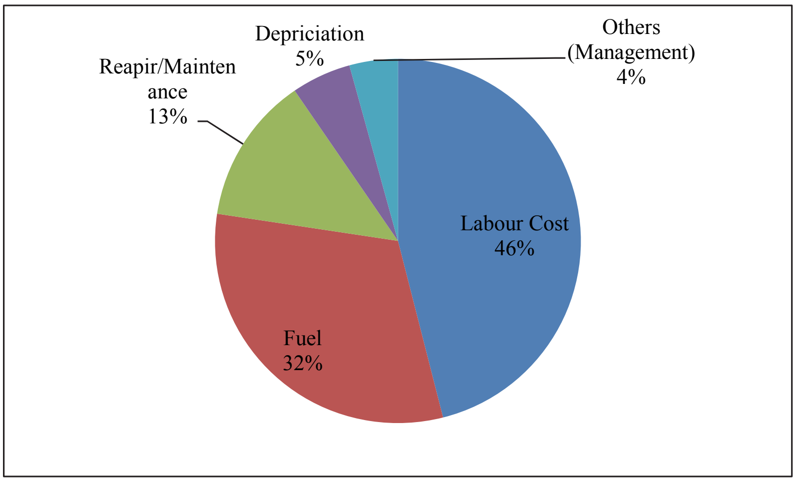
While some statistics mention that the revenue, cost and financial loss of the SLTB are increasing in current prices, those of 2011 prices are almost constant for the last 8 years. The increase in 2009 might be affected by termination of the conflict in Sri Lanka as well as other factors such as a model depot program. The revenue covers around 78% of the expenditures of the SLTB, and the annual financial loss was around 6 billion rupees in 2011.



Source: Economic and Social Statistics of Sri Lanka 2006-2012, Central Bank of Sri Lanka, adjusted by CoMTrans Study Team

Figure 3.3.5 Revenue, Expenditures and Profit/Loss of the SLTB (2011 Prices)

In terms of the composition of the expenditures of the SLTB, 46% accounts for labour cost followed by fuel cost (32%), repair/maintenance (13%), depreciation (5%) and others (4%). More than three fourths of the costs are from labour cost and fuel cost.



Source: National Transport Statistics Report 2011, National Transport Commission

Figure 3.3.6 Expenditure Composition of the SLTB (2011)

3.3.4 Bus Sector Administration and Operators

Bus services in the Western Province are regulated, operated and, implemented by several organisations. The organisations and their functions are summarised in the Table 3.3.4. With route permission issued by the Western Provincial Road Passenger Transport Authority, intra-provincial private buses are typically operated by individuals who own a single bus while there are some owners who own more than one bus. The private operators hire a driver or drive by themselves. With regard to the function of private buses and the SLTB, unprofitable routes are not operated by private buses while the SLTB operates on both profitable and unprofitable routes.

Table 3.3.4 Bus Sector Organizations

Name of Organisation	Level of Government	Purpose	Functional Responsibilities
National Transport Commission	Central	Regulator	· Advise the Central Government on passenger transport policy and services; · Grant permits in specified areas; · Ensure service on unprofitable routes; · Provide permits for inter-provincial bus services; · Provide managerial expertise and assistance to Provincial Transport Authorities
Sri Lanka Transport Board	Central	Operator	· Provide public bus services in Sri Lanka; · Provide shelters/stations/terminals for SLTB buses; and · Provide service for unprofitable routes and times.
Western Province Road Passenger Transport Authority	Province	Regulator	· Regulate intra-provincial private buses and routes; · Provide annual permits for each bus on a specific route; and · Provide shelters/stations/terminals for private buses.
Road Development Authority	Central	Implementer	· Provide bus stops along the routes.
Local Authorities	Municipal	Implementer	· Provide bus stops along the routes.
Operator Federations	Private	Representation	· Represent members' issues to the regulatory authorities; and · Represent members during strike action.
Route Associations	Private	Route Oversight	· Facilitate bus schedules on routes if route timetable does not exist.
Private Bus Operators	Private	Operator	· Operate both inter-provincial and intra-provincial private bus service.

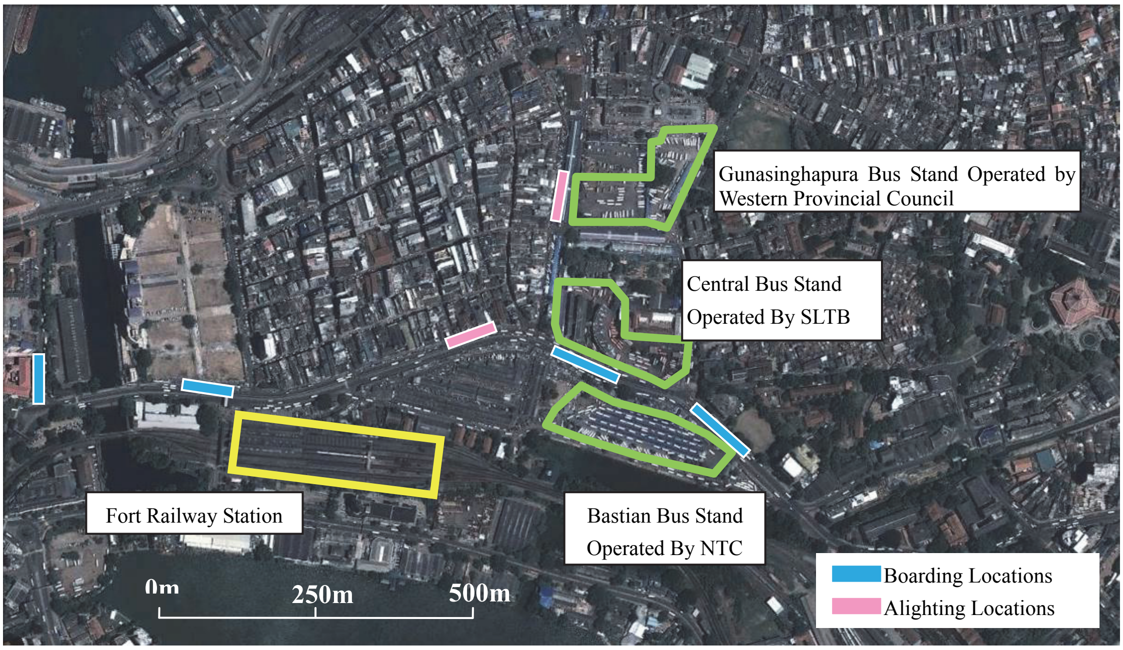
Source: The Study on Urban Transport Development for the Colombo Metropolitan Region by JICA, 2006; modified by the CoMTrans Study Team

3.3.5 Bus Terminals

There are a number of bus routes using bus terminals and bus stops in the Pettah area of Colombo. Three bus terminals are operated by each bus regulator and operator. Colombo Central Bus Stand is operated by the SLTB only for the SLTB buses. The National Transport Commission (NTC) operates Bastian Bus Stand for private inter-province buses. The Western Provincial Council also operates the Gunasinghapura Bus Stand mainly for a bus pool of intra-provincial buses. Passenger boarding and alighting locations of the intra-provincial buses are different by destination and bus routes as shown in Figure 3.3.7. Roughly 11,000 buses arrive and depart in the Fort-Pettah area (Inter-province: about 3,300 and Intra-Province: about 7,500). The summary of the surveys at the three bus terminals are shown in Figure 3.3.8. The number of buses departing from each terminal is roughly 1,000 to 1,200. The loading level of buses when they leave each bus terminal is not high. Especially, at the Gunasinghepura bus terminal, more than 90 percent of buses depart without passengers.

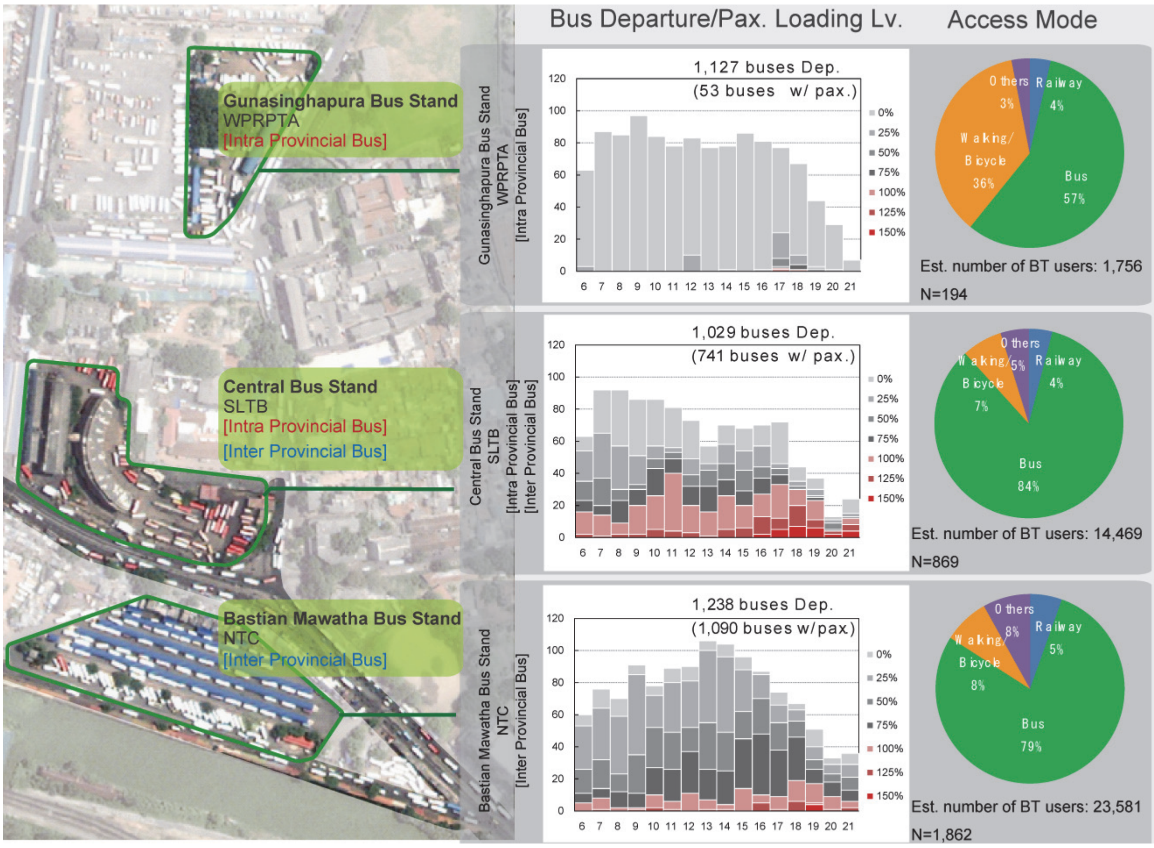
In addition, there are inter-modal transfer passengers at Colombo Fort Railway Station. This segmentation of public transport terminals and Fort railway station makes transfer between buses and the railway as well as between buses difficult. Furthermore, many transfer passengers need to cross arterial roads around this area.

Other major cities in the Western Province also have their own bus terminals. Some bus terminals such as Moratuwa and Gampaha are located adjoining the premises of the railway station square. Some bus terminals do not have enough space or facilities for handling many buses. For instance, Maharagama bus terminal, a key bus terminal where express buses utilising the Southern Expressway depart from, is utilising the median of an arterial road.



Source: Ministry of Transport and CoMTrans Study Team

Figure 3.3.7 Bus Terminals and Stops in the Pettah Area



Source: CoMTrans Study Team Survey,6:00~22:00, Nov.7 (Thu.), 2013

Figure 3.3.8 Locations and Summary of Surveys at 3 Bus Terminals

3.4 Paratransit and Other Road-Based Public Transport

3.4.1 School Vans and Buses

Several types of paratransit and road-based public transport serve the Colombo metropolitan area. This includes 1) school vans and buses and 2) staff services. The security of the buses is a concern for parents; thus, private operators and individuals operate vans called "School Vans" dedicated for school children to go to schools catering to parents' concerns on security.

A "Staff Service", which is operated by a private company or an individual for transporting commuters from suburban areas to the city centre, especially for female office workers who prefer secured service. The Staff Service usually utilises vans or minibuses with a capacity range of 8-30 persons and they collect passengers in suburban areas and drop them off in front of their offices.

3.4.2 Taxis and Hired Three Wheelers

Increase of Three Wheelers

Three-wheelers were introduced to Sri Lankan in the 1980's. The increase in the number of three-wheelers in the Western Province is significant. According to the Department of Motor Traffic, the number of three-wheelers was 25,043 in 1999 and 96,650 in 2004. The number reached 213,045 as of 2011 according to the Divisional Secretariats, Central Bank of Sri Lanka. This is also having a significant impact on urban transport.

The increase in the number of three-wheelers can be explained by the needs of customers in a niche market of short distance trips and the ease of starting a business due to loose restrictions and inexpensive initial cost. Since large buses are not able to enter narrow streets, the three-wheeler caters for service between the house and railway stations or bus stops. There are three-wheeler stops or parking at the junctions of major corridors and minor streets in suburban areas. Three-wheeler driving is also one of the sources of employment for entry-level workers. The drivers can start their business with only a driver's licence and a three-wheeler vehicle. They can also rent their three-wheeler.

Safety Issue of Three Wheelers

However, disadvantages of the three-wheelers are not negligible. Safety is one of the major aspects to be considered for the three wheelers. Since there is virtually no restriction on three-wheeler taxi business, drivers tend to ignore traffic rules such as illegal turns to pick up customers and allow passengers to disembark from the right side of roads. However, they are not the main vehicles which caused fatal accidents according to the statistics of the traffic police. The three-wheeler was responsible for approximately 13% of fatal traffic accidents in the Western Province in 2011. This number is smaller than 18%, the share of three-wheelers in the total number of vehicles in the Western Province. Illegal turns, parking and movement of the three-wheelers affects traffic flow and reduces the capacity of roads.

No Transparent Fare System

Another issue related to the three-wheelers is that it is not a customer-friendly mode of transport. While the number of three-wheeler taxis with metres is increasing, some three-wheelers are not equipped with metres and customers have to negotiate with drivers. The fare decision process is also not transparent. There are several three-wheeler operators' associations in the region. As the market is unregulated, the fare policy is also dependent on each association.

Regulatory Framework on Three Wheelers

This sector is less regulated and is market-driven. While an initial registration and an annual renewal of the three-wheeler licence are required, there is no restriction on the number of three wheelers. The Western Province has tried to regulate it several times. In 2002, the Western Province gazetted the Three-Wheeler Service Statute, No. 6 (2002). The statute established a three-wheeler service bureau within the Western Province Road and Passenger Transport Authority, to introduce passenger transport service permits, and to set the maximum limit of the number of three wheelers. However, it did not come into effect due to strong opposition by some operators and drivers. Although the Western Province amended the same Statute to enable the Provincial government to apply the policy in 2008, this also did not come into effect because of opposition from some operators and politicians. The Private Transport Service Ministry is now working with the associations of three-wheeler operators to work out a policy framework for the three-wheeler industry.

3.4.3 Taxis

Taxi Company

The taxi operation in Sri Lanka is not regulated or controlled by any law at present. There are many taxi operators. Some large operators operate as companies which own several hundreds of vehicles, and some medium scale operators operate with 10 to 30 vehicles whereas small operators are mostly individuals who own a few vehicles (less than 10) to run a taxi service.

Taxi Operation

According to the interview survey of taxi operators by the CoMTrans Study Team in 2013; many taxi operators, around 60%, have opted to employ their drivers on a temporary basis; around 30% on a contract basis and the remaining 10% on a permanent basis. The taxi drivers can use the normal driver's licences for taxi operation. Currently, there is virtually no regulation specifically on taxi service such as taxi service operation licence. Some operators register their company at the registrar of companies under the registration of business names act (section 4 (1) of companies act No:7 of 2007). Taxi operators pay a commercial assessment tax to the local authority they belong to similar to any other business. Due to its relative novelty and scattered nature of operators, the taxi industry does not have any taxi related associations such as taxi industry associations, taxi driver associations or trade unions. There are a variety of vehicles used for taxi service including, small cars (hatchback cars), large cars (sedans), and vans. It should be noted that Tata Nano cars are widely used as taxis in the country.

Taxi Fare

The taxi fare policy is decided by each operator and there is no governing law to regulate it. There are several methods which are used to set the taxi fares considering the service type. Many operators charge a fixed amount for the first 1 to 3 kilometres and a per kilometre rate thereafter. Some operators use a package system, which allows the users to travel up to a fixed number of kilometres within a certain number of hours for a predefined fee. In special cases such as airport drop offs and pickups, a fixed fee is charged per trip. These fares change from operator to operator according to the vehicle type and air-conditioned or non-air-conditioned characteristics and comfort level of the vehicle.

3.5 Road Network

3.5.1 Classification of Road Network in the Western Province

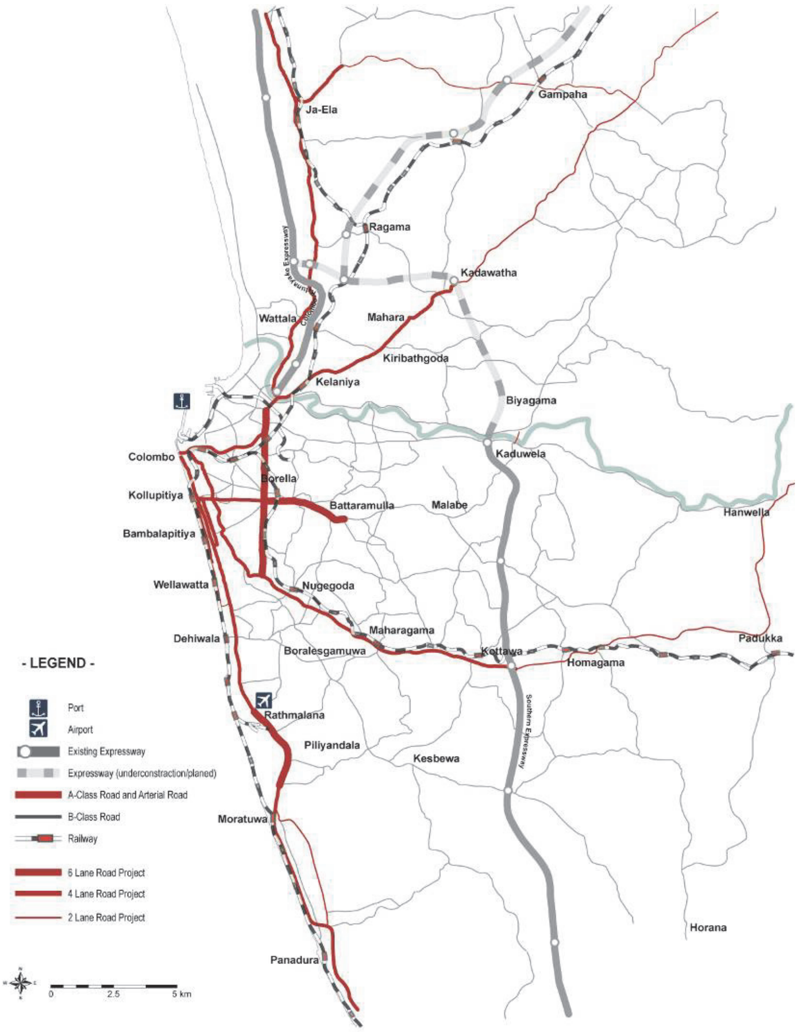
The existing road network of Sri Lanka has been divided into five classes. Classes A and B are applied to national roads managed by RDA, classes C and D are applied to provincial roads managed by the provincial road development department (PRDD), and class E is applied to local roads managed by local authorities.

The national roads that connect major cities of the Western Province to other cities or towns, such as Negombo Road (A3), Kandy Road (A1), Low Level Road (B435), Malabe Road (A0-B240), High Level Road (A4), Horana Road (B84), and Galle Road (A2), are radiated from the Fort area of CMC. As part of the national road network, Baseline road running North-South is connecting some of the above national roads.

Additionally, there are also existing and planned expressways in the province that are already in service or at various stages of construction/planning. Further details are in a later section of this chapter.

3.5.2 Existing Road Network in the Western Province

The existing road network map of the Western Province is shown in Figure 3.5.1. Expressway and major arterial roads are summarised in Table 3.5.1 and Table 3.5.2 respectively.



Source: CoMTrans Study Team

Figure 3.5.1 Existing Road Network in CMA

(1) Expressways

The existing and planned expressways of the Western Province are shown in Table 3.5.1 and Table 3.5.2. The expressways in service in the Western Province as of April 2014 are the Southern Expressway (SEW) including an extension section (Pinnaduwa - Godagama), the Colombo - Katunayake Expressway (CKE) and the 1st section of the Outer Circular Highway (OCH). Additionally, the Outer Circular Highway (OCH) is also under construction, the opening schedules are shown in Table 3.5.1

In addition, there is a plan for the Northern Expressway that is at present under a feasibility study. After construction of the OCH and CKE, the access between the SEW and Bandaranaike International Airport is going to be connected as an expressway link. However, due to these expressways basically running outside the suburbs around Colombo city, there are some serious issues such as a) low accessibility to/from Colombo city and between the northern and southern areas of Colombo city and b) lack of alternative routes in case of emergency.

Table 3.5.1 Existing and Planned Expressways in the Western Province

Name of Expressway	Description	Status
Southern Expressway	a) Developed section Kottawa – Pinnaduwa : 95.3km Pinnaduwa – Godagama : approx. 30km b) Design speed : 120km c) Lanes : Future - 6 , Temporarily – 4	Opening schedule Kottawa - Pinnaduwa : in-service Pinnaduwa – Godagama: in-service
Outer Circular Highway	a) Developed section 1st section Kottawa - Kaduwela : 11.0km 2nd section Kaduwela - Kadawatha : 8.9km 3rd section Kadawatha - Kerawelapitiya: 9.2km b) Design speed : 100km/hr c) Lanes : Future - 6 , Temporarily – 4	Opening schedule 1st Section: in-service 2nd Section: 2015 3rd Section: 2016
Colombo Katunayake Expressway	a) Developed section New Kelani Bridge - Katunayake: 25.8km b) Design speed : 80km and 100km c) Lanes : New Kelani Bridge - Peliyagoda : 6 Peliyagoda - Katunayake : 4	Opening schedule in-service
Northern Expressway	Feasibility study is in progress.	

Source: RDA

(2) Major Arterial Roads

Major arterial roads of the Western Province are shown in Table 3.5.2. According to Table 3.5.2, radial roads have already been developed to some extent, however these roads don't work well under the existing conditions because connections between each major arterial road are not sufficiently developed. Especially, this has become a serious issue outside of the suburbs around the CMC boundary due to low road network development. On the other hand, traffic demands on the existing roads are almost at capacity or exceed each capacity in CMC and around the CMC boundary, it has caused traffic congestion at each point.

In order to solve these problems, although some partial improvement plans such as the development of fly-overs, widening of existing roads and development new roads are planned by RDA, drastic improvement is difficult without a comprehensive planning policy including public transport such as BRT and railway, traffic control and management, and highway development.

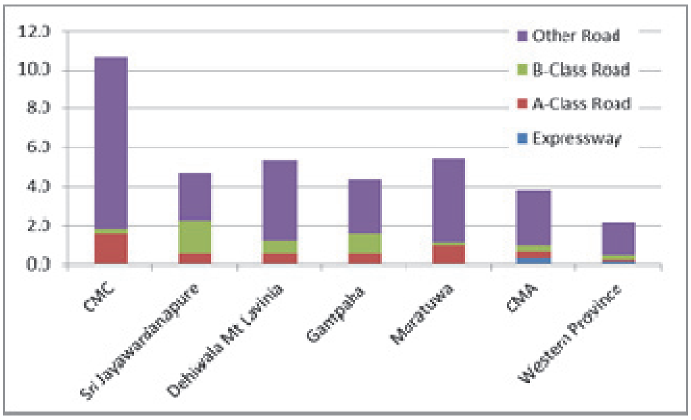
Table 3.5.2 Existing National Roads

Road Name	Road Section	Number of Lanes	Road Width*(m)	Length (km)**
Negombo Road (A3)		4	20	37.8
Kandy Road (A1)	1)Colombo – Kadawatha	4	18 - 20	13.7
	2) Kadawatha -	2	13	41.8
Low Level Road (B435)		2	10 - 12	24.5
Malabe Road (A0 – B240)	1) Colombo – Battaramulla	6	18 – 25	8.1
	2) Battaramulla – Malabe	2	12	27.8
High Level Road (A4)	1) Colombo – Kottawa	4	12 - 18	20.8
	2) Kottawa -	2	12	41.2
Horana Road (B84)		2	12	28.0
(g) Galle Road (A2)	1) Colombo – Ratmalana	4	18 - 25	13.0
	2) Ratmalana – Moratuwa	6	30	48.5
(h) Baseline Road		6	28 - 30	8.0

Source: RDA, Western Provincial Council Ministry of Road Development, CMC
Road width*: This value is not the width of ROW, but the existing cross section.
Length**: This value is calculated using the data provided by RDA and Google Earth. The Baseline Road includes a section which overlaps Kandy road.

3.5.3 Road Density in the Western Province

The road density of CMC is 10.7 % whereas those of the surrounding areas are in the range from 4% to 6%. The average of CMA is 3.8 % at present. Although the urbanised area has expanded outward from CMC, the road network development in these areas has not caught up with the suburbanisation.



Note: Unit is in percent. Road density is a value dividing total land area by road area.
CoMTrans land use survey results were utilised for Colombo Metropolitan Area (CMA). For the area outside of CMA, survey department road network data and road width data from the road development authority were utilised.
CMC stands for Colombo Municipal Council. Sri Jayawardanapure, Dehiwala and Mt. Lavinia, Gampaha and Moratuwa are average road density of municipal council area.

Figure 3.5.2 Road Density of Municipal Councils in CMA and the Western Province

Table 3.5.3 Road Density in Selected Cities

City/Area*	Data Year	Administrative Area (km^2)	Road area km^2	Road area % of Administrative Area
City of London	2005	3.2	0.8	25.0
CMC	2013	40.0	4.3	**10.7**
Inner New York	2010	59.0	15.2	25.7
Inner Tokyo	2009	75.0	16.2	21.6
City of Paris	1999	105.0	27.0	25.7
Inner Shanghai	2008	108.0	13.0	12.0
Inner Bangkok	2006	225.0	16.0	7.1
Taipei City	2008	272.0	20.9	7.7
Inner London	2005	310.0	56.5	18.3
Seoul City	2007	605.0	82.3	13.6
Tokyo 23	2010	622.0	101.2	16.3
Jakarta City	2007	656.0	48.0	7.3
New York City	2010	789.0	165.9	21.0
CMA	2013	996.0	37.4	**3.8**
Greater London	2005	1595.0	196.0	12.3

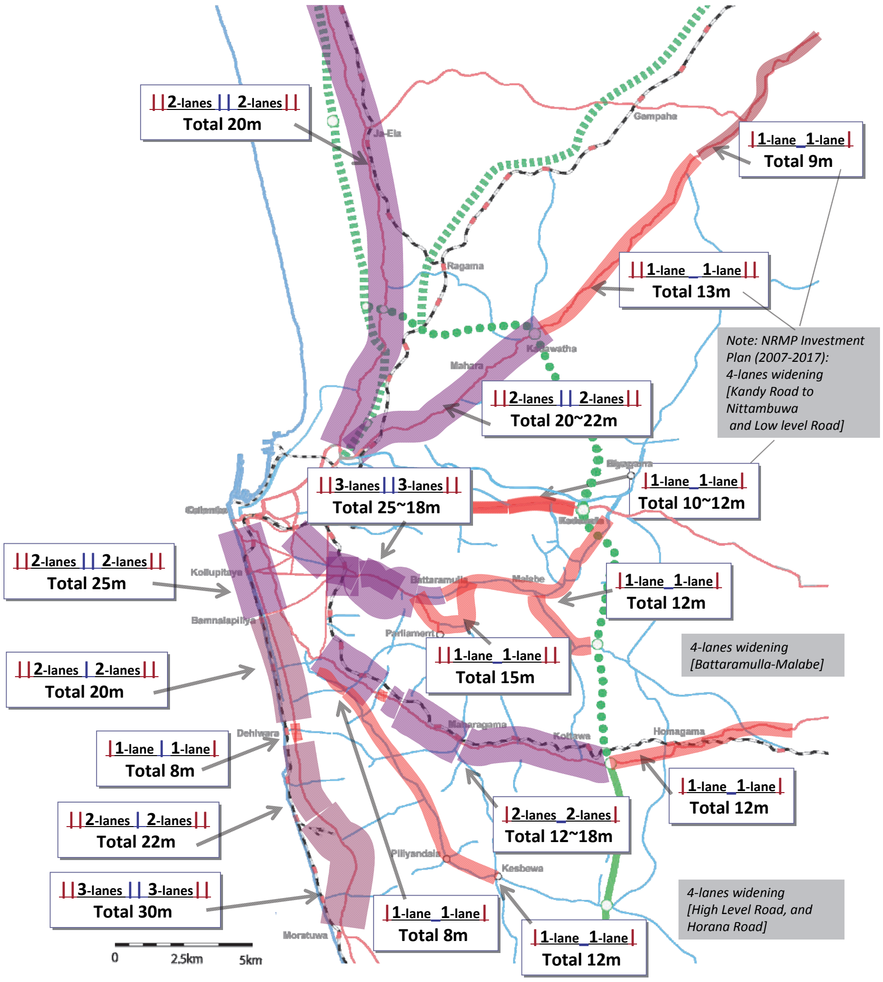
Source: Transport Development in Asian Megacities

CoMTrans Study Team, Land Use Survey

3.5.4 Road Traffic Capacity and Demand of Selected Corridors

The Study Team examined existing road widths and the number of lanes of each corridor. The general lane composition and widths are illustrated in Figure 3.5.3.

Along with the increase in the number of private vehicles in the Western Province, the number of private vehicles entering the Colombo Municipal Council (CMC) is clearly increasing over the past three decades. The annual average growth rate of the number of passengers entering CMC using a private mode of transport reached 4.2% during 1985 and 2013 according to traffic count survey results by Road Development Authority (1985) and the CoMTrans Screen Line Survey (2013). Approximately one million people are entering the CMC every day by private mode of transport.



Note: A flyover section indicates the number of lanes for flyover only and does not include at the number of lanes of the at-grade section.

Figure 3.5.3 Cross Section Composition and Road Width

3.5.5 Average Travel Speed on Road Network

In order to understand the level of traffic congestion, travel speed is a key indicator, and it helps us to find congested intersections and road sections.

Average travel speeds on the roads during morning peak hour of 7 – 8 a.m., afternoon school traffic hour of 1 – 2 p.m. and evening peak hour of 5 – 6 p.m. are illustrated in Figure 3.5.4, Figure 3.5.5 and Figure 3.5.6 respectively based on the survey results of the Travel Speed Survey (TSS). In the Study, the section with 20 km/hour or less travel speed is defined as congested considering the perception of drivers, travel speed survey results and international examples.

(1) Travel Speed of Morning Peak Hour (Inflow to City Centre)

In the morning peak hour from 7 to 8 am, travel speeds in CMC and its surrounding area are mostly less than 20 km per hour and some sections are observed at even less than 10 km per hour.

a) Maradana roundabout and Town Hall intersection are the most remarkable congested points in the city centre.

b) The traffic congestion is seen at many intersections on Baseline road intersecting with radial roads since major traffic flows go from the suburbs to the city centre in the morning and road traffic capacity is limited at the intersections.

c) The other congested points are the intersections where the roads merge with the arterial road in Battaramulla. This is caused by lack of east-west direction arterial roads in the suburban area.

d) Traffic congestion is seen at flyover sections such as Dehiwala flyover. Despite construction of the flyover, it is still congested because straight traffic volume is more than the one-lane traffic capacity on the flyover section.

(2) Travel Speed of Afternoon Peak Hour (School Traffic Hour)

Travel speeds of afternoon peak hour, 1 – 2 p.m., are superimposed with school location and the number of students in Figure 3.5.5. Traffic congestion is severe especially in the city centre where a number of schools are located. This is also fomented by business activities in the city centre.

a) Kularatne Mawatha between Maradana and Borella are heavily congested where there are many large schools such as Ananda College and Zahira College.

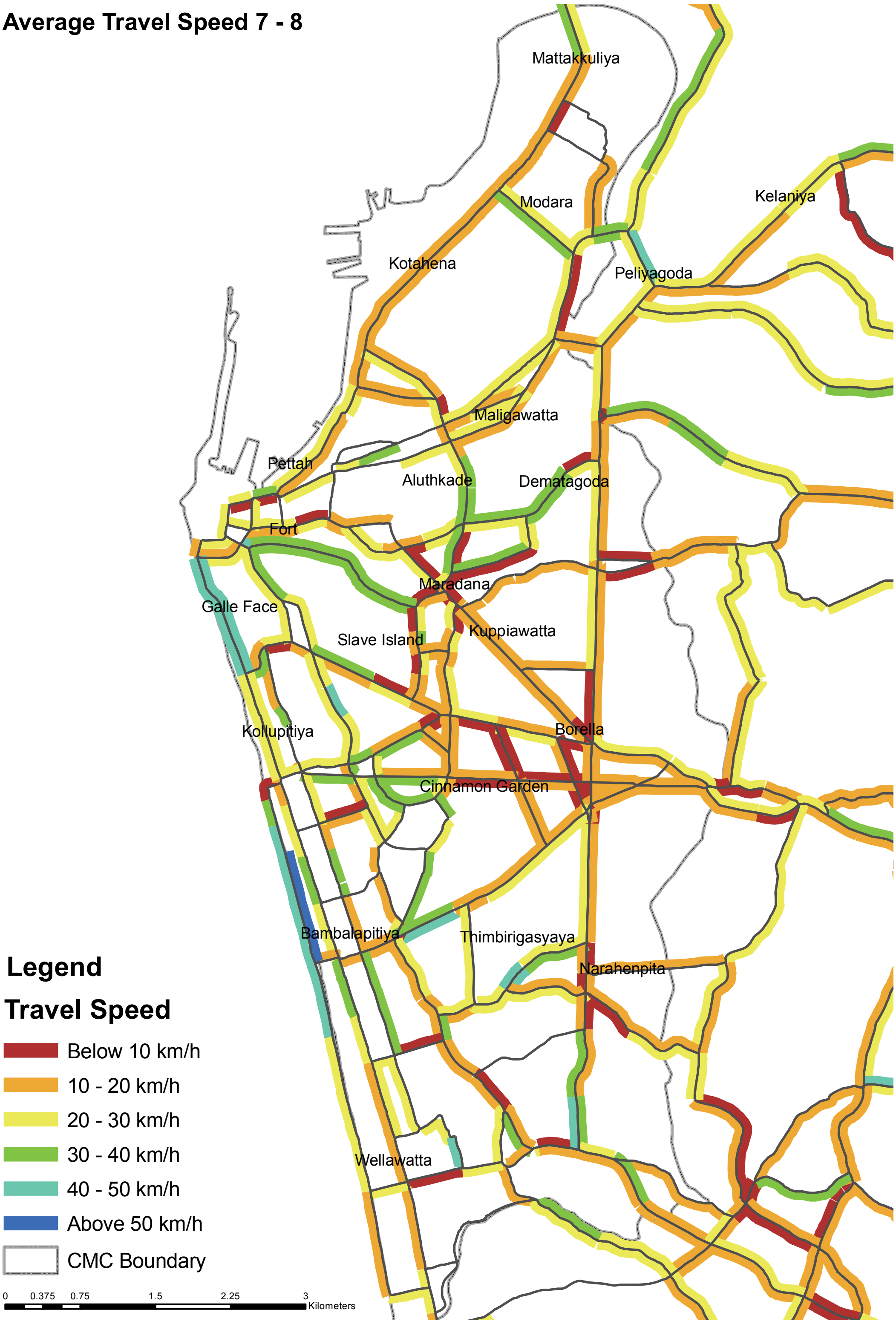
b) The southern part of Duplication Road (R. A. De Mel Mawatha), High Level Road and Armour Street are also congested where there are many schools.

(3) Travel Speed of Evening Peak Hour (Outflow from City Centre)

The area to the west of baseline road is heavily congested in the late afternoon from 5 to 6 pm. The traffic congestion is more severe than that in the morning period. In the city centre, many intersections and roundabouts are congested.

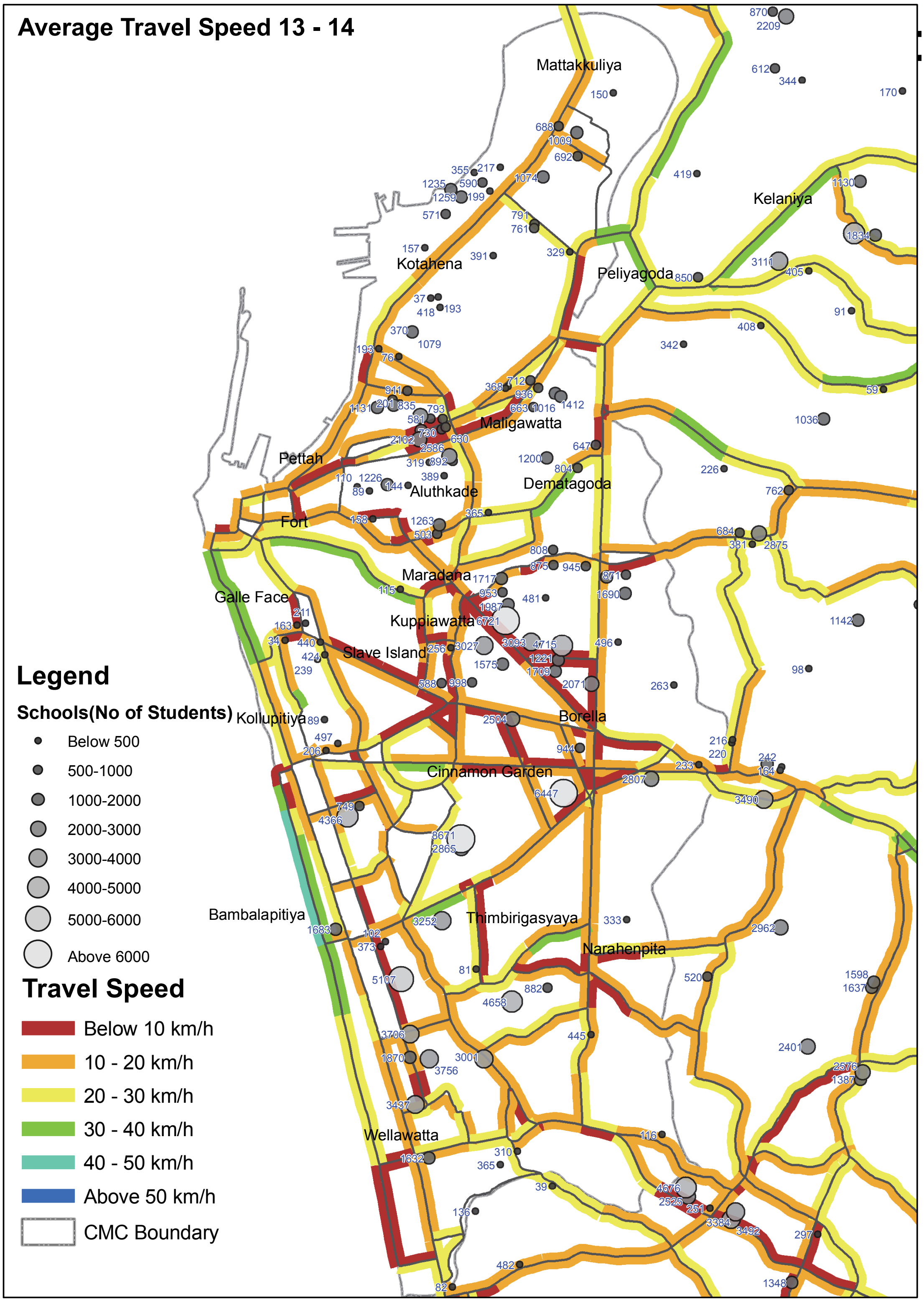
a) Maradana roundabout and the Town Hall intersection are congested in the late afternoon as well. At these intersections traffic flows come to this point from various directions and traffic volume often exceeds traffic capacity of the intersections.

b) Compared to the traffic congestion in the morning peak period, outbound directions are congested at many major intersections on Baseline road.



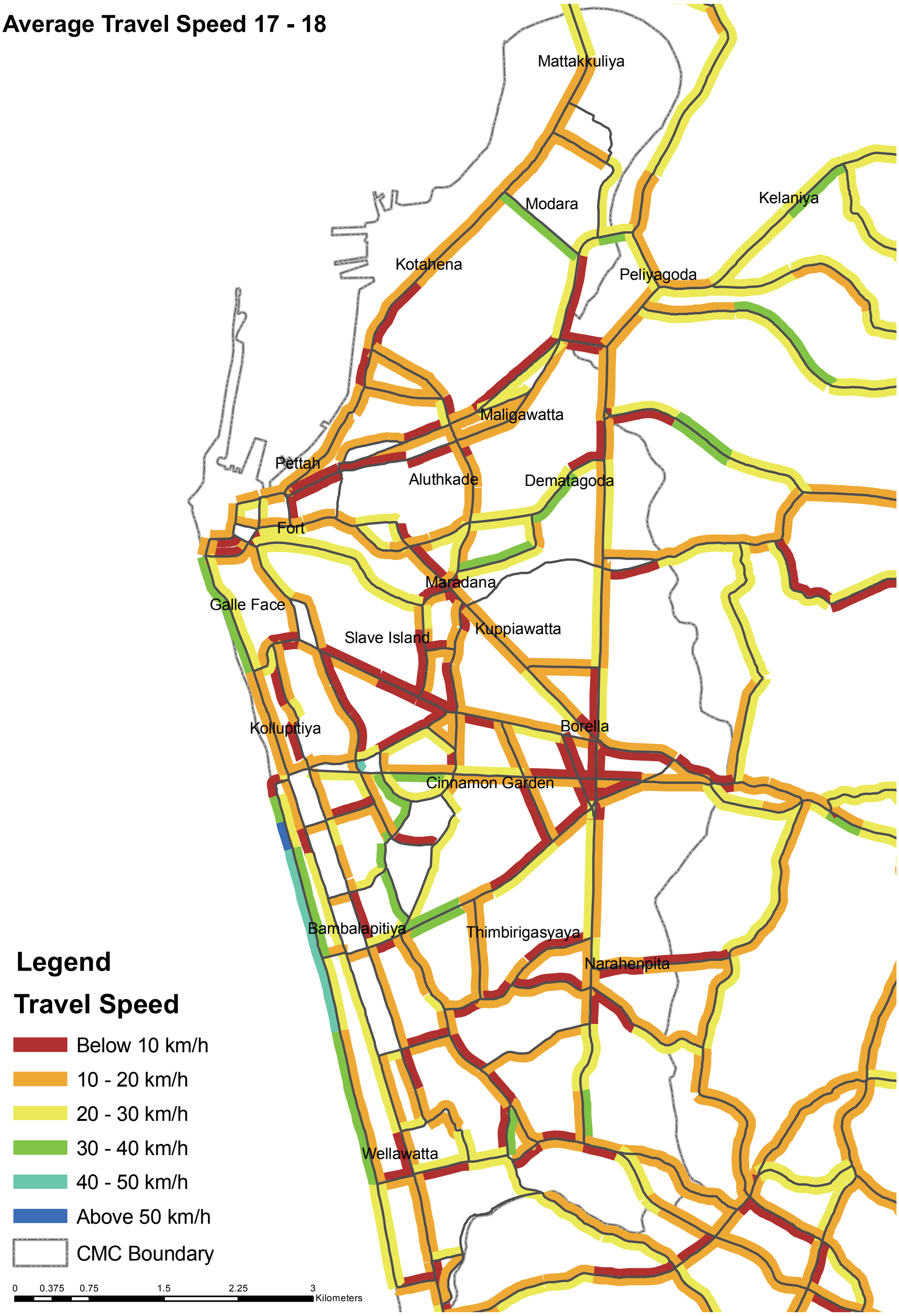
Source: CoMTrans Study Team

Figure 3.5.4 Travel Speed in CMC in the Morning Peak Hour



Source: CoMTrans Study Team

Figure 3.5.5 Travel Speed in CMC in the Afternoon Peak Hour



Source: CoMTrans Study Team

Figure 3.5.6 Travel Speed in CMC in the Evening Peak Hour

3.6 Traffic Control and Management

Traffic control and management can be regarded as an essential countermeasure to tackle the traffic congestion in the metropolitan area. At present many intersections exist with various geometrical and roadside conditions. Especially in urban areas improvement of layout of intersections as well as enhancement of the signal control should be carefully examined to increase its traffic capacity and to enhance traffic safety at the intersections.

3.6.1 Traffic Signal System

(1) Traffic Signals

At many intersections in CMC, traffic demand exceeds traffic capacity of the intersections in particular in peak hours. The majority of traffic signals at these intersections are stand alone; therefore, the signals do not coordinate with each other. The existing signals apply a pattern control unit for the day of week and for time of day; therefore, the existing signal system does not provide efficient traffic control.

Different types of signal control systems are installed at intersections managed by RDA and CMC. These systems are currently manufactured by domestic system and equipment companies. Even though countdown display devices are installed at some intersections, current controllers are basically multi-pattern controllers with different phasing parameters based on the time of day. Traffic-actuated signal systems with vehicle detectors which adjust signal timing to optimise throughput have not been introduced yet. In the past, coordinated signal operation was installed along Malabe Road (A0), centring at Senayayaka intersection where the Malabe road intersects with Baseline road. The system does not work at present due to poor maintenance; hence the signals are being used as a standalone system. Police officers switch off the signals and control traffic by hand signals at signalised intersections when congested.

(2) Signals for Pedestrian Crossing

A few signals for pedestrian crossing have been installed in the Colombo metropolitan area. Some pedestrian signals have been installed on Galle Road and Baseline Road.

Source: CoMTrans Study Team

Figure 3.6.1 Traffic Control by Hand Signal

Source: CoMTrans Study Team

Figure 3.6.2 Signal Switch

Source: CoMTrans Study Team

Figure 3.6.3 Pedestrian Signals

Source: CoMTrans Study Team

Figure 3.6.4 Countdown Display

(3) Roundabouts

Symbolic monuments (Buddha statues, big trees) have been placed in the centre of many roundabouts. Under a certain level of traffic demand, roundabouts are known as an efficient intersection solution because of non-stop operation that maintains higher throughputs based on the first-come-first-in principle. However, once traffic volume exceeds a certain level and there is not enough space to accommodate enlargement of the roundabout layout and circulating lanes to secure room for inbound traffic flows and so congestion will occur. In such cases a roundabout should be converted to a signal controlled intersection. Basically, a signal controlled intersection is more compact than a roundabout, so that it could provide more space for pedestrians and vehicular traffic flows. Current roundabouts with heavy traffic congestion shall be examined carefully to determine whether they will remain as roundabouts or be converted to signal controlled intersections in view of current traffic conditions and projected traffic demand.

Traffic signals have been installed from the 1980's and the most of the current traffic signals were installed in the 1990's at various intersections. Figure 3.6.8 shows the locations in which traffic signal systems have been installed and roundabouts in CMC and its surrounding area.

Source: CoMTrans Study Team

Figure 3.6.5 Roundabout at Panadura

Source: CoMTrans Study Team

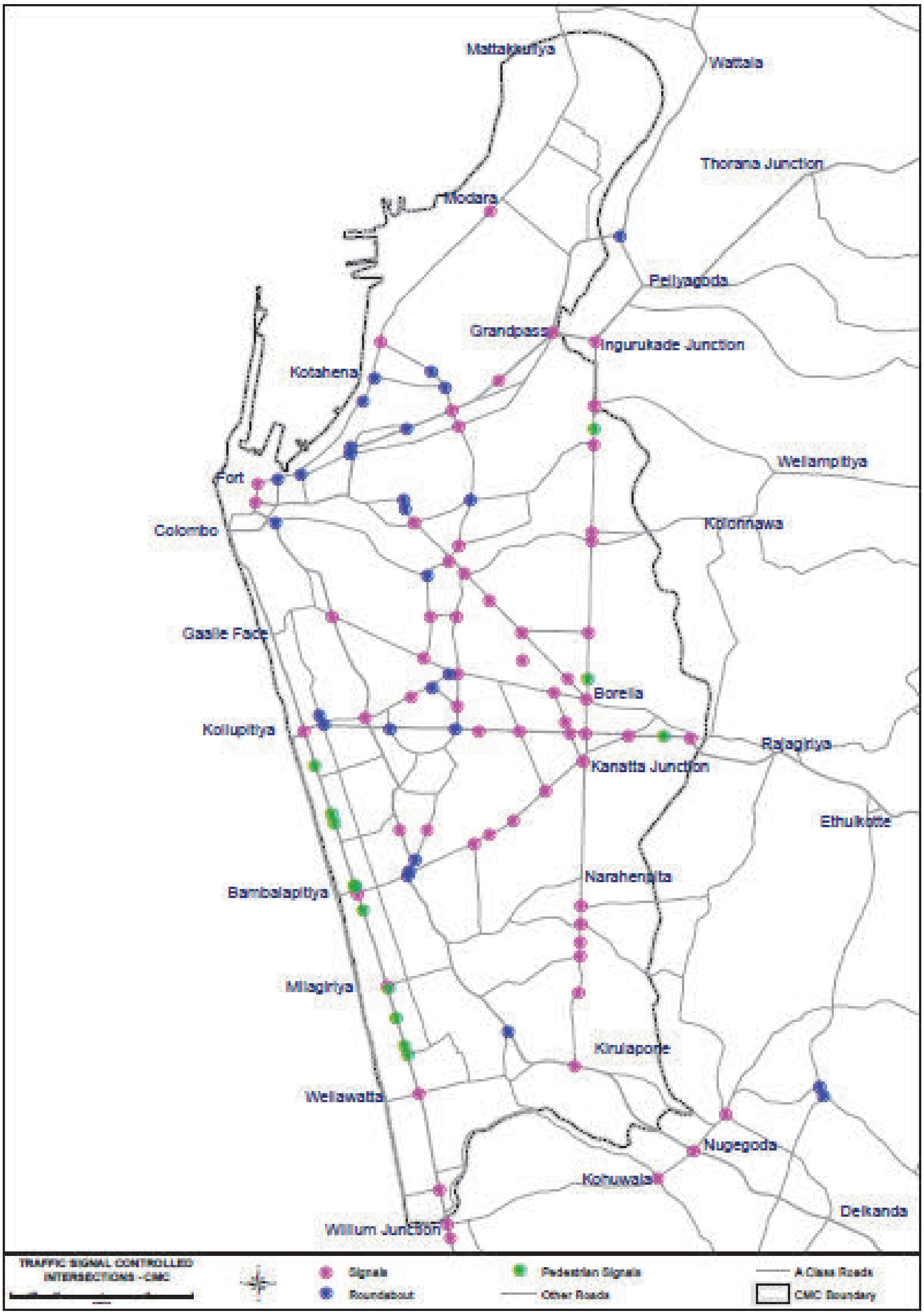
Figure 3.6.6 Roundabout at the Intersection of Main St.

Source: CoMTrans Study Team

Figure 3.6.7 Roundabout at Town Hall

(4) Non-Signalised Intersections

There is limited number of signalised intersection outside of CMC. Exceptions are adjacent area of CMC such as Peliyagoda, Nugegoda and Dehiwala as well as suburban centres such as Moratuwa and Negombo. Roundabouts have been installed in many crossings. This is satisfactory at a crossing with little traffic. However, it has become a dangerous place where traffic volume exceeds a certain level because it is necessary to find a short inter-vehicle space in order to flow into the intersection.



Source: RDA,CMC, CoMTrans Study Team

Figure 3.6.8 Traffic Signal and Roundabouts in CMC

3.6.2 Traffic Surveillance System and Traffic Information System

(1) Traffic Monitoring System (CCTV)

The CCTV Division of the Traffic Police undertakes surveillance for security and for traffic monitoring. The CCTV centre is located on the 6th floor of the Central Welfare Building in the traffic police office. A total of 128 cameras at 27 locations have been installed at major intersections. The system started its operation in March 2009. The system and equipment were made in Singapore. The system is utilised for traffic monitoring but it is not fully utilised for managing traffic.

The Traffic Police disseminates traffic information to radio companies based on traffic conditions collected by patrol teams on-site and CCTV cameras. Some other media tools, such as twitter based disseminations, are in use on a voluntary basis.

(2) Parking Management

Roadside parking is allowed on roads with “P” marks which are managed by RDA, the Western Provincial Council Ministry of Road Development, CMC and local authorities. In case of a violation, a fine of Rs. 500 is imposed. The fine is in fact not very expensive so it is doubtful that it is effective for controlling parking violations. In CMC, fifteen bicycles and five radio cars monitor parking violations. Furthermore, the traffic police are considering the implementation of a driving offence point deduction system as a means to reinforce penalties against violators. CMC is planning to prepare more roadside parking spaces and RDA plans car parking facilities which will be distributed throughout CMC. Recently private parking companies have started business and they are also providing additional parking spaces.

3.7 Road Safety

The number of people injured in traffic accidents has continuously increased in the last five years in the Western Province. Especially, the number of pedestrians injured and killed in traffic accidents is significant compared to other areas in Sri Lanka. If no action is taken, a much more severe situation will develop in the near future.

To reduce traffic accidents, it is necessary to make an effort to decrease both victims and responsible offenders. Therefore, in this section, recent trends and factors of traffic accidents are analysed and discussed from both the victims and offenders side. And based on the analysis, measures to reduce traffic accidents are suggested in the latter part of this section. The analysis is supported by the traffic accident database which is provided by the traffic police.

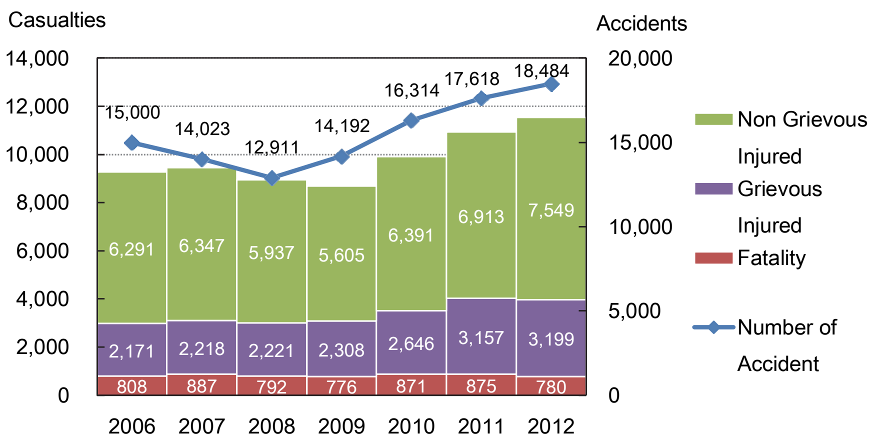
3.7.1 Overview of recent trends in the Western Province

Number of Accidents and Injured/Fatalities

Figure 3.7.1 shows the number of accidents and injured/fatalities in the Western Province. The total number of traffic accidents continuously increased from 2008 to 2012, and the growth rate is 43% in the Western province.

The number of fatalities has not changed much for the last seven years. On the other hand, the number of grievously injured persons continuously increased and the increase rate in the seven years is 47%. Especially, the growth between 2009 and 2012 is remarkable.

With regard to Table 3.7.1, the number of grievously injured per 100,000 people has also increased at the rate of 41%. The number of fatalities per 100,000 registered vehicles has decreased, and that of grievously injured remains roughly flat. The same kind of graph and table for the whole of Sri Lanka is in the Appendix.



Source: CoMTrans Study Team

Figure 3.7.1 Number of Accidents and Injured in the Western Province

Table 3.7.1 Number of Injured/Fatalities per Population and Registered Vehicles

Western Province						
Year	Population	Fatality per 100,000 population	Grievous Injury per 100,000 population	Registered Vehicles	Fatalities per 100,000 vehicles	Grievous Injury per 100,000 vehicles
2006	5,581,430	14	39	876,109	92	248
2007	5,621,477	16	39	967,022	92	229
2008	5,661,523	14	39	972,787	81	228
2009	5,701,570	14	40	969,720	80	238
2010	5,741,617	15	46	1,075,069	81	246
2011	5,781,663	15	55	1,205,708	73	262
2012	5,821,710	13	55	1,279,616	61	250

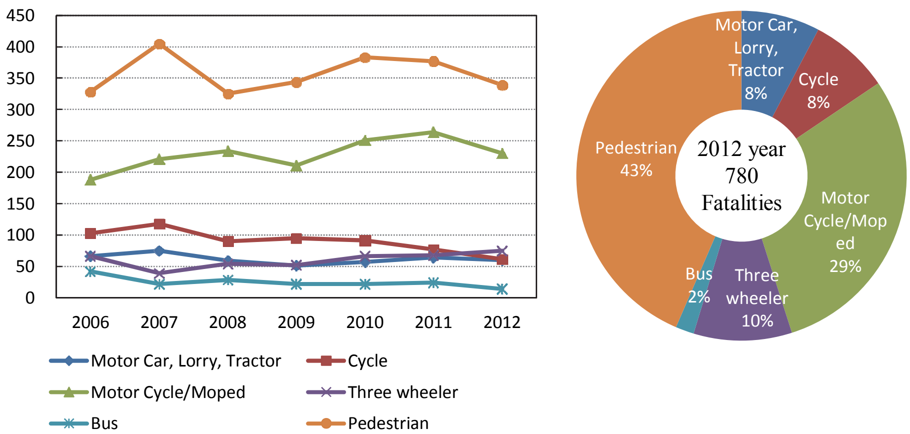
Source: Population from 2006 to 2011 is the liner interpolation of Census population in 2002 and 2012.

<u>Number of Fatalities by Transport Mode</u>

Figure 3.7.2 shows the number of fatalities by transport mode. Generally, the largest part of the fatalities in traffic accidents are pedestrians and motorcycles/mopeds.

In the Western Province, pedestrians have constituted the highest fatality rate for the last seven years. The second highest group is motorcycles/mopeds and the number has gradually increased. In 2012, total fatality was 780 and up to 43% of those fatalities are pedestrians.

Comparing with the whole of Sri Lanka (pedestrian ratio: 31%), which is in the Appendix, it is clear that the number of pedestrian deaths is significant in the Western Province. The number of pedestrian deaths in the Western Province is almost half of that in all of Sri Lanka. The number of deaths in the other mode in the Western Province is only one third of that in all of Sri Lanka.

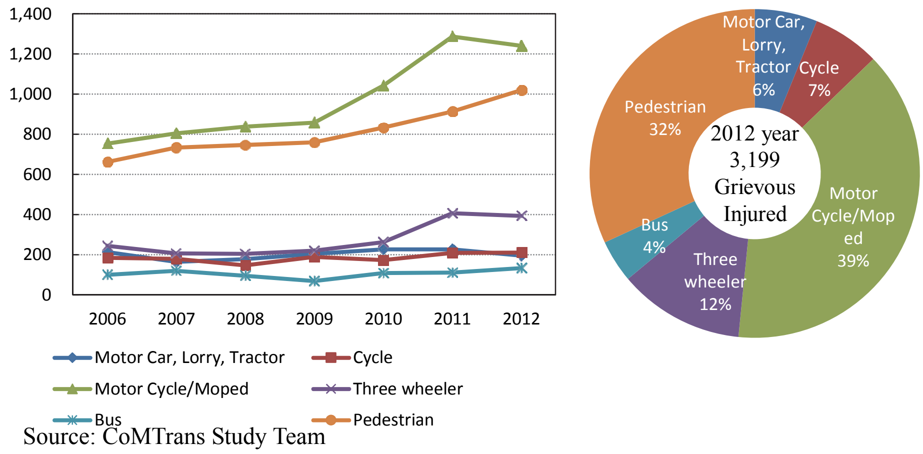


Source: CoMTrans Study Team

Figure 3.7.2 Fatalities by Transport Mode in the Western Province

Number of Grievously Injured by Transport Mode

As shown in Figure 3.7.3, pedestrians and motorcycles/mopeds are remarkable and growing in the number of grievously injured. They combine to more than 70% of all those grievously injured in 2012. Compared to the values in 2006, grievously injured pedestrians increased 54% and motorcycles/mopeds increased 65%. Besides, the number of three wheelers involved in accidents resulting in grievous injury also increased 62% in the last seven years.



Source: CoMTrans Study Team

Figure 3.7.3 Grievously Injured by Transport Mode in Western Province

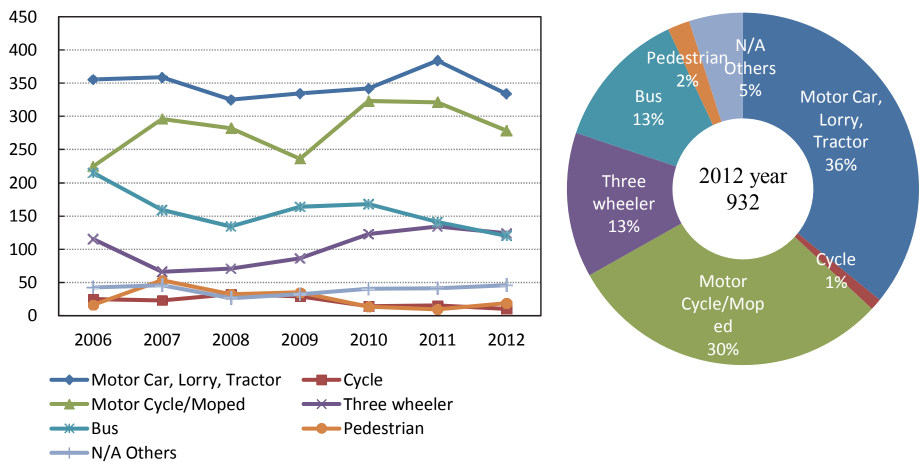
Responsible Offender for Fatal Accidents by Transport Mode

"Responsible for Fatal Accidents" is defined as the driver, rider or pedestrian who is at fault for a fatal accident. Therefore, sometimes the deceased is responsible for the fatal accident. Indeed, 34% of the people responsible for a fatal accident were the fatality.

Figure 3.7.4 shows the offenders in fatal accidents. Motor cars, lorries and tractors amount to 36%, which is broken down into roughly motor cars 8%; dual purpose vehicles 14%; lorries 13%; and tractors 1%, and the number has hovered at around the 350 veh/year level for the last seven years. Motorcycles/mopeds is the second largest group with 30%, and it has been in an increasing trend.

The number of buses involved in fatal accidents has decreased to almost half in the last seven years. However, as shown in the upper half of Table 3.7.2, the responsible bus driver per registered vehicle is more than 20 times than that of others. Of course, bus drivers are at a high risk while they drive long distances. However, the number of responsible per vehicle km for buses is still triple that of all other vehicle types.

The same kinds of graphs for the whole of Sri Lanka are shown in the Appendix, and their trends are similar to that of the Western Province.



Source: CoMTrans Study Team

Figure 3.7.4 Responsible for Fatal Accident in the Western Province

Table 3.7.2 Responsible by Registered Vehicle and Vehicle Kilometres in the Western Province

Year 2011	Registered vehicles	Responsible for Fatal Accidents	Responsible per 1,000 registered vehicles
Omnibuses	7,778	141	18.13
Private Cars	364,197	237	0.65
Goods Transport Vehicles	107,244	147	1.37
Motor Cycles	510,509	321	0.63
Three wheelers	213,177	134	0.63
All vehicle types	1,202,905	980	0.81
Year 2011	Vehicle km Mn.	Responsible for Fatal Accidents	Responsible per Mn. Vehicle km
Bus	362	141	0.39
All vehicle types	8,160	1,045	0.13

Sources : Registered vehicles from Divisional Secretariats;

Vehicle km of Private and Public Bus from Central Bank of Sri Lanka, National Transport Commission

(http://www.cbsl.gov.lk/pics_n_docs/10_pub/_docs/statistics/other/econ_&_ss_2013_e.pdf) page 124.

Responsible for Fatal Accidents and Vehicle km of all vehicle type from The Study Team

3.7.2 Comparison with Other Countries

The following table shows the traffic accident data of western pacific and south-east Asian countries (only countries which have a population of more than a million). The number of road traffic deaths per population and per registered vehicle is comparatively not so high in Sri Lanka, 11^{th} and 10^{th} out of the sixteen countries respectively. On the other hand, the ratio of pedestrian deaths out of all traffic accident fatalities is ranked in the top four. Additionally, the number of pedestrian deaths per population and per registered vehicle is ranked 6^{th} for each.

Table 3.7.3 Comparison with Other Countries

Country	Region	Number of registered vehicles (1,000)	Population (1,000)	Year	Estimated number of road traffic deaths	Estimated road traffic death rate (per 100 000 population)	Estimated road traffic death rate (per 10 000 registered vehicle)	Year	Pedestrian deaths	Number of registered vehicle per 1,000 population	Estimated pedestrian death rate (per 100 000 population)	Estimated pedestrian death rate (per 100 000 registered vehicle)	Pedestrians rate in fatal traffic accident	Year	Gross national income per capita (Atlas method)	Year
Bangladesh	S	1,625	148,692	2010	17,289	11.6	106.4	2010	7,054	11	4.7	0.7	40.8%	2009	700	2010
Republic of Korea	W	19,711	48,184	2010	6,784	14.1	3.4	2010	2,564	409	5.3	2.1	37.8%	2010	19,720	2010
Japan	W	89,871	126,536	2010	6,625	5.2	0.7	2010	2,292	710	1.8	0.8	34.6%	2010	42,050	2010
Sri Lanka	S	4,877	20,328	2012	2,443	12.0	5.0	2012	762	240	3.7	4.9	31.2%	2012	2,260	2010
Singapore	W	946	5,086	2010	259	5.1	2.7	2010	74	186	1.5	19.7	28.5%	2010	39,410	2010
Myanmar	S	2,327	47,963	2011	7,177	15	30.8	2010	1,902	49	4.0	2.1	26.5%	2010	0	2010
Mongolia	W	366	2,756	2010	491	17.8	13.4	2010	123	133	4.5	36.3	25.1%	2010	1,870	2010
China	W	207,061	1,348,932	2010	275,983	20.5	13.3	2010	68,996	154	5.1	0.1	25.0%	2010	4,240	2010
Indonesia	S	72,693	239,871	2010	42,434	17.7	5.8	2010	8,954	303	3.7	0.4	21.1%	2010	2,500	2010
Australia	W	16,061	22,268	2010	1,363	6.1	0.8	2010	174	721	0.8	4.5	12.8%	2010	46,200	2010
Cambodia	W	1,653	14,138	2010	2,431	17.2	14.7	2010	292	117	2.1	7.1	12.0%	2010	750	2010
New Zealand	W	3,227	4,368	2010	398	9.1	1.2	2010	37	739	0.8	22.9	9.3%	2010	29,350	2010
Malaysia	W	20,189	28,401	2010	7,085	25	3.5	2010	645	711	2.3	3.5	9.1%	2010	7,760	2010
India	S	114,952	1,224,614	2009	231,027	18.9	20.1	2010	20,099	94	1.6	0.1	8.7%	2010	1,260	2010
Thailand	S	28,485	69,122	2010	26,312	38.1	9.2	2010	2,052	412	3.0	1.4	7.8%	2010	4,150	2010
Lao People's Democratic Republic	W	1,009	6,201	2010	1,266	20.4	12.5	2010	80	163	1.3	16.1	6.3%	2010	1,010	2010

Source: WHO, *S: South-East Asia, *W: Western Pacific

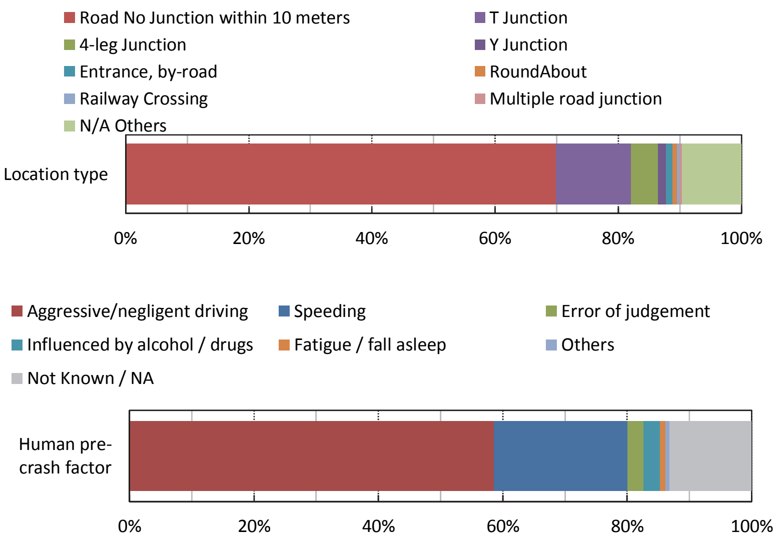
3.7.3 Location type and Collision type top 30

Figure 3.7.5 shows location type and human factor of fatal accidents in the Western Province between 2006 and 2012. About 70 percent of the accidents happened at a cross roads intersection. The second largest group is T-junctions, and it covers 12%. For the human factor, aggressive/negligent driving and speeding covers more than 80% of all factors.

Detailed collision types are shown in Table 3.7.4. The collision types are categorised into 88 types in the original database, but only the top 30 are shown here. Cells shaded with blue colour means pedestrian related accidents, and twelve in top the 30 types are related to pedestrians. Most pedestrians are killed while crossing a road (no. 1,3,6,8,12,14,etc.), and no.1 and 3 together amount to more than 1,000 fatalities.

Other than pedestrians, “Other head on crash”, “In conjunction with overtaking” and “Rear-end crash” are remarkable. They are related to aggressive/negligent driving and speeding in Figure 3.7.5. On main corridors, even when there is only one lane each way, drivers try to overtake others by using the opposite lane. That should be one reason why “Other head on crash” and “In conjunction with overtaking” shows such a large value.

Effective countermeasures: improvement of pedestrian crossings and sidewalks, Traffic lights, Centre Medians, Development of fast lane and no-passing zone, Education, Setup speed traps



Source: CoMTrans Study Team

Figure 3.7.5 Location type and Crash type of Fatal Accidents

Table 3.7.4 Detailed Collision type of Fatal Accidents Top 30

	Description	Fatality	
1	With pedestrian entering the road section from the left sidewalk, shoulder etc.	668	11.5%
2	Other head on crash	630	10.9%
3	With pedestrian entering the road section from the right sidewalk, shoulder etc.	369	6.4%
4	In conjunction with overtaking	306	5.3%
5	Rear-end crash hitting a vehicle in position for going straight ahead	304	5.3%
6	With pedestrian staying on the road	255	4.4%
7	Other crashes with pedestrian	237	4.1%
8	With pedestrian entering the road from behind parked car to the left	209	3.6%
9	Crash between cyclist and motor vehicle both going straight ahead in the same directions on the same road without turning off	184	3.2%
10	With pedestrian walking on the left hand side of the road	156	2.7%
11	Vehicle travelling straight ahead leaving the road to the left	148	2.6%
12	With pedestrian entering the road from the left prior to intersection	143	2.5%
13	Vehicles intersecting without turning off	100	1.7%
14	With pedestrian entering the road from behind parked car to the right	100	1.7%
15	Other crashes with fixed object	100	1.7%
16	Other approaching crashes	97	1.7%
17	Crash between cyclist and motor vehicle going straight ahead in opposite directions on the same road without turning off	92	1.6%
18	Other crashes with cyclists	77	1.3%
19	Vehicle travelling straight ahead leaving the road to the right	76	1.3%
20	With pedestrian entering the road from the left after an intersection	75	1.3%
21	Vehicle turning over and remains on the road	73	1.3%
22	With passenger falling off vehicle	71	1.2%
23	Overtaking on the right	67	1.2%
24	With pedestrian entering the road from the right prior to intersection	58	1.0%
25	With pedestrian entering the road from the right after an intersection	55	1.0%
26	With pedestrian walking on the right hand side of the road	54	0.9%
27	Other single crashes	52	0.9%
28	Crash between cyclist and motor vehicle both going in the same direction on the same road and at least one of them turning off in a T, Y, + junction or roundabout	51	0.9%
29	Between vehicle and train	47	0.8%
30	Turning to the right ahead of vehicle going straight ahead in the opposite direction	45	0.8%
	Abbreviations		
	Total	**5789**	

Source: CoMTrans Study Team

3.7.4 Road Safety for Pedestrians

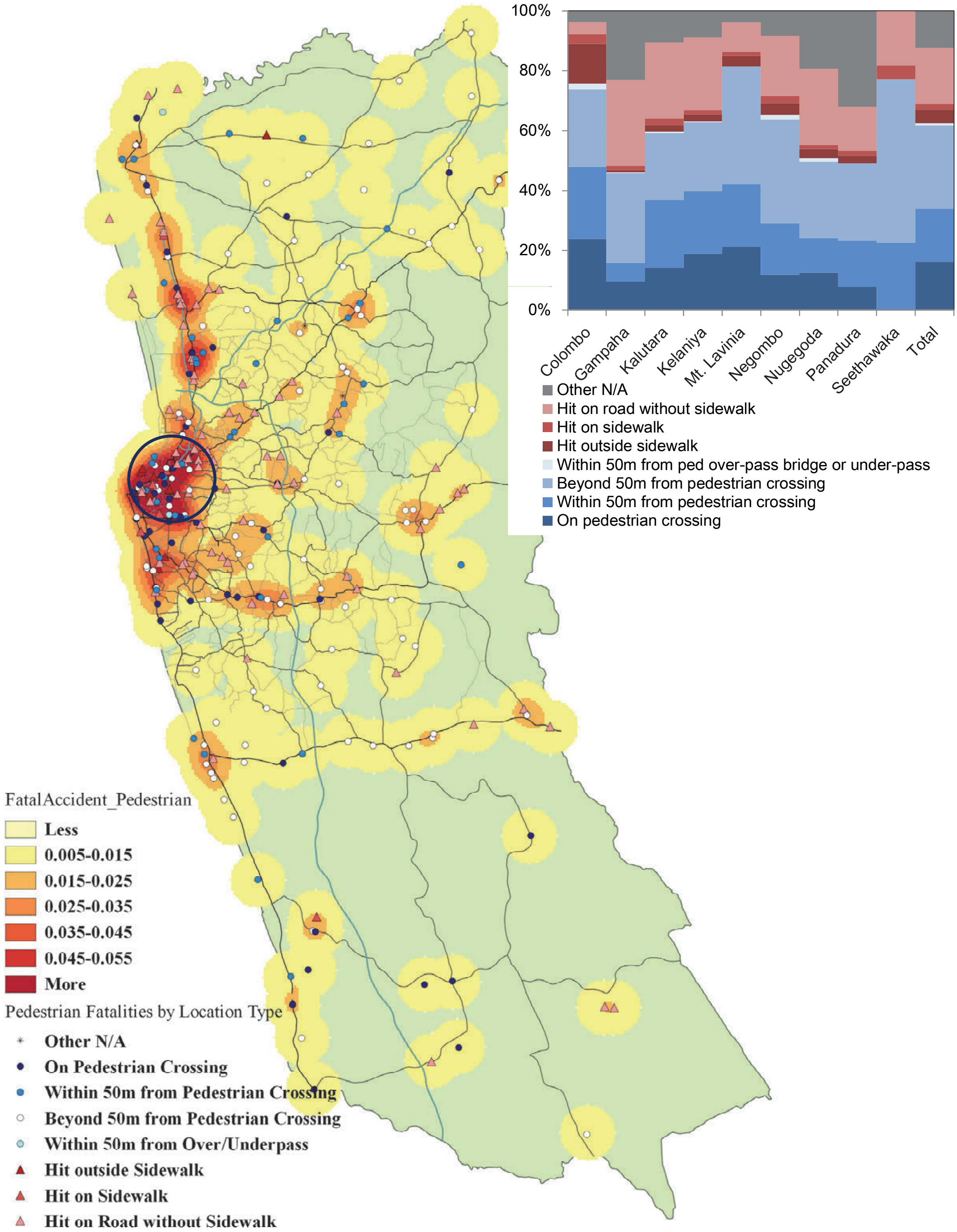
Figure 3.7.6 shows the locations of pedestrian fatal accidents in the Western Province in 2012. The heat map is displayed using a kernel density function with radius parameter of 2.5 km.

The accident location points are concentrated around Colombo, Ja-Ela, Wattala, Dehiwala and Panadura. Especially, 24% of the pedestrian fatal accidents are focused in the circle with a radius of 5 km around Colombo, even though the area of the circle is only 2% of the area of the Western Province.

Location type of accident differs according to area. For example, in suburban areas of Colombo and on the road to Negombo, “Hit on road without sidewalk” is significant. “Beyond 50m from pedestrian crossing” is distributed evenly across the north half of the Western Province, especially near junctions or turns.

As shown in the graph, more than half of the accidents occur during crossing. In many divisions, “Beyond 50m from pedestrian crossing” is the highest factor. In Colombo, Kelaniya and Mt.Lavinia, “Within 50m from Pedestrian Crossing” and “On Pedestrian Crossing” shows a measurable value. In Gampaha, Kalutara, Kelaniya and Negombo, fatal accidents which seemed to be caused by lack of a sidewalk covers 20 to 30%. In Colombo, more than 10% of accidents occurred under the situation that a pedestrian was walking outside of a sidewalk even though there was sidewalk.

Effective countermeasures: improvement of pedestrian crossings and sidewalks in the appropriate locations, installation of road traffic signs warning of pedestrian crossings, installation of traffic lights at intersections in the city area



Source: CoMTrans Study Team

Figure 3.7.6 Location and Heat map of Pedestrian Fatal Accidents in the Western Province

3.8 Urban Transport Problems and Planning Issues

The current status of urban transport has been discussed in the previous Sections. In this section, overall urban transport problems have been dealt with to identify the urban transport planning issues.

3.8.1 Problems and Issues of the Railways

(1) Insufficient Linkage of the Railway Network

The Main Line, the Coastal Line and the Kelani Valley Line go out from Colombo and the Puttalam Line branches from Ragama on the Main Line. All the lines converge on the Fort area but there are no mass transport systems connecting laterally. That will force the passengers to travel a long way to get to their destinations. Some metropolitan areas in developed and developing countries have succeeded in developing an extensive railway network with high service levels. This contributes to promote the use of public transport and to alleviate traffic congestion. While there is a radial railway network in the Western Province, the increase in service level of the existing railway lines and connection of these radial lines with high service level public transport is essential. A well connected railway network is required for the convenience of the passengers.

(2) Lack of Feeder Service for Railways

The circumstances in and around the stations are not sufficient for other transport modes to provide feeder service such as station plazas, bus stands and park and ride facilities. These facilities are not located close to the railway station in some cases. Railway stations should be connected with other modes of transport for easy transfer to the other transport modes.

(3) Insufficient Integration among Public Transport

Railways should not compete with other public transport modes but should cooperate with them. Railways only provide service from station to station. To use the railway, passengers have to come to the station somehow. Bus or other road transport mode will provide feeder service to the railway. However, railways are currently competing with buses running parallel to the railway line such as Galle Road.

In terms of time tables of public transport, railways and buses servicing to railway stations functioning as feeder service are generally independent in the Western Province. If bus and railway frequency is significantly high, there would be minimum waiting time at transfer stations. Coordinated time tables of the railways and buses will be significantly important in suburban railway stations where frequency of railways and buses are relatively low.

(4) Lack of Public Transport Master Plan for the CMA

A number of organisations are involved in planning, implementation and operation of public transport of the Colombo Metropolitan Area such as Ministry of Transport, Ministry of Private Transport Services, Sri Lanka Transport Board (SLTB), Sri Lanka Railways (SLR), Department of Motor Traffic (DMT), National Transport Commission (NTC), Western Province Road and

Passenger Transport Authority (WPRPTA), and local authorities. Coordination with road sector organisations such as the Ministry of Highways, Ports and Shipping and the Road Development Authority (RDA) is also essential as road-based public transport use roads. However, there is no master plan for urban public transport for Colombo Metropolitan Area (CMA). In addition to sector-based or organisation-based plans, a comprehensive master plan to integrate all public transport is also essential to plan, implement and operate public transport in a coordinated and integrated manner.

(5) Necessity to Provide Sidewalks for the Access Roads to Railway Stations

In urbanised areas, a number of passengers walk to railway stations. According to experiences in many countries, the walking distance from a railway station can reach 500 to 800 metres. A good walking environment around a railway station is also essential to increase railway passengers. However, there are only a limited number of railway stations which have a sidewalk network.

(6) No Public Transport Fare Integration

The current fare system of railways is independent from other public transport modes such as buses. Thus, passengers have to pay a fare every time they transfer between public transport modes. There is no incentive for transfer passengers such as discount fares for feeder bus services.

(7) Lack of Public Transport Information

Information on railway transport as well as connections with other modes of transport is not sufficiently provided in Sri Lanka. Although the railway time table is available on the internet, the real time information such as the delay of trains is not accurate. Even at railway stations, bus routes departing from the station are not available.

(8) Lack of Railway Access to the International Airport

Railways can also provide feeder service to the International Airport. The Puttalam line runs close to the airport but passenger service is not provided.

(9) Slow Operational Speed of Trains

As shown in Table 3.2.1 the average speed is less than 30 km/h which is relatively slow compared to commuter railways in other countries. For instance, ordinary trains of private railways in Tokyo is in the range of 40 – 45 km/hour and that of express trains are 50 – 60 km/h according to Morichi (2005). Other typical urban heavy railway examples in the world show the range of 40 – 50 km/hour (Gwilliam, 2002).

Gwilliam, K. (2002) “Cities on the move – a World Bank urban transport strategy review”, The World Bank, pp. 113.

Morichi S. (2005) “Long term strategy for Transport System in Asian megacities” Journal of Eastern Asia Society for Transport Studies. Volume 6, pp. 1-22.

(10) Less Comfort on the Train

Most trains are not air-conditioned except for the upper class cars of express trains. This is not attractive to passengers and they might choose another mode of transport.

(11) Deteriorated Rolling Stock, Track and Signalling Systems

Of the total rolling stock, the availability of functional locomotives is about 70% and that of DMUs about 75%. It can be said that more than half of the rolling stock are aged or not available. DMUs and lower class passenger coaches are not air-conditioned. Trains are running without closing the doors to intake air for cooling. This is very dangerous for the passengers. In modern railway systems trains cannot start when a door is open and the doors cannot open when the train is running. Renewal and modernisation of the rolling stock is urgently required.

As explained in Section 3.4, railway tracks are deteriorated and in a dangerous condition. An important point is to build safe tracks with minimum irregularities by replacing railroad materials including rails and fasteners and then maintaining ballast in good condition to counteract age-based deterioration and lack of maintenance.

The Signalling System has deteriorated and it causes delays and the cancellation of trains occasionally.

(12) Insufficient Line Capacity

The tracks of Sri Lanka Railways are installed in a way that they are radiating from Colombo, the capital city of Sri Lanka. Therefore, many trains gather near Colombo Fort and Maradana during morning and evening rush hours. Thus, triple tracks and quadruple tracks are already used in the Main Line.

(13) Insufficient Expenditure for Maintenance

Distribution of recurrent expenses of Sri Lanka Railway in Year 2010 indicates labour cost accounts for almost three quarters of the total cost and fuel cost follows. Material cost is only 0.5% and this is extremely small. Internationally, in most systems it will cost 5 to 10 % for procuring spare parts or replacing the systems. It is deemed that maintenance of the system is neglected or postponed.

Higher efficiency in the use of labour and energy is required to reduce these costs and more allocation for maintenance cost is required.

(14) Low Level of Service of Kelani Valley Line

The Kelani Valley Line runs along High Level Road. It is located in highly populated areas and reaches Fort station. However, only ten trains a day are operated in each direction. Trains going to Fort are concentrated in the morning and most of the trains from Fort are operated in the afternoon. KV line was originally constructed as narrow gauge and converted to broad gauge in 1996. There are still a lot of sharp curves and the track condition is not good. The line does not fulfil its role. Modernisation of this line is also recommended.

(15) Small Share of Railway in Freight Transport

The share of freight transport in Sri Lanka railway is only 0.7% while it was 38% in 1964. Railway freight transport has come into disfavour as road transport has developed. The declining share of the railways in freight transport could be attributable to the double handling of cargo. Additional unloading and loading is required at the station from truck to train or train to truck compared to transporting the goods directly by truck. This causes transport time to increase and an additional handling charge thus it makes railway transport less attractive for consigners.

3.8.2 Problems and Issues in Bus Transport and Other Road-Based Public Transport

(1) Low Bus Operation Speed due to Traffic Congestion on Roads

As mentioned in Section 3.3, roads in the CMA, especially radial transport corridors, are congested during peak hours. Since buses share the road space with private motorised modes of transport such as cars, motorcycles and three-wheelers the travel speed of bus transport is dependent on the other modes. Moreover, travel speeds of buses are usually even slower than passenger cars as they have to stop at bus stops and passenger car can take the shortest path regardless of routes.

In line with economic growth, the shift to private motorised modes of transport is expected. This will further decrease the travel speed of buses. Therefore, this causes a vicious circle of losing public transport. Public transport with a dedicated track, lane or road is requisite to break the vicious circle. Thus, the development of space for bus and road-based public transport is required.

(2) Pettah-Centred Bus Network

In the Western Province, approximately 25,000 round-trips of intra-province buses are operated. Amongst those, 8,000 round-trips are made from/to the Pettah and Fort areas of Colombo. This means that bus routes in the Western Province are directed toward the Pettah area. In the case of inter-province buses, a half of the bus routes which cross the boundary of the Western Province have one of their terminal points in the Pettah or Fort area. The route system in the region is a radial pattern. This creates a significant load on the road system in the city centre. From the passengers' point of view, they cannot help going to the Pettah or Fort area to go to a city in another corridor.

(3) Lack of Integration with Railways and Other Bus Terminals

Unlike private modes of transport, public transport requires connecting with each other. Railways are generally suitable for longer and high demand trunk routes with high capacity and relatively straight alignment. On the other hand, buses can serve narrow roads even with less traffic demand. However, some buses in Colombo have both of these functions. These two modes are often competing such as on the Colombo to Negombo, Gampaha, Homagama and Moratuwa corridors. This results in excessive congestion in the bus fleets and congestion on the roads.

Although some railway stations have station squares and bus stops in front of them, those two modes of public transport are not properly connected in terms of train/bus schedules and routes. Since the public transport is a network system, these two modes should be planned in an integrated manner.

(4) Low Service Level of Bus Operation

Although the private bus operators are making a profit with the current fare levels, their business is dependent on depreciated bus fleets with minimum maintenance due to the lack of proper management and ownership.

(5) Difficulty in Improvement of SLTB's Bus Service

The SLTB suffers a financial loss every year and they are not able to improve the level of bus service, including frequency, travel time and the comfort of bus fleets. This is partly because the SLTB is providing a public service such as school buses for school children, night buses and buses for rural areas where sufficient bus passenger revenue cannot be obtained. Inefficiency in operation and political intervention and competition with private operators are also affecting this.

(6) Inconvenient Bus Operation for Passengers due to Bus Rental System of Private Operators

Although some operators have a large number of buses, the majority of private bus operators are small scale companies and owners have only a few buses for rent to bus crews. In some cases bus drivers and conductors must pay the bus rental cost and fuel cost from the bus fares they collect from bus passengers. They attempt to maximise fare revenue and they are not very concerned with the convenience of passengers. This leads to unpleasant bus services to bus passengers.

On the other hand bus owners are not able to manage bus operation since they cannot trace the location of buses on the road. Furthermore bus operators cannot check the bus fare collection exactly which is collected by bus conductors on board. Thus the bus owner and operators utilise the bus rental system to reduce their management efforts and risk from the bus operation. This bus operation system makes it difficult to provide reliable bus operation; buses on the same routes are operated based on the time table but it is difficult to make real time adjustments of bus operation due to lack of coordination.

(7) Difficult Coordination between Public and Private Bus Operators

The bus time tables are prepared for many bus routes in the region; however, in the case of public and private bus operators jointly operate buses on the same route, bus operation in accordance with timetables is difficult to achieve due to traffic congestion and difficult coordination between two operators.

(8) Insufficient Support for Bus Fare Discount for Transport the Transport Poor

Bus fare is set by NTC at an affordable level by taking the ability to pay of ordinary people into account. Bus crews of private operators should operate buses at regulated fare levels thus it is difficult for them to get students and pupils on board at discounted rates compared to the SLTB buses and Sisu Seriya. Under these situations, only public buses and limited private buses could provide transport service for students and pupils at a discounted fare. Since these people are regarded as "transport poor" whose ability to pay for transport is generally low, the government provides subsidy for this kind of service.

The support for public transport is available for passengers on SLTB buses and the limited private buses and Sri Lanka Railway only. There is no discount ticket for pupils and students on private bus services except Sisu Seriya because the government does not provide financial support to the private bus operators. As a result, pupils and students do not use private bus services except special bus services supported by the government due to relatively high fares. From the bus operator point of view, private bus operators are not able to take pupils and students at very low discounted fare.

SLTB operates buses on the same bus routes where private bus operators run buses for helping bus passengers who travel at a discount rate. However this kind of arrangement of bus operation made by two different operators brings about inconvenience for bus passengers. Eventually bus frequency is reduced for students and pupils.

(9) Insufficient Management on Bus Operation

Bus operation is not well managed since it is difficult for the management to monitor the bus operation on a real time basis. Moreover bus fare collection is also difficult to check whether it is properly collected and whether the full amount is submitted to the management of the bus. To avoid such difficulties, sometimes management use a bus rental system with bus crews. In the bus rental system, bus operators and bus owners do not have to take care of bus operation and bus fare collection. They do not take operational risks and force responsibility on to the bus crews. This improper management of bus operation leads to a low level of bus service.

(10) Market-Driven Regulatory Scheme of Road-Based Public Transport Modes

Three wheelers and other road-based public transport vehicles are usually owned by small operators and individuals as this sector is less regulated and is market-driven. While an initial registration and an annual renewal of the three-wheeler licences are required, there is no restriction on the number of three wheelers.

Notably the surge in the number of three-wheelers is significant. As the industry is directly linked with the employment of drivers as well as transport in areas which are not covered by buses, coordination among relevant agencies and stakeholders to find a solution which will not affect the employment or transport service is essential.

3.8.3 Problems and Issues on regarding the Road Network

(1) Insufficient Road Network

Current traffic demands mean that the roads are almost at capacity or exceed capacity at several points during the peak hours as shown in Sub-section 3.5. Especially, road traffic between the CMC and the eastern part of the suburban areas, such as Battaramulla, depends on one major arterial road and no alternative roads parallel to the major arterial road have been developed yet.

As a consequence the road network forms a "fish bone" shape and excessive traffic flows are concentrated on the one major arterial road. Merging points at major intersections in suburban areas have become bottleneck intersections.

(2) Lack of Pedestrian Space

Almost none of the roads have sufficient space for sidewalks and shoulders under the existing conditions as shown in Sub-section 3.5.1. Most urban roads lack space for pedestrian traffic. Only a few arterial roads provide sidewalks for pedestrians and this lack of sidewalks might cause frequent and serious traffic accidents involving pedestrians. Therefore, establishment of design standards for urban roads is needed and it is essential to improve the urban roads in accordance with the urban road design standards for road traffic safety.

(3) Lack of Road Network Master Plan for the CMA

The arterial road network has been developed and maintained by the Road Development Authority and CMC, however, no arterial road network development plan has been established for the whole of CMA. Therefore a road network master plan which considers comprehensive development of public transport should be established.

(4) Lack of Road Design Standards for Urban Roads

Highway design standards for interurban roads have been established and have been applied for road development and maintenance. The characteristics of urban traffic are different than intercity traffic, for instance, the traffic speed of interurban traffic is generally higher than urban traffic and pedestrian traffic is more important in urban areas. Thus it is desirable to develop a highway design standard specifically for urban roads.

(5) Low Accessibility of the Existing Expressway Network

The existing Southern Expressway (SEW) and on-going Outer Circular Highway (OCH) will form a circumferential expressway network which will run in the fringe of the metropolitan area. At present it is a considerable distance from the existing Kottawa interchange to the City centre of Colombo and it takes around one hour, depending on traffic conditions. Car drivers and passengers cannot fully enjoy express service on the expressway due to the long distance from the nearest interchange. Therefore, accessibility between expressway's interchanges, the suburbs and the centre of Colombo should be enhanced. In addition traffic flows on the existing ordinary road network should also be distributed to secure proper travel time and speed.

(6) Need to Enhance Access to Colombo Port for Cargo Transport

In terms of cargo transport, there is no expressway access to the Port of Colombo at this moment. The Port of Colombo is an international hub in the Indian Ocean and the nation's largest port. Roughly three quarters of container throughput is transhipped in the Port of Colombo and the volume of import and export cargo has drastically increased in the last decade. According to the Screen Line Survey results and Truck OD Interview Survey results of the CoMTrans, a large number of large trucks utilise the Negombo corridor where several export processing zones (EPZs) and industrial estates are located followed by the Kandy corridor which has large hinterlands in the northern and central parts of the Island.

Although the Port Access Road functions as a main access road to the Port as an exclusive road for the port-related vehicles, the Port Access Road does not connect with the expressway network of the Colombo Katunayake Expressway (CKE) and the Southern Expressway. Congestion is, therefore, observed in the area around the entry points of the Port Access Road as explained in Section 3.3. The situation might be similar or even aggravated after the completion of on-going expressway projects, the Outer Circular Highway (OCH) and the Northern Expressway, as there is no direct access from the Port to the expressway network. This can significantly contribute to worsen the congestion along with the projected surge in the number of private vehicles in urban areas.

(7) Planning Issues Regarding Expressway Network Development

When the Colombo – Katunayake Expressway (CKE) is connected with the on-going OCH and the planned Northern Expressway, a considerable amount of vehicular traffic flow from the northern parts such as Kandy and Negombo would come to the city centre through CKE and cause traffic congestion at the end of CKE at the northern part of the new Kelani Bridge. A significant amount of traffic flow would approach the bridge but it is expected to cause traffic congestion at the bridge due to the limited traffic capacity. To deal with this anticipated traffic problem at the bridge, elevated road development is planned to distribute the traffic concentration to other areas. Even if an elevated road which connects with the CKE is developed, it would merely move the traffic congestion to the next intersection.

3.8.4 Problems and Issues on Traffic Control and Traffic Management

(1) Traffic Congestion at Intersections

Traffic congestion is seen at many intersections in the city centre of Colombo Municipality. Signal phasing is not appropriate at many signalised intersections. Traffic congestion is also observed at roundabouts and it is caused by the shortage of traffic capacity at roundabouts. As traffic demand increases, traffic flows cannot be properly dealt with without traffic signals.

(2) Reduction of Traffic Capacity due to On-street Parking

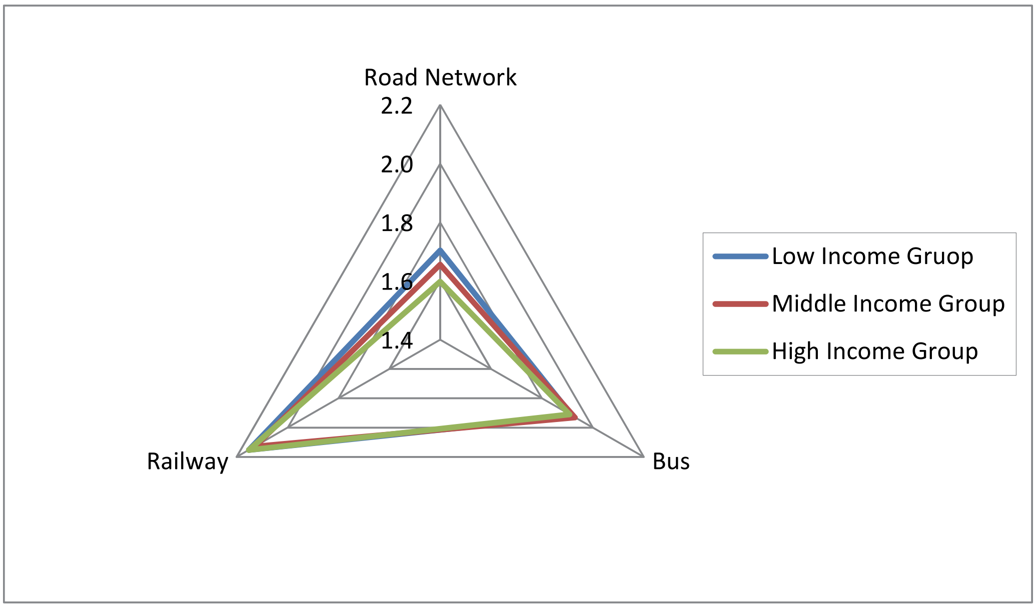
Traffic congestion is caused by the reduction of traffic capacity due to on-street parking because there are only a few parking spaces available in the city and the regulation of street parking is not strict in the Colombo Municipality.

3.8.5 Residents' Evaluation of Transport System Performance

(1) Transport Sector's Evaluation by Residents

To get an insight into people's perceptions regarding urban transport problems, respondents to the HVS were asked to score from 1, for "Strongly Agree", to 5, for "Strongly Disagree", with the given statements pertaining to problems related to the urban transport sector.

Figure 3.8.1 shows how residents of the Western Province evaluate transport sectors which they use in their daily life. The average score for all statements relevant to “Road Network”, “Bus” and “Railway” are shown in Figure 3.8.1, in which the higher the average score, the better the perception of the transport sector is. Figure 3.8.1 reveals that the evaluation of the “Road Network” is generally lower than “Bus” and “Railway”. From the viewpoint of income group, the average score of the “Road Network” decreases as income increases. However, there are no noticeable differences of average scores across income groups on “Railway” and “Bus”.



Source: CoMTrans Home Visit Survey 2013,

Figure 3.8.1 Transport Sector Evaluation

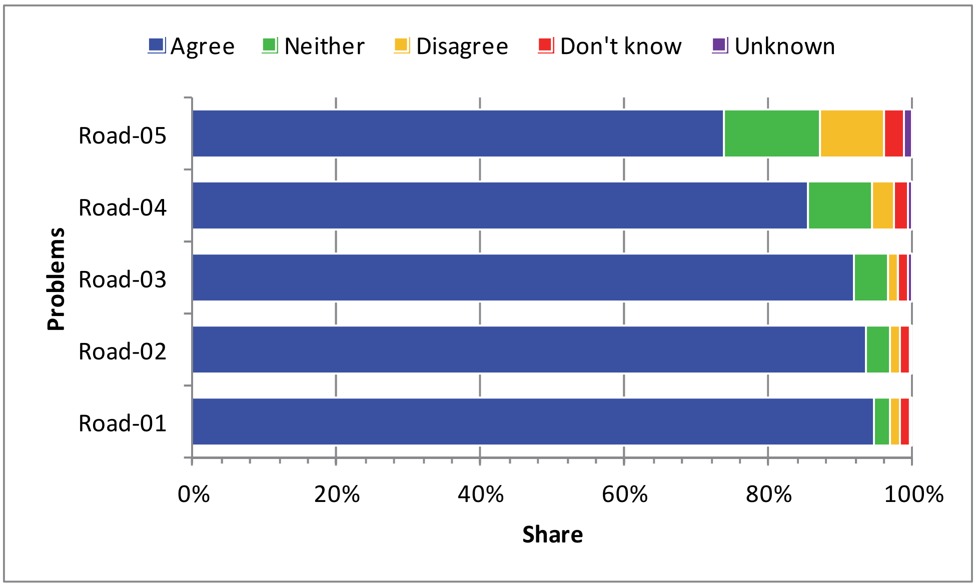
(2) Evaluation of Road Network’s Problems

Figure 3.8.5 shows the residents’ evaluation of the road network. Over 80% of the respondents agreed all the problems asked in the questionnaire exist.

Table 3.8.1 Description of Road Network Problems

Problems/Issues on Road Network	Problem Code
(a) Roads are congested in the morning peak period	*Road-01*
(b) Roads in the areas surrounding schools are congested in 1:30-2:30 P.M.	*Road-02*
(c) Roads are congested in the evening when people go home	*Road-03*
(d) On-street parking reduces road capacity thus results in road congestion	*Road-04*
(e) Roads are in poor condition and they are dangerous for driving	*Road-05*

Source: CoMTrans Home Visit Survey 2013



Source: CoMTrans Home Visit Survey 2013

Figure 3.8.2 Residents' Evaluation on Problems Related to the Road Network

(3) Evaluation of Public Transport's Problems

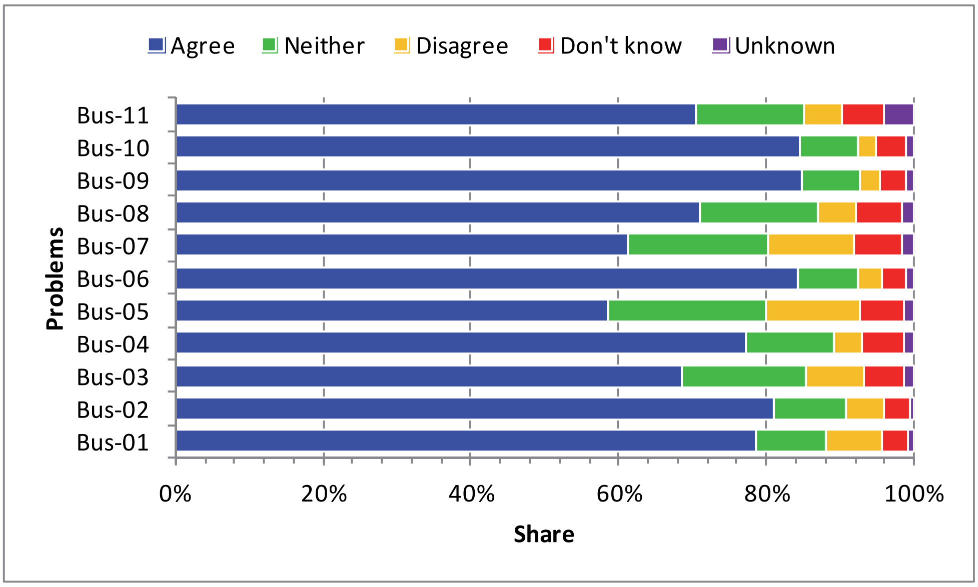
The evaluation of public transport, including bus and railway, is presented in Figure 3.8.3 and Figure 3.8.4. Current bus services also exhibits severe dissatisfaction from the residents' points of view. As for the railway, there are a notable number of respondents who answered "Don't know" because they do not use the railway. However, the share of respondents who agree is absolutely larger than those who disagree on the statements of the problems pertaining to the current railway service.

Table 3.8.2 Description of Public Transport Problem

Problems/Issues on Public Transport	Problem Code
Bus	
(a) It is not comfortable because it is overcrowded on buses	*Bus-01*
(b) It is not convenient because of long waiting time when it has few passengers	*Bus-02*
(c) It is not convenient because bus frequency reduces during the night	*Bus-03*
(d) Frequency of bus operation is not sufficient thus waiting time is long	*Bus-04*
(e) Buses are often delayed due to traffic congestion	*Bus-05*
(f) It is too expensive if we get on air-conditioned buses	*Bus-06*
(g) It is not comfortable because behaviour of the bus conductor and staff is not good	*Bus-07*
(h) Security on buses is not fully guaranteed	*Bus-08*

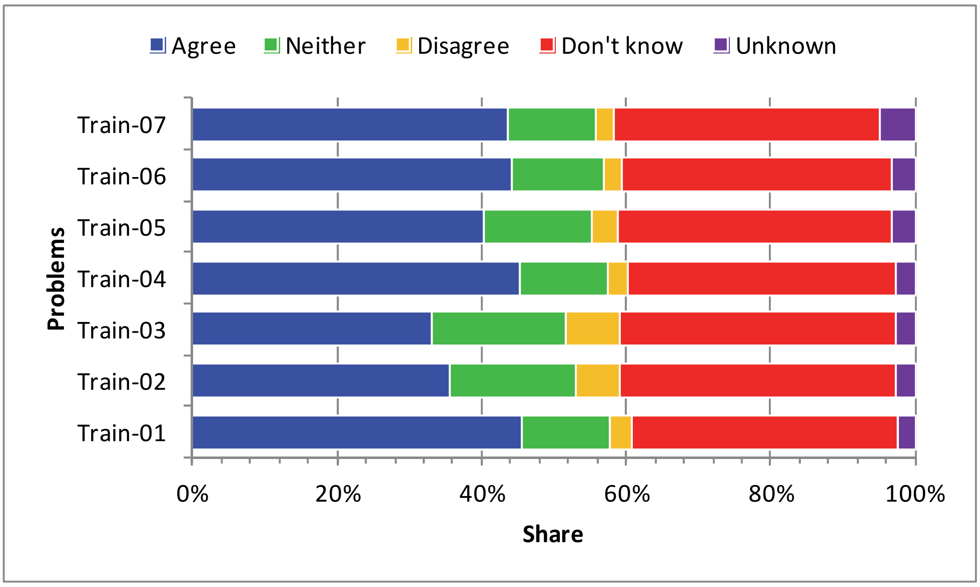
Problems/Issues on Public Transport	Problem Code
(i) It is not comfortable since it is hot on buses without air conditioners	*Bus-09*
(j) Bus routes are limited thus bus passengers need several transfers	*Bus-10*
(k) It is not comfortable because buses are dirty on board	*Bus-11*
Railway	
(a) Frequency of train operation is not sufficient thus waiting time is long	*Train-01*
(b) It is not comfortable because it is overcrowded on trains	*Train-02*
(c) It is not convenient because train frequency reduces during the night	*Train-03*
(d) It is not convenient because connection of railways and buses are not well organised	*Train-04*
(e) Security on trains is not fully guaranteed	*Train-05*
(f) It is not comfortable since it is hot on trains without air conditioners	*Train-06*
(g) It is not comfortable because rail coaches are dirty on board	*Train-07*

Source: CoMTrans HVS 2013



Source: CoMTrans HVS 2013

Figure 3.8.3 Residents' Evaluation on Problems Related to Bus Service



Source: CoMTrans HVS 2013

Figure 3.8.4 Evaluation of Public Transport

3.8.6 Overall Urban Transport Problems and Planning Issues

(1) Traffic Congestion

Traffic congestion has been worsening in recent years on the road network in the central area of CMA. Traffic congestion has brought about huge economic loss by increasing vehicle operating cost as well as travel time cost.

Traffic congestion is observed in the morning and evening peak periods at intersections of radial arterial roads, especially around the periphery of CMC and inner cities such as Borella, Maradana, Dematagoda, Town Hall and Nugegoda according to the travel speed survey and the traffic volume and capacity analyses.

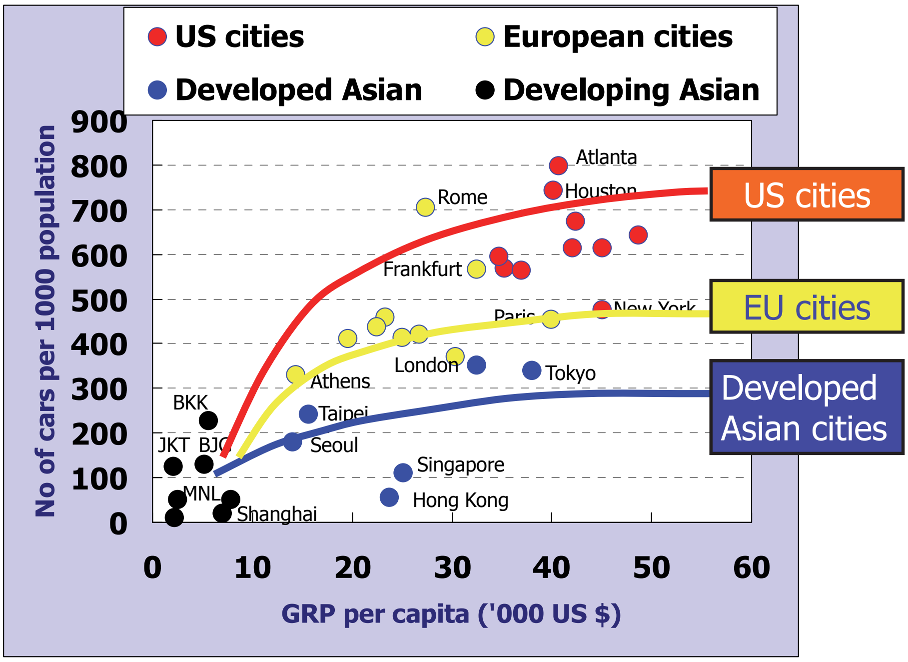
In terms of the seven major transport corridors, heavy traffic congestion is observed in Malabe corridor. Lack of high capacity and high service level public transport is one of causes of the congestion. This is also partly due to the characteristics of the Malabe corridor. As the only east-west direction 4-lane-arterial road, Parliament Road (Malabe - Battaramulla – Borella) serves the traffic flows from these areas to the CBD; a number of private vehicles are merging onto the Parliament Road from the north-south roads connecting to it. It should be noted that the population has been increasing in this area as an administrative capital. Considering the future growth in this area, it is expected that the road will be grid-locked.

(2) Need to Shift to Public Modes of Transport

According to the historical trend of modal shift in the last 28 years, the number of passengers crossing CMC boundary by private mode of transport increased approximately 2.5 times while the number of passengers using public transport remained roughly static. The vehicle ownership in recent years also shows a surge in the number of passenger cars, three-wheelers and motorcycles.

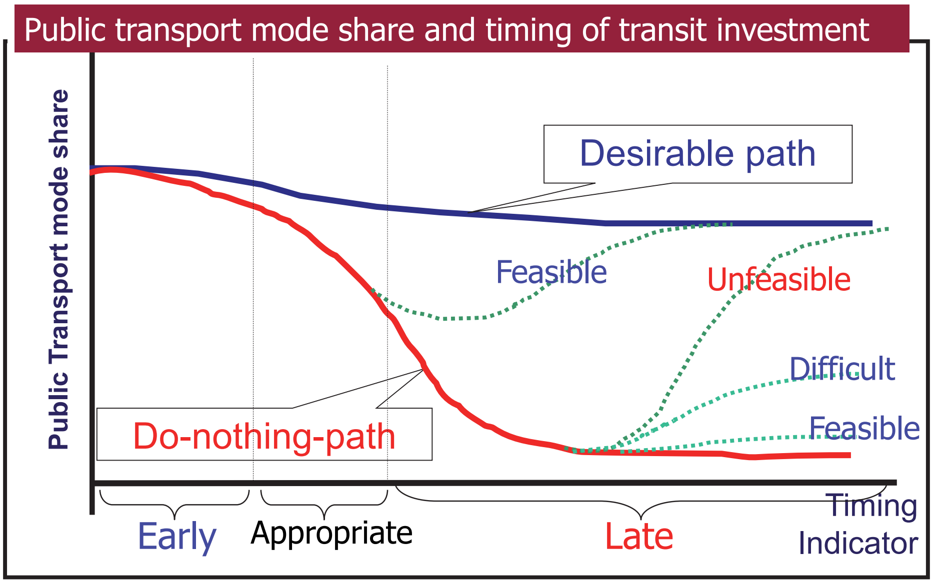
Group A households are captive to private modes of transport according to the Home Visit Survey results. Taking into consideration the fact that economic growth is expected in the CMA with huge urban development projects, the modal shift to private modes of transport will be accelerated if no government intervention is taken. Figure 3.8.5 shows vehicle ownership and gross regional products (GRP) per capita of cities in the United States (U.S.), the European Union (EU) and Asia. Cities in U.S., EU and developed Asian cities took different paths. While U.S. cities are dependent on cars, developed Asian cities succeeded to deter vehicle ownership with development of public transport systems. As show in Figure 3.8.6, the share of public transport will continuously decrease with economic growth if the government does nothing. While some U.S. cities are recently trying to increase the share of public transport to reduce externalities of private mode of transports, a limited number of cities have succeeded to regain a share of public transport. Once car ownership and a share of private mode of transport increases, it is difficult to reverse it due to the captive characteristics of car users.

With the decrease of travel speeds on the roads due to the abovementioned severe traffic congestion, the travel time of buses will increase. This might accelerate the shift to private modes of transport. It is highly expected to break this vicious circle though provision of convenient, fast and high capacity public transport modes.



Source: Morichi, S and Acharya, S.R. (eds.) (2012) Transport Development in Asian Megacities -A New Perspective-, Springer

Figure 3.8.5 Vehicle Ownership and GRP per Capita of Cities in U.S., E.U. and Asian Cities



Source: Hanaoka, S. (2014) " International Experiences in Urban Transport Policies and Financial Options for Urban Transport Projects" presented for CoMTrans Special Seminar on Sustainable Urban Transport Development on 21st January, 2014

Figure 3.8.6 Public Transport Mode Share and Timing of Transit Investment

(3) Provision of Sufficient Capacity for Increasing Transport Demand

Travel speeds on the road network appear low in the peak periods as described in Subsection 3.4.7. It is noteworthy that the capacity of public transit is much higher than that of private motorised modes of transport. As high economic growth is expected, all major corridors, especially high demand corridors such as Malabe, Kandy, Galle, Negombo and High Level corridor should have public transit systems.

(4) Provision of Affordable Transport Means for the Poverty Group

The Home Visit Survey indicates that travel characteristics vary significantly according to income level. The modal share of Group C household members depends on non-motorised modes of transport and public modes of transport such as buses and the railway. It is expected to provide affordable public transport for them in addition to non-motorised transport.

Expenditure for transport in a household budget is limited; for instance, about 50% of Group C, of which monthly income is less than Rs. 40,000, spend less than Rs. 4,000 per month.

(5) Lack of Transport Facilities for the Physically Handicapped

At present barrier free facilities such as elevators and escalators are not yet provided at railway stations and bus terminals. Thus it is not convenient for physically handicapped people to use public transport. It is required to provide such facilities to support them to travel as normal people in the city.

(6) Environmental Friendly Transport System

The result of ambient air quality monitoring for PM10 conducted at Colombo Fort Station from 2006 to 2009 shows that PM10 occasionally exceeded the national air quality standard (100ug/m3). The exceedance was observed mainly during the period from November to February.

In Sri Lanka, the transport sector contributed more than 50% of the CO_2 emissions in 2010. Road transport contributes 94 percent of CO_2 emissions produced by the transport sector. Since it is expected that CO_2 emissions will grow in accordance with the increase in vehicle ownership, the environmental policy for the promotion of lower emission vehicles such as electric cars and hybrid cars should be supported to control CO_2 emissions. At the same time, the promotion of public transport should also be taken into account for reduction of CO_2 emissions.

(7) Transport System to Promote Health

Transport facilities for walking and bicycles have not had attention paid to it for a long time. Walking and bicycling has become popular since these modes are environmentally friendly and good for health. Walking is the most basic means for travel; therefore, the walking environment should be improved and developed in the future. Development of a pedestrian network separated from car traffic is good from the viewpoint of safety and good health overall.

Furthermore, improvement in the walking environment would support the promotion of public transport use since when people use buses and the railways, they usually access the railway station and bus stops on foot.

(8) Problems regarding Traffic Safety

The number of traffic accidents has been increasing from 2009 to present in the Western Province. Fatalities involved in traffic accidents are pedestrian (43%) and motorcycles/mopeds (29%). About 75% of pedestrian fatalities are in the age group over 40 years old. Special attention should be paid for protection of older people from a traffic safety point of view. About 70% of traffic accidents occurred at road sections between intersections. This implies a lack of sidewalks on arterial roads. This suggests the necessity of developing more sidewalks and pedestrian facilities to protect people from traffic accidents. Regarding the causes of traffic accidents 80% are from human factors such as aggressive/negligent driving and speeding. To reduce this kind of dangerous driving practices, driving education might be effective.

CHAPTER 4 Perspective of the Colombo Metropolitan Area

4.1 Identification of the Colombo Metropolitan Area

4.1.1 Definition

The Western Province is the most developed province in Sri Lanka and is where the administrative functions and economic activities are concentrated. At the same time, forestry and agricultural lands still remain, mainly in the eastern and south-eastern parts of the province. And also, there are some local urban centres which are less dependent on Colombo. These areas have less relation with the centre of Colombo.

The Colombo Metropolitan Area is defined in order to analyse and assess future transport demands and formulate a master plan. For this purpose, Colombo Metropolitan Area is defined by:

A) areas that are already urbanised and those to be urbanised by 2035, and

B) areas that are dependent on Colombo.

In an urbanised area, urban activities, which are mainly commercial and business activities, are active and it is assumed that demand for transport is high. People living in areas dependent on Colombo area assumed to travel to Colombo by some transport measures.

4.1.2 Factors to Consider for Future Urban Structures

In order to identify the CMA, the following factors are considered. These factors will also define the urban structure, which is described in Section 4.3. An effective transport network will be proposed based on the urban structure as well as the traffic demand. At the same time, the new transport network proposed will affect the urban structure and lead to urban development.

In Technical Report No.4, more details are illustrated with maps of each factor.

(1) Population Distribution and Increase

Existing population distribution and growth are mentioned in Chapter 2. They indicate the urbanised areas in the Western Province and the trend of urbanisation in the past years.

1) **Population Distribution**: Most of the population is concentrated in CMC coastal areas, and along major roads. The employed population density is more clearly concentrated in CMC. Existing urban centres such as Negombo, Gampaha, Panadura and Kalutara have higher densities as well. The population distributions are explained in Chapter 4.4.
2) **Population Increase:** the average annual growth rates from 2001 to 2012 clearly show that the population in CMC decreased and suburbs located around 15-20km from the centre of Colombo increased. It clearly indicates the movement of resident population from CMC

toward the suburbs, especially in the eastern direction.

(2) Existing Land Use and Urban Structure

Subsequent to the past trends in population growth, the urbanisation along the major roads, bus routes, railway lines, and around the active urban centres is expected to continue in the future.

1) **Land Use:** As mentioned in Chapter 2.2, major urban activities are highly concentrated in the Colombo Centre and along the major corridors as ribbon development. Residential areas are scattered in many parts of the province as the population density map shows.
2) **Expressway Network and Interchanges:** Expressways are a new aspect in the Sri Lankan context. Although the expressway network was originally planned as truck roads, the network and the interchanges will affect human settlement and future urbanisation patterns.
3) **Major Roads:** Urbanisation has been concentrated along the major roads. Many of the bus routes are overlapped with the major roads, and they have boosted the urbanisation more. The roads have been upgraded by RDA and other related agencies. Following urban growth and urbanisation will continue to concentrate along the roads.
4) **Railways and Stations:** Dependence on public transport would become higher, and TOD is expected to be proposed in transport nodes around the railway stations. More commercial and business activities would gather around the node stations and more commuters would be attracted to the areas. This trend will take place along with improving the transport system.
5) **Urban Centres:** The existing urban centres are spread around the Western Province. Urban structures are expanding greatly around these centres. Effective and well planned concentration of urban areas should be guided.
6) **Industry and Employment Centres:** The existing and proposed export processing zones (EPZ), industrial parks, IT parks, and other industrial estates would continue to affect the population growth. Due to land availability, they are located in suburban areas and would affect land use changes. Any new employment centres expected to locate around urban centres would also be an attraction for urbanisation.

(3) Proposed and On-going Urban Development Plans and Projects

1) **Urban Development Plan:** There is the "Colombo Metropolitan Regional Structure Plan"(1998) and the "Western Region Megapolis Master Plan"(2004) created by UDA. Although they did not define urbanised areas clearly, they can be references to consider future urbanised areas.
2) **UDA Declared Area:** UDA declared areas are the areas that UDA considers as urban. This is also a reference to examine the CMA and the future urban structure.
3) **Urban Development Projects:** Approximately 100 projects are proposed and/or are on-going in the Western Province. They are directly affecting the new urban structure in the Western Province, although many of the projects are proposed in the heart of Colombo. Especially, major projects such as the Battaramulla administrative centre should be strongly considered.
4) **Station Development Projects:** "Re-development of Railway Stations" prepared by the Strategic Enterprise Management Agency (SEMA) and UDA suggests developments

on/around stations on the Costal Railway Line. There are high potentials for TOD on/around not only the stations on this particular railway line, but also for the stations of the other railway lines as well.

(4) Commuters Trips

Some of the results of the CoMTrans Home Visit Survey 2013 indicate the areas that depend on Colombo and those that are independent urban centres.

1) **Workers Commuting to CMC:** It is clearly illustrated that many workers that reside in the areas along the Main Line and Coast Line commute to CMC. On the other hand, the South-eastern parts of the province and around Negombo area have considerably fewer workers commuting to CMC.
2) **Employed Population Living and Working in DSD Area:** In the south-eastern and northern parts of the province, the majority of the employed population are working for agriculture in their residential Area. Negombo DSD, Hanwella DSD, Beruwala DSD, and Horana DSD have high rates of employed population living and working in the same DSD. These areas have their own centrality.
3) **Density of Trip Ends:** Higher density of trip ends shows the concentration of urban activities. Colombo and areas along the major corridors have a high density of trip ends, namely the areas have concentrated urban activities such as commercial and business endeavours.
4) **Desire Line for OD Pairs with the 2 Highest Trip Rates:** The destinations indicate urban centres. Concentrations of the destinations are found in CMC and urban centres along the major corridors. Avissawella, Padukka, Negombo, Matugama are more independently concentrated, and it is assumed that they have their own centrality.

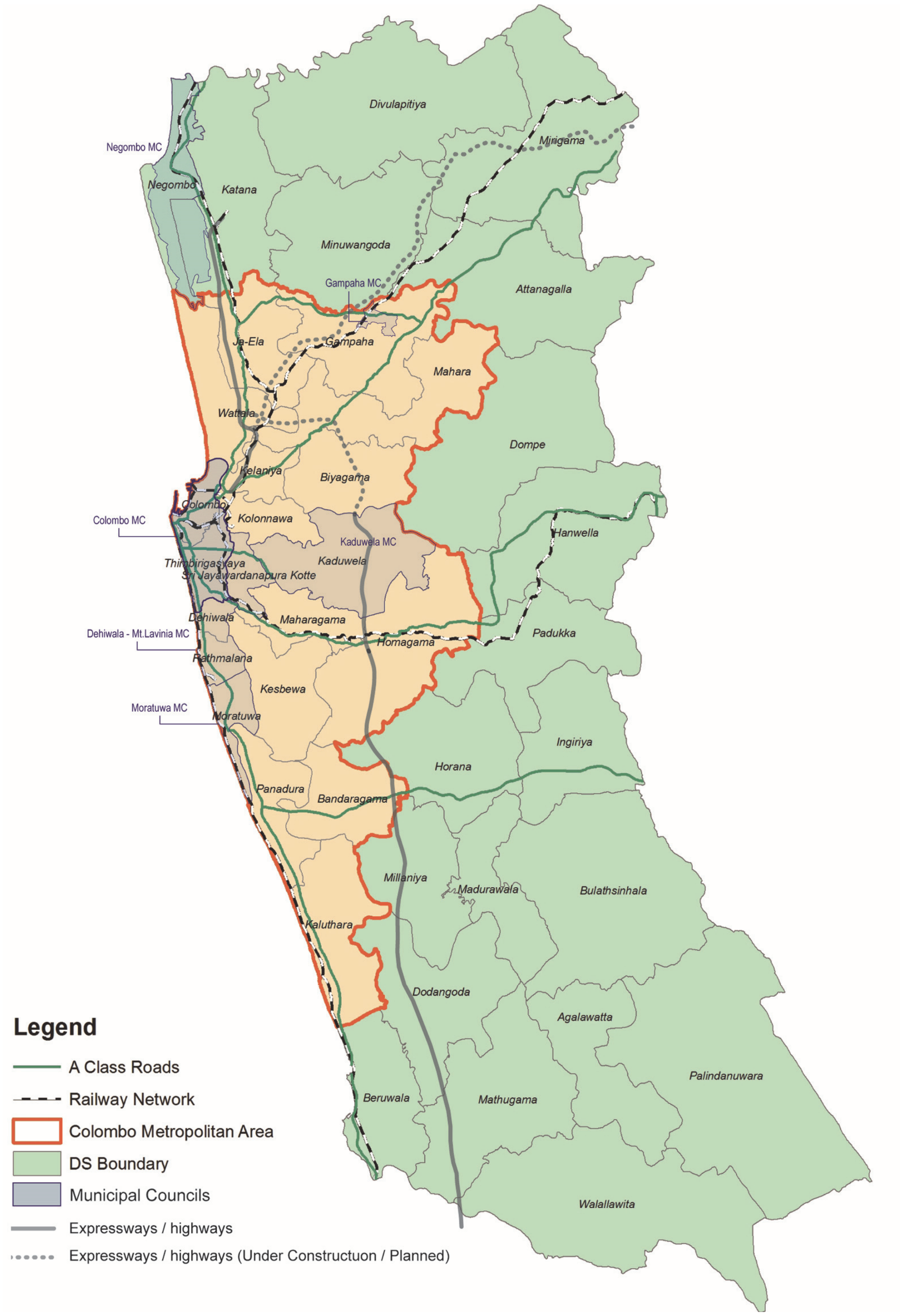
4.1.3 Identification of the Colombo Metropolitan Area(CMA)

According to the factors mentioned above, the urbanised area, namely the Colombo Metropolitan Area (CMA) was identified based on the DSD boundaries.

Especially the existing population distribution and population growth guided the determination of the boundaries of CMA. Both night time and day time population densities having more than 20 people/ha roughly indicate the boundaries of CMA. High population growth areas also confirmed the boundary. After consideration of other factors, such as current land use, urban structure, and urban development projects, the results of the CoMTrans Home Visit Survey were considered more carefully. In the result, dependency on the CMC is observed as they showed strong connectivity between the CMC and the other areas of the Western Province. These factors would form a suitable basis for defining the CMA.

On Galle Road, continuous urbanised areas reach to Kalutara while Beruwala shows independency from CMC. On High Level Road, the urbanised areas end after Homagama. On Negombo Road, the populated areas are almost continuous up to Negombo, but Negombo shows their own centrality in the northern part of Western Province. On Kandy Road, although strong dependency on CMC is observed especially along the railway, separate centralities are observed after Gampaha.

Thus, the identification of CMA was finalised and is shown in Figure 4.1.1. The CMA has a strong influence on the centre of Colombo, and continuous urban growth is anticipated.



Source: CoMTrans Study Team

Figure 4.1.1 Colombo Metropolitan Area

CMA consists of 20 DSDs. The extent is 995.5 km2, which is 27% of the Western Province, and the population is 3,682,531, which was 63% of the Western Province in 2012. The DSDs constituting CMA are listed in Table 4.1.1 along with the area and census population of 2012.

Table 4.1.1 Area and Census Population 2012of DSDs constituting CMA

District	DSD	Area (km2)	Population 2012
Colombo	Colombo	17.9	318,397
	Dehiwala	8.4	87,758
	Homagama	119.0	236,270
	Kaduwela	87.8	252,168
	Kesbewa	61.4	243,907
	Kolonnawa	26.0	190,931
	Maharagama	37.4	195,303
	Moratuwa	19.2	167,301
	Rathmalana	13.1	95,037
	Sri Jayawardanapura Kotte	16.5	107,172
	Thimbirigasyaya	22.4	236,903
Gampaha	Biyagama	60.3	186,730
	Gampaha	90.7	196,308
	Ja-Ela	61.4	201,217
	Kelaniya	21.9	135,994
	Mahara	94.3	207,077
	Wattala	57.7	174,281
Kalutara	Bandaragama	57.4	108,877
	Kaluthara	77.7	159,208
	Panadura	45.0	181,692
CMA		995.5	3,682,531

Source: Census of Population and Housing 2012, Department of Census and Statistics

Further demand forecasts, other transport analyses and assessments have been carried out for the CMA. They are described in following chapters.

4.2 Socio-Economic Framework

4.2.1 Population Projection

(1) Method

The estimated population in 2012, which is described in Chapter 2.1, is considered as the baseline population for future projections.

The future population is obtained from the baseline population giving consideration to the natural increase and the social increase. The natural increase is obtained from the future crude birth rate and the future crude mortality rate, which can be estimated from the historical data and trends. The social increase is mainly based on the internal migration in the case of the Western Province. However, there is not enough reliable data available for the migration. Therefore, anticipated migration trends need to be set up as high, medium, and low scenarios. Thus, the future population projections to 2035 by these scenarios are obtained.

More details of the population projection are described in the Technical Report No.4.

(2) Birth Rate Forecast

The historical data of crude birth rates in Sri Lanka is available from 1964. Around 1970, the crude birth rate of Sri Lanka was approximately 30, however, it is falling gradually, and in recent years, the rate dropped to approximately 18.

As for the district level, the registered numbers of live births from 2000 to 2008 are available in “Statistics on Vital Events” published by the Registrar General’s Department in 2011. From this, the actual birth rates of usual residents according to the districts can be obtained. The Crude Birth Rate in the Western Province at 2009 was 17.4, which is a little lower than the national level of 18.8.

As many countries have experienced, the crude birth rate of Sri Lanka is decreasing. In the past ten years, the crude birth rate of Sri Lanka has declined by an average 0.6% annually. This rate will be applied to the crude birth rate for the three districts. Thus, it is forecasted that the crude birth rates would be dropped to around 14-16 by 2035. The sex ratio at birth has stayed the same in Sri Lanka as well as the three districts; about 104.5 males per 100 females (Male 51.1%, Female 48.9%). It is assumed that the average sex ratio would stay the same in the future.

(3) Mortality Rate Forecast

The historical data of crude mortality rates is available from 1959 in Sri Lanka. During the ‘60s, the crude mortality rate was around 8.5, however, it is improving gradually, and it became around 6.0 in the ‘90s. In recent years, the rate has been almost stable.

The “Statistics on Vital Events” in 2011 shows the number of deaths of usual residents from 2000 to 2007. From these, the actual mortality rates of usual residents according to the districts can be obtained. In 2008, the crude mortality rate of Sri Lanka was 5.8, and that of the Western Province was 6.6. The Kalutara District shows a higher mortality rate of 7.1 than that of the other two districts in the Province.

Crude mortality rates by cohort, or five year age group population, in 2001 can be calculated by census population and the registered number of deaths of usual residents. And also, it is possible to estimate the crude mortality rates at 2007 from the estimated population in 2007 and the registered number of deaths. From these mortality rates in 2001 and 2007, the annual rate of change or improvement rate can be obtained. Most of the age groups show improvement of mortality rates.

For the future, it is anticipated that the mortality rate of each cohort will decrease due to the assumption of the improvement of medical facilities and treatment. For the forecast, there is not enough data available, therefore, the improvement rate of the crude mortality rates from 2001 to 2007 are taken in consideration.

In general, it is assumed that the mortality rates of infants and the elderly would decrease due to improvement of medical conditions. Some cohorts, in which the crude mortality rates are already small, would not be expected to improve drastically. Similarly, some cohorts, which have already shown significant improvement, would not be expected to continue such a high improvement rate. For those cohorts, improvement rates are adjusted. Taking into consideration these factors, future crude mortality rates are forecast according to the districts.

(4) Population Growth Scenarios

As mentioned in section 3.1.2, migration has moved outward from the Western Province in the past. However, the after-conflict situation and anticipated future developments in the Western Province should change the migration trend. Development of the country would focus on the Western Province, or the most developed province. This would cause more population to be attracted to the Western Province.

On the other hand, “A Population Projection in Sri Lanka – For the New Millennium 2001-2100” by W, Indralal De Silva, Institute of Health Policy, mentioned that the Sri Lankan population will be decreasing around 2030 to 2035. And, there is a nationwide development policy that will also be implemented, such as development of Hambantota and the northern part of the islands. Therefore, outflow migration from the Western Province would continue due to the national population scenario and the development of other areas.

Taking into consideration the two opposing factors, the following scenarios of migration trends are considered for the population projection:

<u>Scenario 1: High Growth with Rapid Urbanisation</u>

Due to rapid urbanisation and economic growth in the Western Province, job opportunities and educational facilities would be expanded. This would attract a large number of people towards the Western Province. This trend would be remarkable in the working age population, especially for those of a young age. They would live in the suburbs of Colombo and surrounding areas that would become employment centres such as EPZ and Industrial estates. New employment centres would be generated around the suburbs as well. Also, the expressway network would affect this population concentration. In some areas of the Kalutara District, rural conditions would transform to urban, especially along major roads and around the interchanges of the Southern Expressway. New development in the other provinces will take place. However, the central role of the Colombo Metropolitan Area as an economical capital would become stronger.

As a whole, many migrants would be attracted to the Western Province and the recent slow population growth would turn to rapid growth.

Scenario 2 Medium Growth with Moderate Urbanisation

Economic growth and urbanisation would continue moderately. As it has till now, the central area of Colombo would not show more population concentration, but suburbanisation would occur strongly and more people would come to suburban areas. In the Gampaha District, the population would grow continuously, but not drastically. The Kalutara District used to be rural, however, the Southern Highway would affect and change the growth scenario towards urban. On the other hand, the expected development in the other provinces would reduce growth and population concentration in the Western Province. However, the importance of Colombo Metropolitan Area would remain. As a total, more migrants than now would gradually come to the Western Province.

Scenario 3 Low Growth with Minor Social Change in Western Province

Even though the civil conflict ended in 2009, the population growth speed has been slow after 2009 up to now. Following this trend, economic and urban growth would not be expected to attain a high pace in the Western Province. Some of the population would be concentrated in Colombo, but more population will move outward. At the same time, the development in Hambantota and the northern and eastern part of the island will be promoted in the national policy, and more people would be attracted to these areas. As a result, negative migration of the Western Province would continue, and Colombo Metropolitan Area would not show a high population growth in this case.

(5) Projected Population to 2035

From the above scenarios, projected populations to 2035 are summarised in the following Table 4.2.1 and Figure 4.2.1.

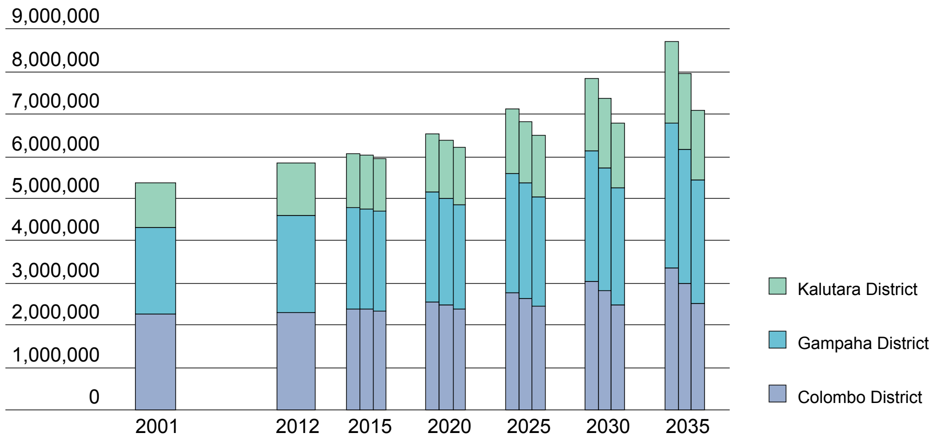
Population of the Western Province is now 5.8 million, and it is estimated to reach 8.7 million in the high growth scenario, 7.9 million in the medium growth scenario, and 7.1 million in the low growth scenario.

As for AAGR, historically it has been falling from 2.5% in the 1960's to 0.7% in the 2000's. By 2035, it would be raising to 2.0% in the high scenario, raising to 1.5%, which is the same as the AAGR between 1981 and 2001 in the medium growth scenario, and maintaining the same level as the current AAGR in the low growth scenario.

Table 4.2.1 Projected Population to 2035

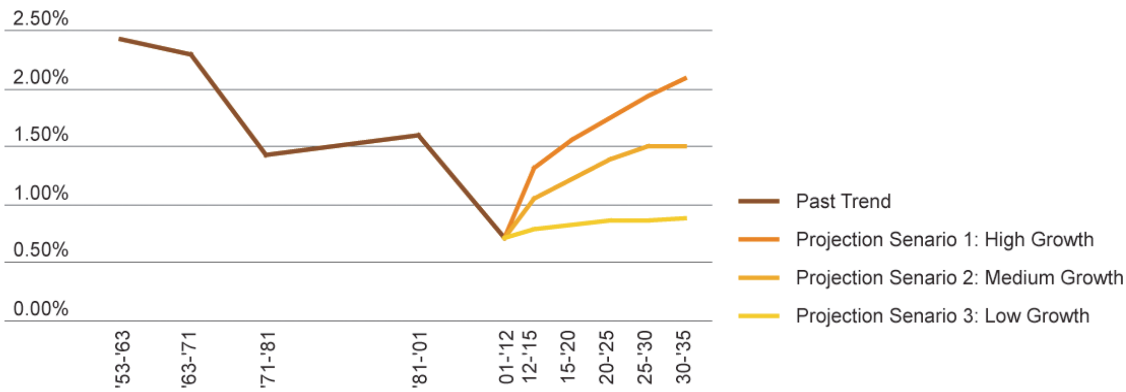
Scenario 1 High	**2001**	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
Colombo District	2,251,274	2,309,809	2,382,600	2,555,700	2,774,400	3,045,800	3,368,800
Gampaha District	2,063,684	2,294,641	2,393,200	2,586,000	2,821,400	3,101,800	3,435,900
Kalutara District	1,066,239	1,217,260	1,277,500	1,396,500	1,537,300	1,704,300	1,903,100
Western Province	5,381,197	5,821,710	6,053,300	6,538,200	7,133,100	7,851,900	8,707,800
AAGR		**'01-'12**	**'12-'15**	**'15-'20**	**'20-'25**	**'25-'30**	**'30-'35**
Colombo District		0.23%	1.04%	1.41%	1.66%	1.88%	2.04%
Gampaha District		0.97%	1.41%	1.56%	1.76%	1.91%	2.07%
Kalutara District		1.21%	1.62%	1.80%	1.94%	2.08%	2.23%
Western Province		0.72%	1.31%	1.55%	1.76%	1.94%	2.09%
Scenario 2 Mid	**2001**	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
Colombo District	2,251,274	2,309,809	2,359,400	2,476,100	2,624,400	2,795,900	2,979,700
Gampaha District	2,063,684	2,294,641	2,377,900	2,536,700	2,725,700	2,943,500	3,178,500
Kalutara District	1,066,239	1,217,260	1,270,200	1,373,200	1,492,100	1,629,700	1,782,000
Western Province	5,381,197	5,821,710	6,007,500	6,386,000	6,842,200	7,369,100	7,940,200
AAGR		**'01-'12**	**'12-'15**	**'15-'20**	**'20-'25**	**'25-'30**	**'30-'35**
Colombo District		0.23%	0.71%	0.97%	1.17%	1.27%	1.28%
Gampaha District		0.97%	1.20%	1.30%	1.45%	1.55%	1.55%
Kalutara District		1.21%	1.43%	1.57%	1.67%	1.78%	1.80%
Western Province		0.72%	1.05%	1.23%	1.39%	1.50%	1.50%
Scenario 3 Low	**2001**	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
Colombo District	2,251,274	2,309,809	2,332,500	2,379,500	2,428,700	2,480,200	2,534,100
Gampaha District	2,063,684	2,294,641	2,364,200	2,485,300	2,618,000	2,757,200	2,903,000
Kalutara District	1,066,239	1,217,260	1,262,800	1,346,700	1,437,000	1,534,600	1,640,600
Western Province	5,381,197	5,821,710	5,959,500	6,211,500	6,483,700	6,772,000	7,077,700
AAGR		**'01-'12**	**'12-'15**	**'15-'20**	**'20-'25**	**'25-'30**	**'30-'35**
Colombo District		0.23%	0.33%	0.40%	0.41%	0.42%	0.43%
Gampaha District		0.97%	1.00%	1.00%	1.05%	1.04%	1.04%
Kalutara District		1.21%	1.23%	1.29%	1.31%	1.32%	1.34%
Western Province		0.72%	0.78%	0.83%	0.86%	0.87%	0.89%

Source: CoMTrans Study Team



Note: After 2015, the projected populations are shown in the High, Medium, and Low growth scenarios.
Source: CoMTrans Study Team

Figure 4.2.1 Population Projections to 2035



Source: CoMTrans Study Team

Figure 4.2.2 Average Annual Growth Rates of Western Province to 2035

The population pyramids of the Western Province in 2035 according to these three scenarios are shown in Figure 4.2.3.

In the high scenario, it is obvious that more young people would come to the Western Province. On the other hand, in the low scenario, outward migration would reduce the population in all age groups.

Source: CoMTrans Study Team

Figure 4.2.3 Population Pyramids in Western Province in 2035

(6) Selected Growth Scenario

In the above mentioned three scenarios, the medium growth scenario is taken as an example.

Five years have passed after the end of the civil conflict and after that, the economic growth of Sri Lanka has been recovering favourably. These positive conditions attract more people to the Western Province and population growth would be expected. Under these conditions, the same growth rate as that of present in the scenario 3 – Low Growth - is not suitable for the future projection.

On the other hand, there is a population projection report, namely "A Population Projection in Sri Lanka – For the New Millennium 2001-2100" by W, Indralal De Silva, Institute of Health Policy. This mentioned the population of Sri Lanka decreasing at around 2030. High population growth in the nation would not be expected. There is another negative factor for the population growth of the Western Province; the development of the other regions would affect concentration of the population in the Western Province. By considering the factors, the rapid population growth mentioned as the scenario 1 –High Growth is also not likely to happen.

Therefore, scenario 2 - Medium Growth is taken for further forecasts of spatial distribution, framework by industry and students, population by income, day-time population and also traffic analyses.

4.2.2 Forecast of GRDP Growth

In order to project employed population by sector and population by income in the following sections, the GRDP of the Western Province is forecast.

<u>GDP Growth</u>

National GDP growth reached over 8% at 2010 and 2011. Now it has slowed down and became 6.4% in 2012. In the Western Province, nearly 45% of the National GDP is concentrated. These GDP growths are shown in the table below.

Table 4.2.2 GDP growth in Sri Lanka and Western Province

Year	Sri Lanka				Western Province			
	GDP in Sri Lanka (Current Prices) (Mil.Rs.)	GDP in Sri Lanka (Constant Prices) (Mil.Rs.)	GDP Deflator (Base Year 2002)	Annual GDP Growth	GRDP in WP (Current Prices) (Mil.Rs.)	GRDP in WP (Constant Prices) (Mil.Rs.)	Annual GRDP Growth	Share
2007	3,578,688	2,232,656	160		1,663,759	1,037,979		46.5%
2008	4,410,682	2,365,501	187	6.0%	2,003,055	1,074,024	3.5%	45.4%
2009	4,835,293	2,449,214	197	3.5%	2,216,346	1,122,769	4.5%	45.8%
2010	5,604,104	2,645,542	212	8.0%	2,512,908	1,186,453	5.7%	44.8%
2011	6,544,009	2,863,715	229	8.2%	2,905,159	1,271,404	7.2%	44.4%
2012	7,582,376	3,047,277	249	6.4%	* 3,336,245	* 1,340,802	* 5.5%	* 44.0%

Note: * Estimation, CoMTrans Study Team
Source: Central Bank of Sri Lanka

In Mahinda Chintana, which is a development policy framework of Sri Lanka setting out development visions for a ten year period, Sri Lanka is targeting that the annual GDP growth will hold at more than 8% continuously till 2016. On the other hand, IMF published the "World Economic Outlook – April 2013" and projected that GDP growths will be 6.3 % in 2013, 6.7% in 2014, and 6.5 % in 2018.

It is assumed that the high GDP growth targeted by the Sri Lankan government will not continue to 2035. The IMF assumption is taken. After 2018, the growth rate will gradually become lower since it is assumed that the GDP has become high and it is quite unlikely to keep the high rate of the growth rate as of now. It would drop to around 4% in 2035, as shown in Table 4.2.3.

Table 4.2.3 Assumption of GDP growth

Year	GDP Annual Growth Rate	Note
2013	6.3%	IMF Forecast
2014	6.7%	IMF Forecast
2015-2017	6.7%	Assumption
2018	6.5%	IMF Forecast
2019-2020	6.5%	Assumption
2012-2025	6.0%	Assumption
2026-2030	5.0%	Assumption
2031-2035	4.0%	Assumption

Source: "World Economic Outlook - April 2013 - Hopes, Realities, Risks", IMF and CoMTrans Study Team

<u>GRDP Growth</u>

It is also assumed GRDP growth in the Western Province would follow the national rate.

As for the GRDP growth by Sector, it is assumed that the share of the primary sector would decrease at the same rate of decrease as that in the employed population of the primary sector, which is described in the following section. The share of the secondary sector increased in the past five years at the annual average rate of 0.5%, and the share of the tertiary sector is slowly decreasing at the annual average rate of -0.3%. It would continue till 2035 at the same trend.

Table 4.2.4 shows GRDP forecast by each industrial sector.

Table 4.2.4 GRDP Forecast

	GRDP (Constant Price) (Mil. Rs.)	GRDP of Primary Industry **(Mil. Rs.)**	GRDP Secondary Industry **(Mil. Rs.)**	GRDP Tertiary Industry **(Mil. Rs.)**	*Share of Primary Industry*	*Share of Secondary Industry*	*Share of Tertiary Industry*
2007*	**1,037,979**	30,101	331,115	675,724	*2.9%*	*31.9%*	*65.1%*
2008*	**1,074,024**	33,295	340,466	700,264	*3.1%*	*31.7%*	*65.2%*
2009*	**1,122,769**	31,438	370,514	720,818	*2.8%*	*33.0%*	*64.2%*
2010*	**1,186,453**	35,594	378,479	771,195	*3.0%*	*31.9%*	*65.0%*
2011*	**1,271,404**	40,685	415,749	814,970	*3.2%*	*32.7%*	*64.1%*
2012**	**1,340,802**	42,906	438,442	859,454	*3.2%*	*32.7%*	*64.1%*
2015***	**1,603,800**	47,900	532,300	1,023,600	*3.0%*	*33.2%*	*63.8%*
2020***	**2,209,700**	58,900	751,800	1,399,000	*2.7%*	*34.0%*	*63.3%*
2025***	**2,971,100**	70,600	1,036,200	1,864,300	*2.4%*	*34.9%*	*62.7%*
2030***	**3,828,000**	81,200	1,368,500	2,378,300	*2.1%*	*35.7%*	*62.1%*
2035***	**4,702,200**	88,900	1,723,200	2,890,100	*1.9%*	*36.6%*	*61.5%*

Note: * Source: Central Bank of Sri Lanka, ** Estimation, CoMTrans Study Team, *** Projection, CoMTrans Study Team

4.2.3 Forecast of Employed Population

Employed population is forecast by the following process:

1) Projection of Working Age population
2) Projection of Labour Force (Economically Active Population):
3) Projection of Unemployed Population / Employed Population
4) Projection of Employed Population by Sector:

The Technical Report No.4 describes more details.

(1) Working Age Population

In the case of Sri Lankan statistics, the Working Age population is defined as those people in the population aged 10 years and over. The working age populations by GND are available in the census of 2001. Although the population details of the 2012 Census by age have not been published yet, the CoMTrans Study Team has estimated the population by Cohort. Future population projections are calculated by cohort analysis by the CoMTrans Study Team as well. Thus, estimated and projected working age populations are shown in Table 4.2.5

(2) Labour Force Participation Rate and Economically Active Population

For the future, it is assumed that the labour force participation rate would decrease due to the following factors, which are assumed to occur in the course of the development in the Western Province.

a) Decreasing Working Age Population: The population share of 15 to 60 years old was 67% in 2001, 64% in 2012 according to the Census of Population and Housing 2001 and 2012, and it would drop to 57 % in 2035 according to the estimation by the CoMTrans Study Team. This is considered as a base of the future economically active population.

b) Increasing School Enrolment: The Sri Lankan government has a policy to increase the number of students of secondary and tertiary education. In the course of the policy, it is assumed that the number of students will increased. This increase of the student population will cause a decrease in the economically active population.

c) Women's Social Progress: More women will have jobs. This will increase the Labour Force Participation Rate. In the Western Province, the rate of female employed population is assumed to increase continuously at the same level as the national trend.

Thus, the economically active populations are forecast as shown in Table 4.2.5.

(3) Employment / Unemployment Rates and Employed Population

The unemployment rate improved from 2001 to 2011, from 7.7% to 3.5% in the Western Province. The unemployment rate in 2012 would hold the same level since the unemployment rates are already low in comparison with other countries. According to the estimated and forecast unemployment rate, employed populations are projected in the following Table 4.2.5.

Table 4.2.5 Employed Population Forecast

		2001	2012	2015	2020	2025	2030	2035
Total Population	Colombo Dis.	2,251,274	2,309,809	2,359,400	2,476,100	2,624,400	2,795,900	2,979,700
	Gampaha Dis.	2,063,684	2,294,641	2,377,900	2,536,700	2,725,700	2,943,500	3,178,500
	Kalutara Dis.	1,066,239	1,217,260	1,270,200	1,373,200	1,492,100	1,629,700	1,782,000
	Western Prov.	**5,381,197**	**5,821,710**	**6,007,500**	**6,386,000**	**6,842,200**	**7,369,100**	**7,940,200**
10 years and over Population	Colombo Dis.	1,924,867	1,949,970	1,986,800	2,086,300	2,220,200	2,374,800	2,540,900
	Gampaha Dis.	1,739,940	1,928,702	2,004,600	2,157,500	2,330,600	2,521,700	2,732,600
	Kalutara Dis.	892,511	1,006,632	1,051,600	1,145,200	1,253,600	1,376,300	1,511,900
	Western Prov.	**4,557,318**	**4,885,304**	**5,043,000**	**5,389,000**	**5,804,400**	**6,272,800**	**6,785,400**
Economically Active population	Colombo Dis.	912,231	906,811	915,000	950,900	1,009,900	1,078,800	1,152,900
	Gampaha Dis.	824,425	827,438	857,600	919,700	992,000	1,071,800	1,159,600
	Kalutara Dis.	395,777	464,605	483,600	522,300	568,300	621,800	682,200
	Western Prov.	**2,132,433**	**2,198,854**	**2,256,200**	**2,392,900**	**2,570,200**	**2,772,400**	**2,994,700**
Labour Force participation Rate	Colombo Dis.	47.4%	46.5%	46.1%	45.6%	45.5%	45.4%	45.4%
	Gampaha Dis.	47.4%	42.9%	42.8%	42.6%	42.6%	42.5%	42.4%
	Kalutara Dis.	44.3%	46.2%	46.0%	45.6%	45.3%	45.2%	45.1%
	Western Prov.	**46.8%**	**45.0%**	**44.7%**	**44.4%**	**44.3%**	**44.2%**	**44.1%**
Employed Population	Colombo Dis.	855,142	880,303	888,100	923,100	980,300	1,047,100	1,119,000
	Gampaha Dis.	756,186	794,738	823,600	883,200	952,500	1,029,300	1,113,700
	Kalutara Dis.	356,837	444,964	463,200	500,200	544,300	595,600	653,600
	Western Prov.	**1,968,165**	**2,120,005**	**2,174,900**	**2,306,500**	**2,477,100**	**2,672,000**	**2,886,300**
Unemployment Rate	Colombo Dis.	6.3%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%
	Gampaha Dis.	8.3%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
	Kalutara Dis.	9.8%	4.2%	4.2%	4.2%	4.2%	4.2%	4.2%
	Western Prov.	**7.7%**	**3.6%**	**3.6%**	**3.6%**	**3.6%**	**3.6%**	**3.6%**

Note: 2001: Census of Population and Housing 2001, Department of Census and Statistics
2012: Estimation by CoMTrans Study Team based on the preliminary result of Census of Population and Housing 2012 and Sri Lanka Labour Force Survey Annual Report 2011, the Department of Census and Statistics
2015-2035: Estimation based on the population projection (medium growth scenario), CoMTrans Study Team

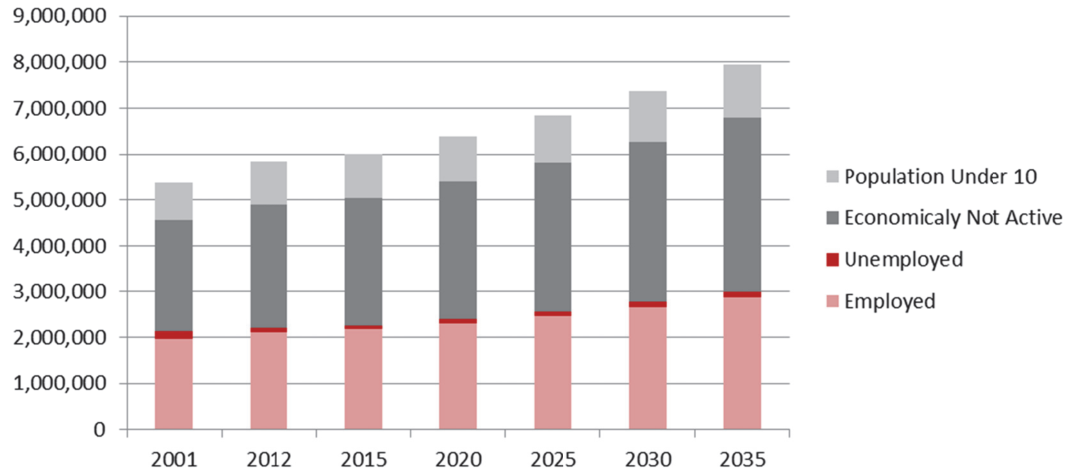


Figure 4.2.4 Proportion of Forecast Employed Population in Western Province

(4) Forecast of Employed Population by Industrial Sector

In the past ten years in Sri Lanka, the employed population share of the primary sector was slowly decreasing, the secondary sector was increasing, and the tertiary sector was almost stable. These are shown in Table 4.2.6.

Table 4.2.6 Population Share by Industrial Sector in Sri Lanka (2003-2012)

Employed Population Share by Industrial Sector (%)	2003 (a)	2004 (b)	2005 (c)	2006 (d)	2007 (d)	2008 (a)	2009 (a)	2010 (a)	2011 (c)	2012 (c)
Primary Sector	34.0	33.5	30.7	32.2	31.3	32.6	32.6	32.7	33.0	31.0
Secondary Sector	21.8	22.9	25.6	26.6	26.6	26.2	25.2	24.2	24.1	26.1
Tertiary Sector	44.2	43.6	43.7	41.3	42.1	41.3	42.4	43.1	42.8	43.0

Note: (a) Data excludes the Northern Province, (b) Data excludes both Mullaitivu and Kilinochchi districts, (c) Data covers the entire island, (d) Data excludes both Northern and Eastern Provinces, (e) Data includes Mining & Quarrying, Electricity, Gas & Water sub sectors also.

Source: Economic and Social Statistics of Sri Lanka 2013, Central Bank, Department of Census and Statistics

In the trend of the Sri Lanka, population share of the primary sector has been decreasing slowly. On the other hand, the secondary sector has been increasing. The tertiary sector was decreasing till 2006, however, recently it is increasing. The population share of the employed population in the Western Province is as follows; Primary Sector 6%, Secondary Sector 33% and Tertiary Sector 61%. Obviously, the share of the service sector in the Western Province is much higher than the national level.

For the future, it is assumed that the primary sector will be decreasing, and the tertiary sectors will be growing more, in general. In the Gampaha district, there is an international airport and a proposed junction of the expressway network (CKE, OCH, and Northern Expressway). It may affect the concentration of the secondary sector. In the Kalutara District, the Southern

Expressway has been opened and land availability will attract industry activities as well.

The projections for the industrial sector were given by the following assumptions:

a) Primary Sector

The employed population of the primary sector would decrease following urbanisation in the Western Province. Agricultural lands are assumed to decrease due to the population growth. It is forecasted that approximately 500,000 houses will be required by 2035 in the Western Province. For those houses, 8,200 ha from agricultural land are required to convert for residential use. From the land use survey, there are 88,000 ha in agricultural use, therefore 9% of the agricultural land would be diverted to residential areas.

At the same time, lands used for manufacturing, commercial, and infrastructure should be considered. It is assumed that those lands would increase at the same rate as the increasing population. As a result, 2% of the agricultural land is required for those land uses.

In total, 11% of the agricultural land would be converted to the residential and other built-up land.

The employed population of the primary sector would decrease at the same rate as the decreasing agricultural land. As a result, the employed population of the primary sector will decrease from 117,400 in 2012 to 97,400 in 2035.

b) Secondary and Tertiary Sectors

From the forecast of GRDP and population, GRDP per capita can be calculated and it is increasing annually by 4.2%. By considering the increasing productivity of the secondary sector, GRDP per capita of the secondary sector is increasing at a higher rate than that of the tertiary sector. This means that GRDP per capita in the industrial sector in 2035 would be 1,931,000 and the tertiary sector would be 1,527,000.

From the forecast of GRDP by industrial sector, the employed populations by sectors can be projected. The employed population of the secondary sector in 2035 would be 897,000, which is 200,000 larger than 2012, and the employed population of the tertiary Sector in 2035 would be 1,891,000, which is 600,000 larger than 2012. This is deemed reasonable when new developments, new urban centres, and the possibilities of expansion of the industrial activities are considered.

Accordingly, projected employed populations by industrial sector are shown in Table 4.2.7.

Table 4.2.7 Projected Employed Populations by Industry Sector

		2001	2012	2015	2020	2025	2030	2035
Colombo District	Primary Sector	20,392	20,052	18,700	17,000	15,700	14,500	13,300
	Secondary Sector	245,492	251,083	249,300	251,600	258,400	266,400	273,800
	Tertiary Sector	589,258	609,169	620,000	654,500	706,100	766,200	831,900
	Share of Primary Sec.	*2.4%*	*2.3%*	*2.1%*	*1.8%*	*1.6%*	*1.4%*	*1.2%*
	Share of Secondary Sec.	*28.7%*	*28.5%*	*28.1%*	*27.3%*	*26.4%*	*25.4%*	*24.5%*
	Share of Secondary Sec.	*68.9%*	*69.2%*	*69.8%*	*70.9%*	*72.0%*	*73.2%*	*74.3%*
Gampaha District	Primary Sector	40,055	38,853	38,200	36,600	34,900	33,100	31,100
	Secondary Sector	305,194	319,025	328,300	347,900	376,700	408,200	435,100
	Tertiary Sector	410,937	436,860	457,100	498,800	541,000	588,000	647,400
	Share of Primary Sec.	*5.3%*	*4.9%*	*4.6%*	*4.1%*	*3.7%*	*3.2%*	*2.8%*
	Share of Secondary Sec.	*40.4%*	*40.1%*	*39.9%*	*39.4%*	*39.5%*	*39.7%*	*39.1%*
	Share of Secondary Sec.	*54.3%*	*55.0%*	*55.5%*	*56.5%*	*56.8%*	*57.1%*	*58.1%*
Kalutara District	Primary Sector	57,668	58,574	58,400	57,500	55,400	54,200	52,900
	Secondary Sector	99,675	129,343	134,500	145,100	158,100	172,400	188,300
	Tertiary Sector	199,494	257,048	270,300	297,600	330,900	368,900	412,300
	Share of Primary Sec.	*16.2%*	*13.2%*	*12.6%*	*11.5%*	*10.2%*	*9.1%*	*8.1%*
	Share of Secondary Sec.	*27.9%*	*29.1%*	*29.0%*	*29.0%*	*29.0%*	*29.0%*	*28.8%*
	Share of Secondary Sec.	*55.9%*	*57.8%*	*58.4%*	*59.5%*	*60.8%*	*61.9%*	*63.1%*
Western Province	Primary Sector	118,115	117,478	115,300	111,100	106,000	101,800	97,300
	Secondary Sector	650,361	699,451	712,100	744,600	793,200	847,000	897,200
	Tertiary Sector	1,199,689	1,303,076	1,347,400	1,450,900	1,578,000	1,723,100	1,891,600
	Share of Primary Sec.	*6.0%*	*5.5%*	*5.3%*	*4.8%*	*4.3%*	*3.8%*	*3.4%*
	Share of Secondary Sec.	*33.0%*	*33.0%*	*32.7%*	*32.3%*	*32.0%*	*31.7%*	*31.1%*
	Share of Secondary Sec.	*61.0%*	*61.5%*	*62.0%*	*62.9%*	*63.7%*	*64.5%*	*65.5%*

Note: 2001: Census of Population and Housing 2001, Department of Census and Statistics
2012: Estimation by CoMTrans Study Team based on the preliminary result of Census of Population and Housing 2012 and Sri Lanka Labour Force Survey Annual report 2011, Department of Census and Statistics
2015-2035: Projection, CoMTrans Study Team

4.2.4 Forecast of Student Population

Since the result of Census 2012 is not published yet, the latest information for students is taken from the CoMTrans Home Visit Survey 2013. Based on the survey and government policies on education, future student populations are forecast.

a) School Students of Grade 1-10

This is the compulsory education period. It is assumed that the enrolment rate would not be changed drastically, since the primary education system in Sri Lanka has already been established and the enrolment rate is fairly high, approximately 95%. Only the proportion of school-age population would affect the school enrolment rate.

b) School Student of G.C.E. (Ordinary Level)

The forecast is based on the national policy to widen the opportunity for education for all children. The policy was mentioned in the 2012 Annual Performance Report, ministry of Education as "National Development Targets in Education and Strategic Plan for the period of 2012 – 2016". In the report, a target was set as increasing the survival rate from 85% to 90% up to G.C.E. (O/L).

According to the CoMTrans Home Visit Survey, school enrolment rate of G.C.E. (O/L) is 85% in the Colombo District, 76% in the Gampaha District, and 67% in the Kalutara District.

The Colombo Districta lready has a high rate, and the target of 90% can be achieved by 2016. For the Gampaha and Kalutara Districts, the target is too high to be reached by 2016. It is assumed that the target would be achieved by 2020 in the Gampaha District and by 2025 in the Kalutara District. After that, the enrolment rate would be static till 2035.

c) School Students of G.C.E. Advanced Level

This forecast is also based on the national policy mentioned in the 2012 Annual Performance Report, Ministry of Education. It mentioned increasing the percentage of students passing the G.C.E (O/L) examination from 61% to 75%.

According to the CoMTrans Home Visit Survey, the rate is 62% in the Colombo District, 57% in the Gampaha District, and 55% in the Kalutara District.

It is assumed that the target of 75% by 2016 is too high. The target would be achieved by 2020 in the Colombo District, and by 2025 in the Gampaha and Kalutara Districts. After that, the rate would be static till 2035.

d) University Students

The forecast is based on the national policy to widen the opportunity for higher education. The National Higher Education Strategic Management Plan of the Sri Lanka 2012-2015 Mid Term Plan (The Ministry of Education) described the target, that the gross enrolment ratio in higher education will rise from 15% in 2011 to 20% in 2035, and students of state universities will increases from 22,000 in 2011 to 25,500 in 2015.

According to the CoMTrans Home Visit Survey, the enrolment ratio of higher education is 19% in the Colombo District, 12% in the Gampaha District, and 7% in the Kalutara District.

Colombo District already has a high rate, and the target of 20% can be achieved by 2015. For the Gampaha and Kalutara Districts, the target is too high to be reached by 2015. It is assumed that the target would be achieved by 2020 in the Gampaha District and by 2025 in the Kalutara District. After the achievement, it is assumed that the rate will increase to 25% by 2035. Since the number of students of G.C.E. (A/L) will be increased, the rate of 25% is required in order to secure the rate of successful applicants for university to the same level.

e) Students of Other Types of Schools

It is assumed that the other types of school students will increase as well, due to increasing the employed population of the tertiary sector. There are not enough data available, but students who passed G.C.E (A/L) examination would pursue the other types of schools such as vocational schools. Therefore, it is assumed that the increase of the other types of school students will follow the same rate as the G.C.E. (A/L) student.

f) Kindergarten

Due to women's social progress, it is assumed that the number of young children participating Kindergarten will increase at the same rate as the female employment.

Accordingly, the following Table 4.2.8 shows the existing and projected student populations:

Table 4.2.8 Projected Student Populations in Western Province and CMA

Western Province	2012	2015	2020	2025	2030	2035
Total Population	**5,821,710**	**6,007,500**	**6,386,000**	**6,842,200**	**7,369,200**	**7,940,200**
Kindergarten	**15,982**	**17,100**	**18,200**	**19,400**	**20,800**	**22,200**
School Students (Grade1-G.C.E.(A/L)	**1,131,382**	**1,197,000**	**1,318,400**	**1,419,200**	**1,501,800**	**1,587,300**
Students (grade1 - grade5)	422,049	438,100	461,600	474,300	504,500	532,800
Students (grade6 - grade8)	276,612	290,400	315,900	336,900	349,800	373,300
Students (grade9 - grade10)	170,290	178,800	194,500	207,500	215,500	229,900
Students (G.C.E. (O/L))	123,303	135,500	157,800	178,000	192,000	200,600
Students (G.C.E. (A/L))	139,128	154,200	188,600	222,500	240,000	250,700
University Students	**42,398**	**48,200**	**65,800**	**83,000**	**99,500**	**116,400**
Other Students	**27,681**	**32,000**	**39,100**	**46,200**	**49,800**	**52,000**
Total Students	**1,217,442**	**1,294,300**	**1,441,500**	**1,567,800**	**1,671,900**	**1,777,900**
% of Student Population to Total	*20.9%*	*21.5%*	*22.6%*	*22.9%*	*22.7%*	*22.4%*

Source: CoMTrans Study Team

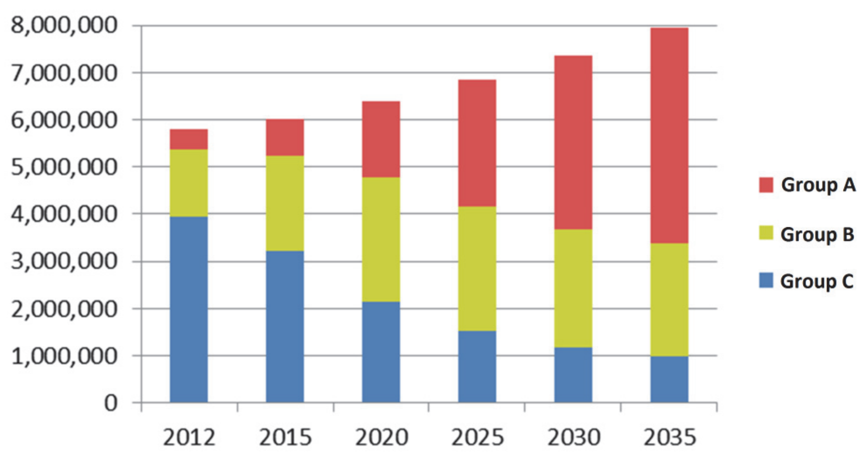
4.2.5 Forecast of Population by Income Group

Considering the economic growth mentioned above, it is assumed that income for households would simply grow at the same rate of the GRDP growth projection. The following Table 4.2.9 and Figure 4.2.5 show the projected population by income level. In 2012, 68% of total population was Group C and only 8% was Group A. In 2035 the Group C population will be less than 1 million, which is 13% of the total projected population, and over 4.5 million will be in the Group A population, which is 57% of the total.

Table 4.2.9 Projected Population by Income Level in Western Province

Year	Group C Less than Rs. 40,000		Group B Rs. 40,000 - 79,999		Group A Rs. 80,000 and Above	
	Population	%	Population	%	Population	%
2012	3,947,663	*67.8%*	1,419,174	*24.4%*	443,912	*7.6%*
2015	3,226,500	*53.7%*	2,016,500	*33.6%*	764,500	*12.7%*
2020	2,143,600	*33.6%*	2,623,500	*41.1%*	1,618,900	*25.4%*
2025	1,520,500	*22.2%*	2,636,900	*38.5%*	2,684,800	*39.2%*
2030	1,181,400	*16.0%*	2,503,200	*34.0%*	3,684,600	*50.0%*
2035	994,500	*12.5%*	2,386,800	*30.1%*	4,558,900	*57.4%*

Note: 2012 Estimation from CoMTrans Home Visit Survey. Income Unknown: 10,961 (0.2%)
2015-2035 projection, CoMTrans Study Team



Source: CoMTrans Study Team

Figure 4.2.5 Proportion of Projected Population by Income Level in Western Province

4.3 Urban Structure of the Western Province

4.3.1 Envisioned Urban Centres and Urbanised Area

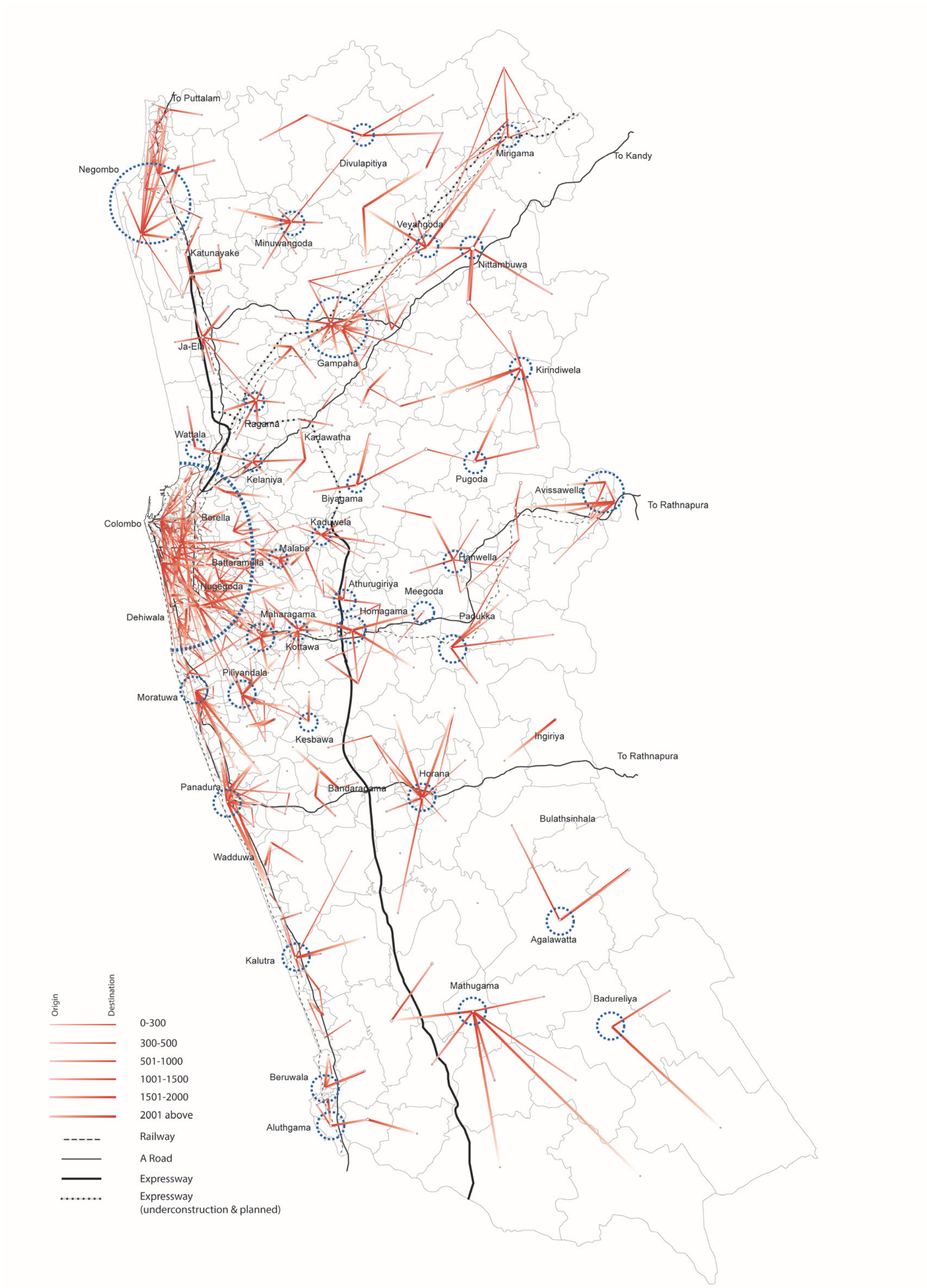
In the same way that urban structures were considered based on the factors mentioned in section 4.1, identifying urban centres is an essential step to formulate the urban structure.

Commuter trips are a new finding from the CoMTrans Home Visit Survey, in addition to the current land use, population density, and other factors. It guides the identification of urban centres as a base of urban structure. Figure 4.3.1 shows desire lines for OD pairs with the two highest trip rates (Home-to-Other) in the Western Province. The origins and destinations show urban units, and this becomes clearer in observing the trip ends.

In the Colombo District, without considering the concentration in Colombo, urban centres are found along the High Level Road, Maharagama, Kottawa, and Homagama. And they are also connecting to the centre of Colombo. Trips to Avissawella and Padukka are more independently concentrated, and it is assumed that they have their own centrality.

In the Gampaha District, there are strong connections along the railway line. Gampaha is the centre of the trips along the railway. Trips to Minuwangoda, Mirigama, Ragama and Ja-Ela are also concentrated. Especially, the concentration in Negombo is independent from Colombo and shows its own centrality.

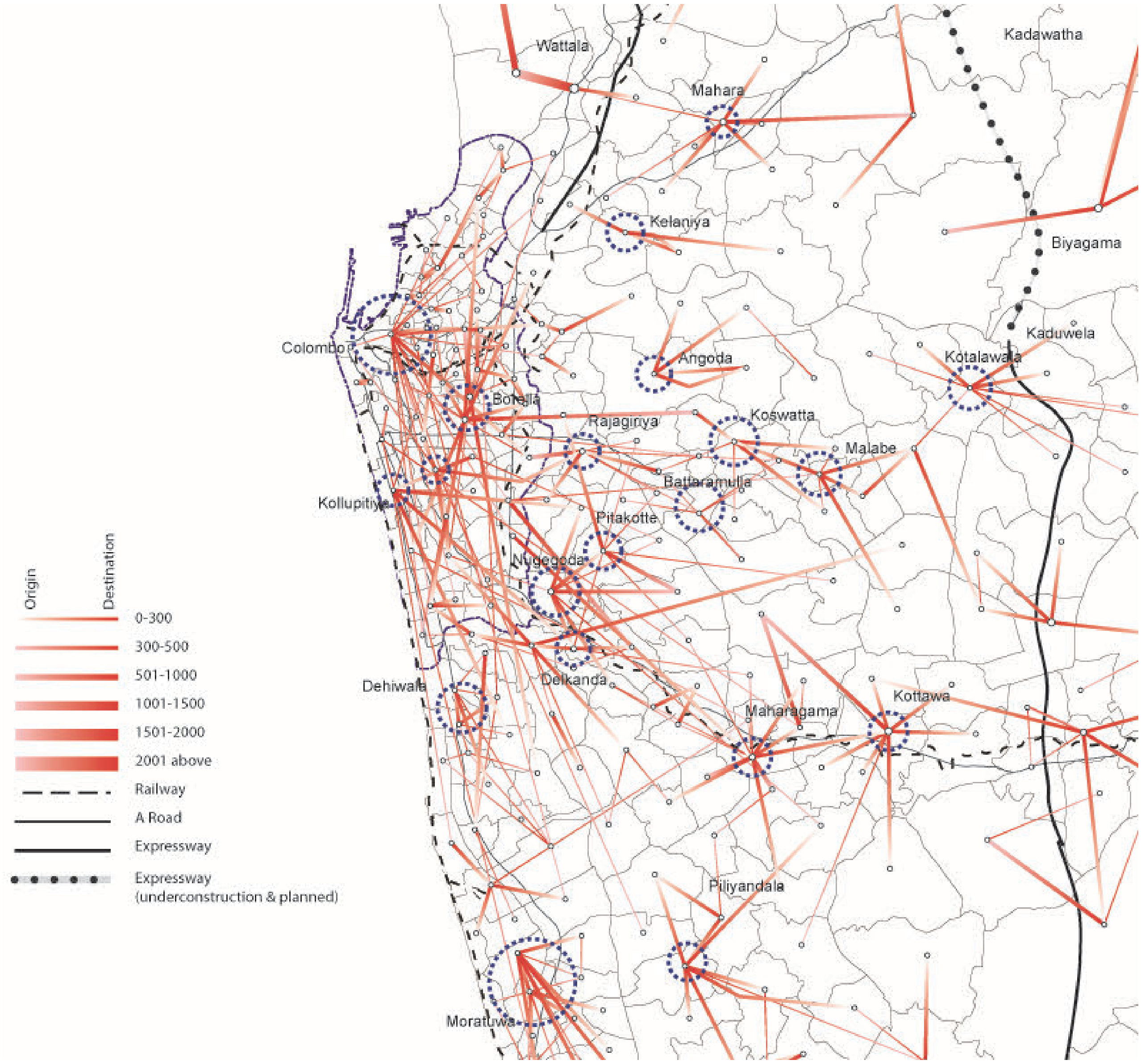
In the Kalutara District, the trips show urban centres along the Galle Road. At the same time, concentration in Horana is also found in the northern part of Kalutara District. Matugama is assumed to be the centre of the rural area having a concentration of trips.



Source: CoMTrans Home Visit Survey 2013

Figure 4.3.1 Desire Line for OD Pairs with the 2 Highest Trip Rates in Western Province

Figure 4.3.2 shows desire lines for OD pairs with the two highest trip rates (Home-to-Other) around CMC. Pettah, Borella, and Kollupitiya are the major destinations in CMC. Nugegoda and Dehiwala are also concentrated. Battaramulla shows a few concentrations in terms of the trip ends.



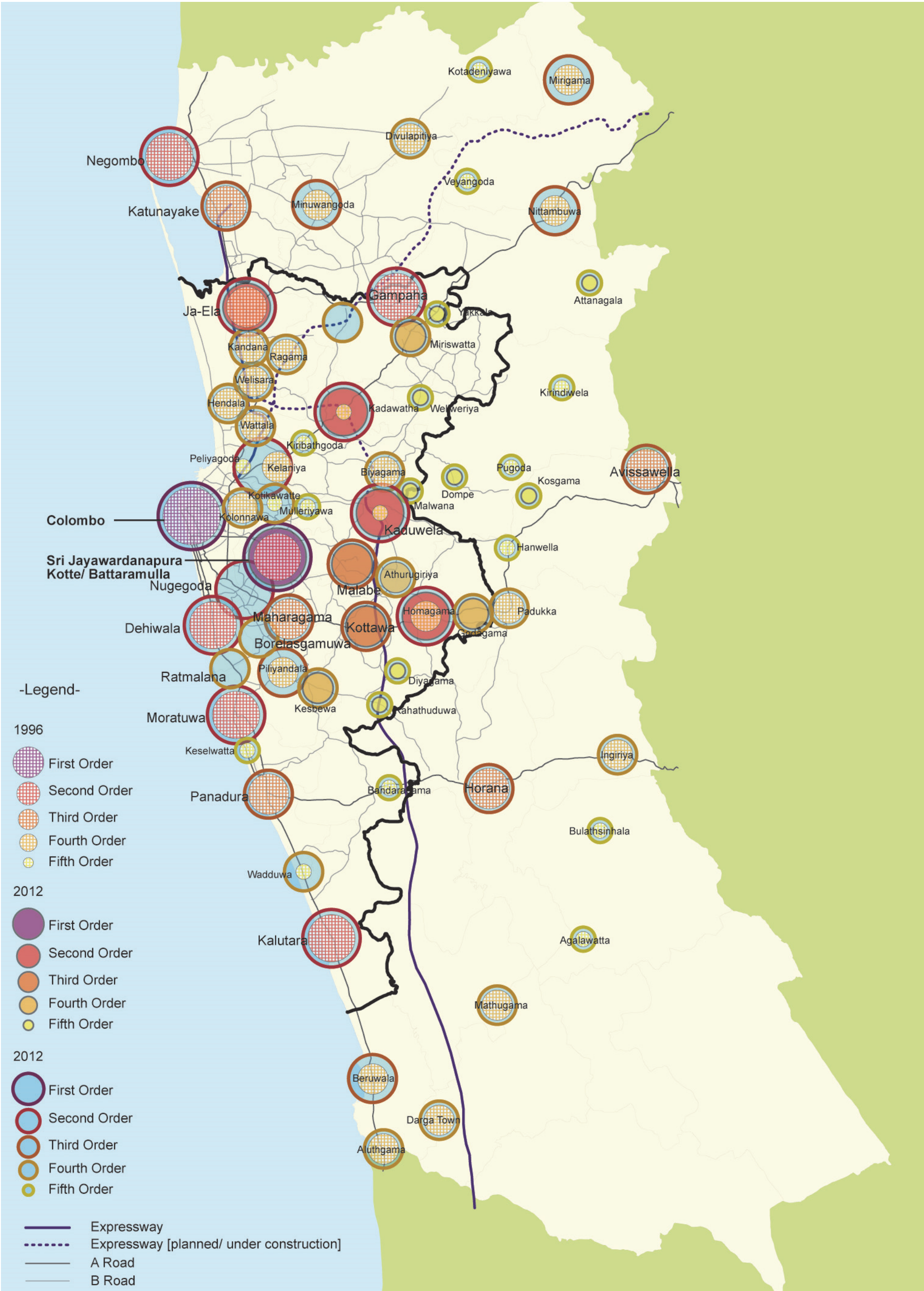
Source: CoMTrans Home Visit Survey 2013

Figure 4.3.2 Desire Line for OD Pairs with the 2 Highest Trip Rates around CMC

The figures above show where the active commercial and business areas are in the present condition, namely, urban centres. In the future, a strategic scenario is to be adapted and major urban centres identified, as shown in Figure 4.3.3.

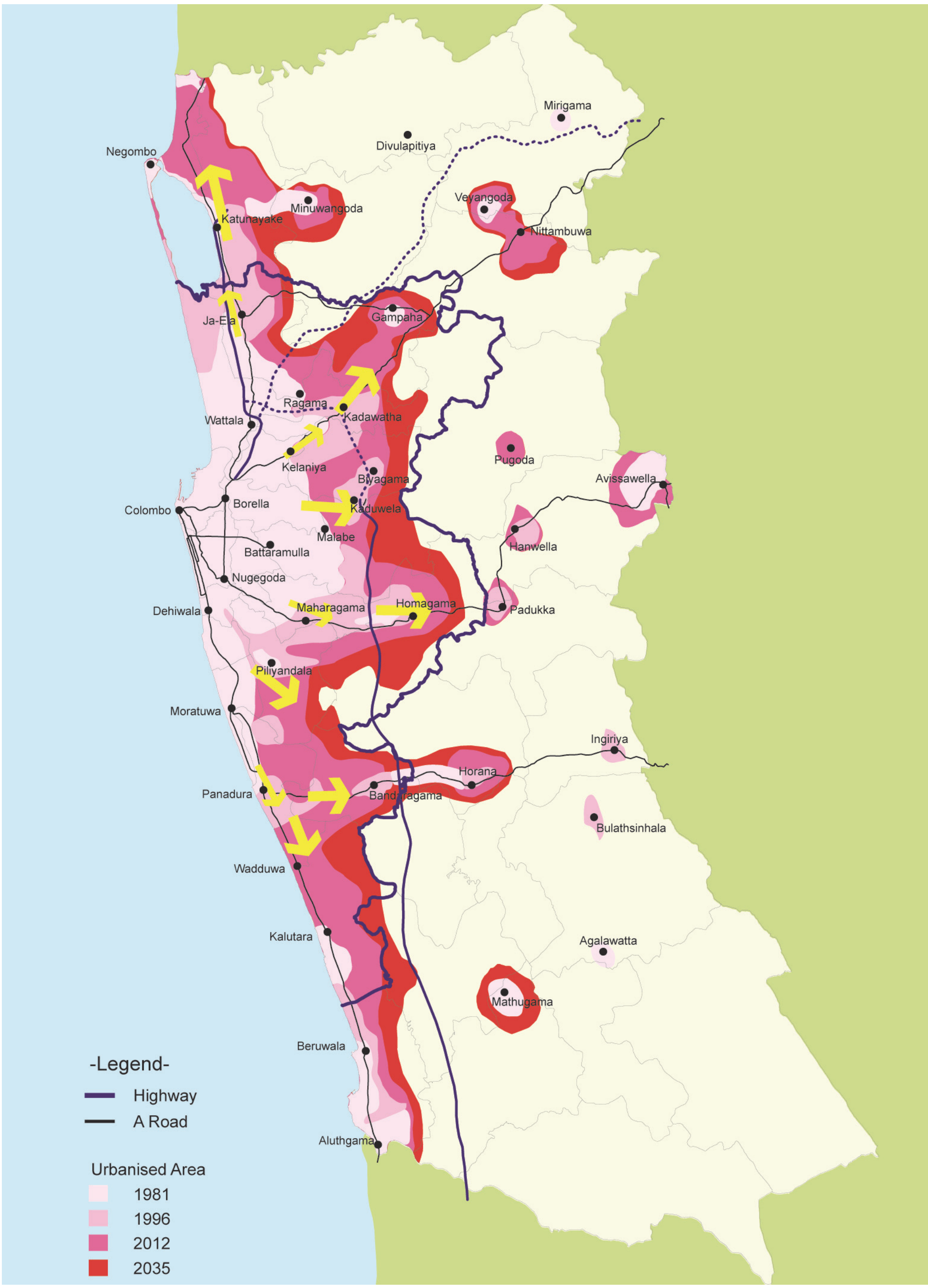
Based on the envisioned urban centres, the population forecast, and past trend of the expansion of urbanised area, the future urbanised area for 2035 is presumed as shown Figure 4.3.4

Both of the envisioned urban centres and urbanised area would be the basis of formulating urban structure.



Source: CoMTrans Study Team

Figure 4.3.3 Envisioned Urban Centres for 2035

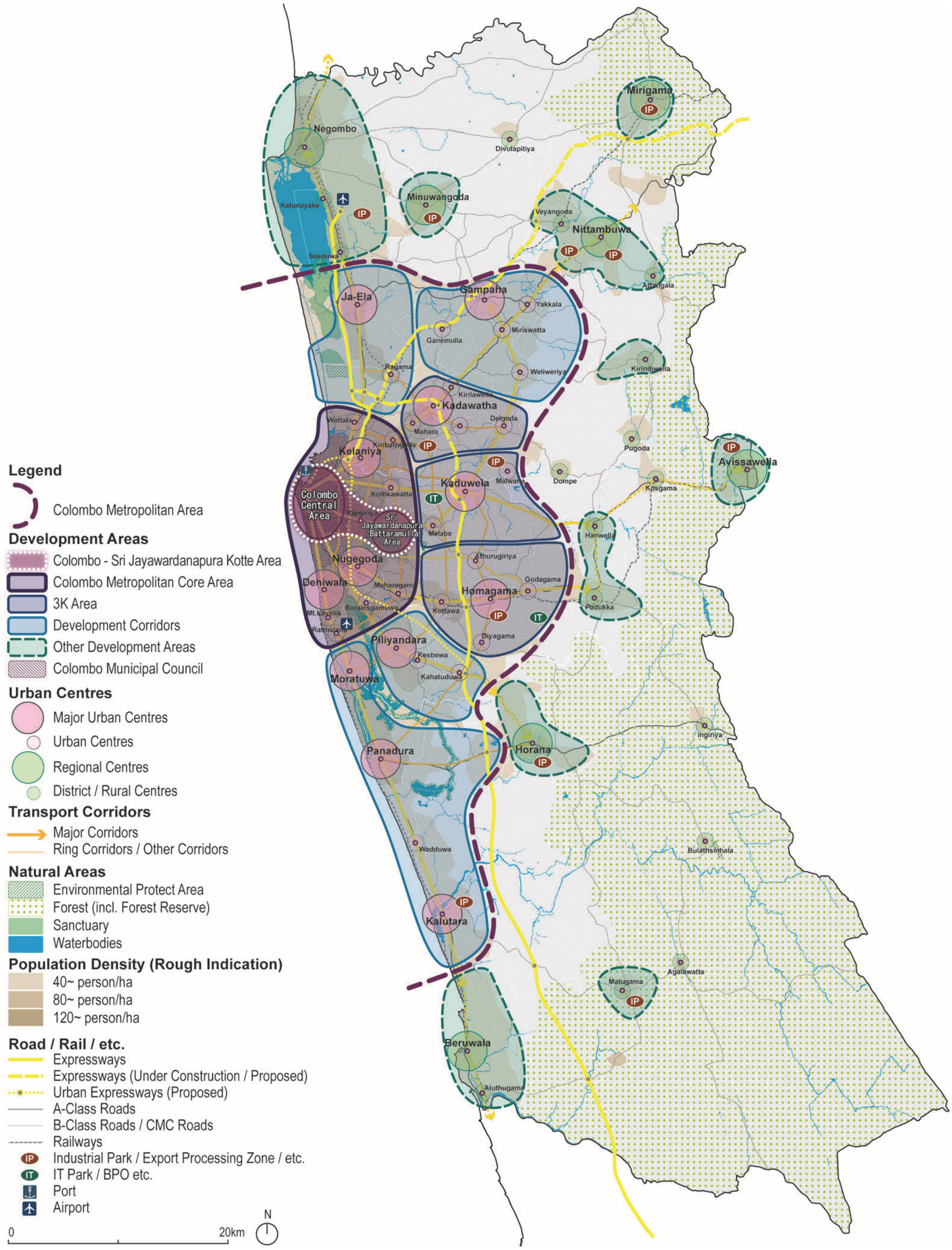


Source: CoMTrans Study Team

Figure 4.3.4 Envisioned Urbanised Area for 2035

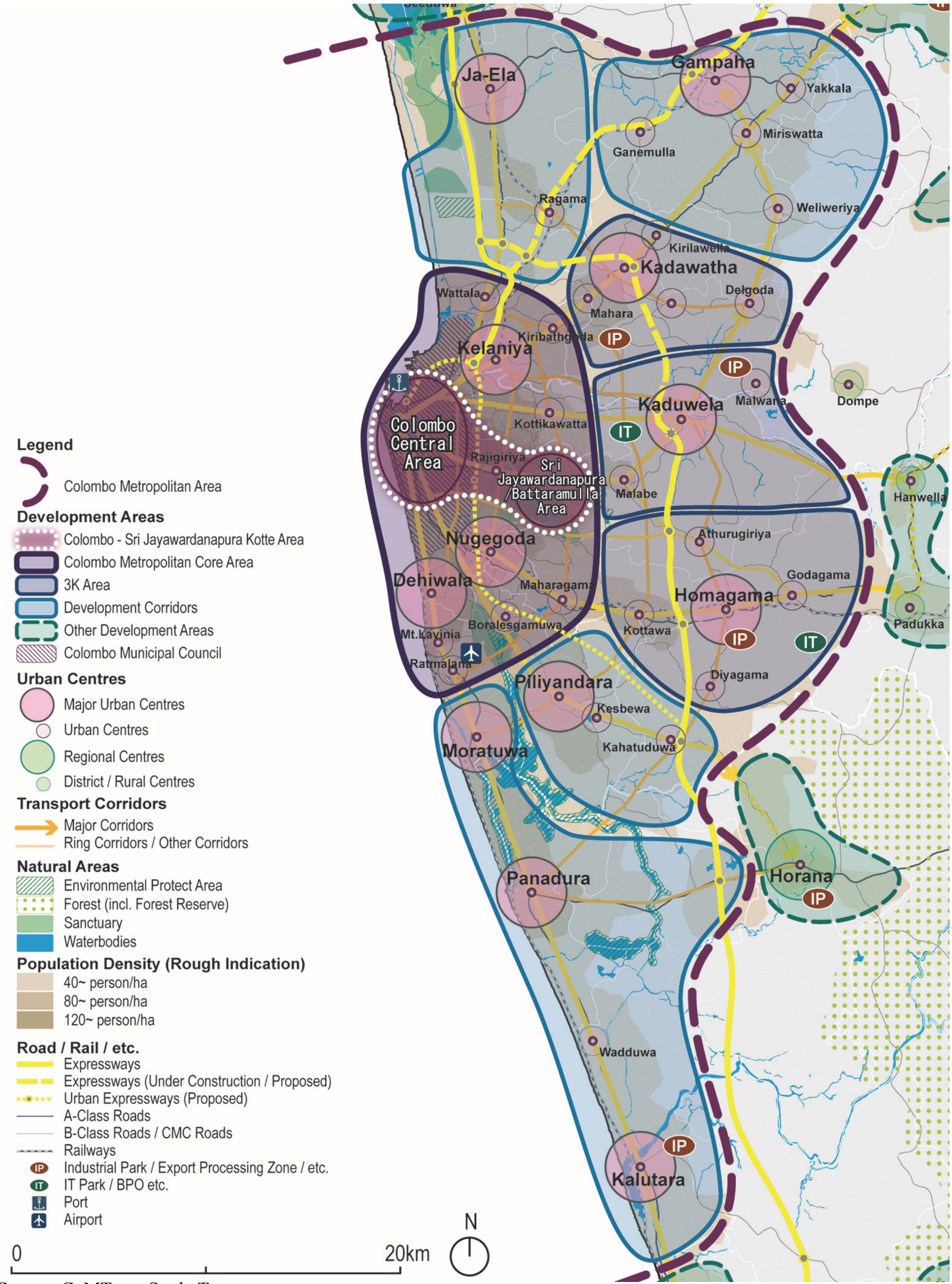
4.3.2 Urban Structure

Agglomerations of urbanised areas are characterised by the corridors or other special functions, and clustered. Thus, the urban structure of the Western Province is formulated as shown in Figure 4.3.5, and CMA is enlarged in Figure 4.3.6.



Source: CoMTrans Study Team

Figure 4.3.5 Envisioned Urban Structure of Western Province



Source: CoMTrans Study Team

Figure 4.3.6 Envisioned Urban Structure of CMA

CMA consists of the Colombo Metropolitan Core including the administrative and economic capital area, and other development areas. Urban Centres are scattered around CMA, and they are centres of urban services and activities. The importance of the centres can be defined depending on the characteristics of each urban area.

Population density is one of the indicators to explain the urban structure functioned efficiently in terms of the concentration to the sub-centres. At the present, the population density is 20 persons/ha, which is low for an urbanised area. Following the urbanisation projected in the CMA, the population density would be increased to approximately 40 persons/ha, and the main land use would be residential. Within the area, some urban centres would be located, and they would have more dense residential area and commercial and business activities. The population density of these urban centres would be approximately 80 persons/ha. At the same time, some natural elements such as wetlands should be retained in the CMA. Urban activities and environmental areas would be able to coexist and provide sustainable environment.

In terms of population density, CMA would function well with a population density of 40 persons/ha as it is an urbanised area. While the main land use is residential, it should have a higher population density, as it has a low density at the present with roughly 20 persons/ha. However, around the urban centres it is denser with some 80 persons/ha. In this area, some natural elements such as wetlands should be retained and urban activities and environmental areas should coexist.

Outside of CMA, there are some urban centres which are relatively independent from the Centre of Colombo where most economic activities are concentrated. They are the centres of rural regions.

A Transport Network plan as well as a Land Use plan should be established effectively in order to achieve sustainable development in CMA.

Each area in the urban structure is described as follows.

(1) Colombo Metropolitan Core

The area is identified as having an agglomeration of continuous urban conditions from the centre of Colombo, where most economic activities are concentrated. The political capital, Sri Jayawardenapura Kotte is in the Colombo Metropolitan Core as well. This area is the centre of Sri Lanka, economically and administratively.

In the Colombo Metropolitan Core, population density will rise to 80 persons/ha. The area targets more active urban activities. Especially, in the Colombo Central Area, the resident population is decreasing, but more commercial and business enterprises will concentrate there. This area has had a high residential population density with as much as 160 persons/ha. Some residential areas would be replaced with commercial/business areas. Therefore the population density of residents will decrease from 120 persons/ha.

1) **Colombo Central Area:** Mainly made up of the Colombo Municipal Council area. This is the economic centre and most commercial and business activities are concentrated here. Although the residential population is decreasing, the day-time population will grow and the importance of Colombo will increase.

2) **Sri Jayawardanapura / Battaramulla Area:** Sri Jayawardanapura Kotte is the political capital. And most administrative functions have been relocating to the Battaramulla area. This area will be the administrative capital and will grow with a concentration of more services and commercial activities. The area is also considered a part of the **Malabe Corridor** connecting to the Kaduwela (Interchange) Township Area.
3) **Urban Centres:** There are urban centres within the Area. They were originally independent centres, however, land use shows continuing urban conditions. They are becoming a part of Colombo Metropolitan Core. The major urban centres are;
   - Dehiwala, Nugegoda, Kelaniya, Ratmalana, Boralesgamuwa, Maharagama, Kotikawatta, Kiribathgoda, and Wattala

(2) Development Areas in the Suburbs

Urbanised areas have developed along the major roads, especially the radial corridors from Colombo towards the suburbs and this trend will continue. However, this ribbon development is not suitable, and an effective and sustainable growth scenario is required to support rapid urbanisation. Since natural conditions and environmental values still remain, the areas should be developed keeping these natural conditions. Therefore, the urban centres are to be strategically located in each corridor, and major developments should be guided around the centres. UDA has proposed some projects in the centres, and similarly TOD or other mixed developments, including commercial and residential development are expected in and around the centres.

At the same time, the “3K area” located in the eastern suburb of Colombo where the Outer Circular Highway is being built is specially identified since the area will have a direct impact on the highway. The highway is perpendicular to the radial roads, therefore the 3K area has different characteristics than the other development corridors. The area is rapidly growing in terms of population in recent years, and rapid growth is expected even well beyond the highway. Many lands are being converted to residential use from the natural condition. New employment centres would be developed around the town centres, and TOD is also expected to be developed around the transport nodes such as stations.

The following Development Areas are identified in the suburbs of CMA:

1) **3K Area - Kottawa (Interchange) Township Area:** This is located around the Kottawa Interchange. It is also considered as part of the **High level Road Corridor** and the Kelani Valley Railway Line. Homagama is the main urban centre, and Kottawa, Godgama, Athurugiriya, Diyagama are the other urban centres. New projects are on-going, such as Diyagama development with a sports complex and the Mahenawatta Nanotechnology Park. They are the catalysts for further development.
2) **3K Area - Kaduwela (Interchange) Township Area:** This is located around the proposed Kaduwela interchange. It is also considered as part of the **Malabe Corridor** continuing from Aattaramulla Area and the **Low Level Road Corridor**. Located there is the Kelani River and this has negative impacts, such as flood risk, but also positive potential as waterfront is attractive in terms of urban design. The area also has Biyagama EPZ, or one of the biggest industrial estates which attracts population. Kaduwela is the main urban centre, and Malabe and Malwana are the other centres.

3) **3K Area - Kadawatha (Interchange) Township Area:** This is located around the proposed Kadawatha Interchanges. The western part of the area is also considered as a part of **Kandy Road Corridor**. The eastern part is relatively rural. Kadawatha is the main urban centre, and Mahara, Kirilawella and Delgoda are the other urban centres.

4) **Negombo Road Corridor:** The main urbanised areas are developed along Negombo Road and around Ragama where a station is located. There are the main urban centres, namely Ja-ela on Negombo Road and Ragama. Recently, the Colombo–Katunayake Expressway opened, and it will affect urbanisation in this corridor.

5) **Kandy Road Corridor:** The corridor is developed on Kandy Road as well as the main railway line. Gampaha is the main urban centre of the area, and other urban centres, such as Ganemulla, Miriswatta, Yakkala, and Weliweriya, are supporting the area.

6) **Horana Road Corridor:** The urbanised area on Horana Road is located there. There are also the main urban centres of Piliyandara and Kesbewa. The corridor continues to the Kahatuduwa Interchange on the Southern Expressway.

7) **Galle Road Corridor:** Urbanised areas have been developed on Galle Road in ribbons. There is a series of urban centres such as Moratuwa, Panadura, and Kalutara. Parallel to Galle Road, there is the Southern Expressway. Although the expressway is approximately 10 km from Galle Road, it will affect the development in this corridor.

(3) Out Side of CMA: Local Development Area

Outside of CMA is mainly considered as rural area. However, there are some characteristic regional and rural centres located there. They are independent from Colombo and create their own urban areas.

Negombo is located north of CMA. Together with the area around Katunayake International Airport, it creates its own urban area with employment centres, rather than depending on Colombo.

Avissawella is located on the eastern edge of the Western Province. The area does not have many influences from Colombo. It is considered as a regional centre.

Padukka and Hanwella are located on High Level Road just outside of CMA. Now, the two towns are separated, but they are expected to merge as an urban group.

Horana is located just outside of CMA on Horana Road. The town is considered as a regional centre since the town plays a major role in the area.

Nittambuwa, Mirigama, **Beruwala, and Matugama** are also considered as important urban centres of the surrounding region.

4.3.3 Urban Land Use Structure Model

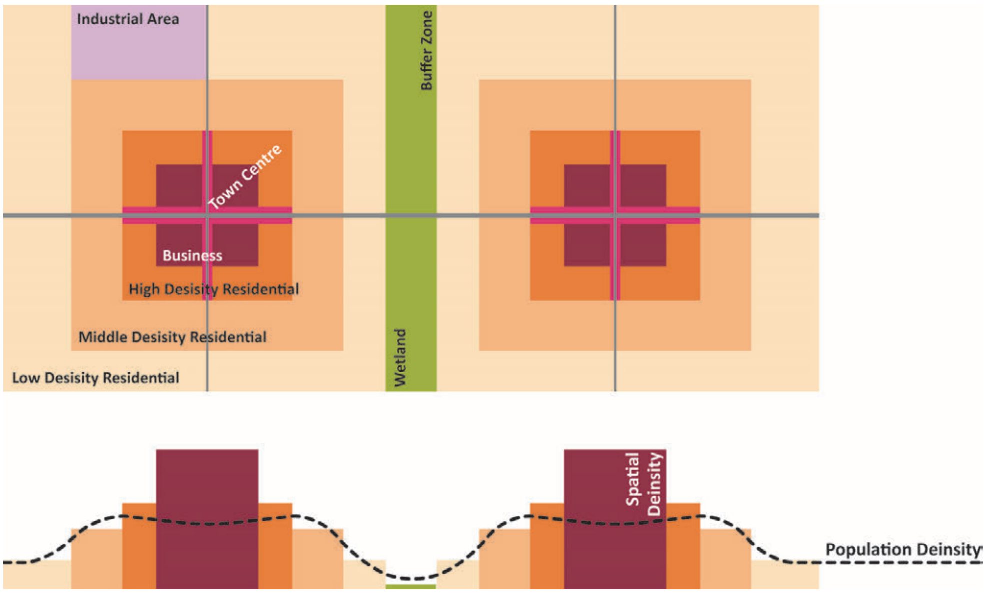
Land use is one of the most important elements of an urban structure. For the urban structure in the future, land use planning should directly guide the development. In the planning system in Sri Lanka, Development Plans of Local Authorities include land use zoning plans and building regulations. Therefore, the Development Plans are the statutory documents to lead the future.

However, there are no integrated models of land use zoning at the regional level. In order to establish effective transport systems, such land use models for the regional level, which will work with the new transport network, are necessary and should be recommended.

The land use zoning should seek to promote compact urban centres and not encourage ribbon development or sprawl. The model below, Figure 4.3.7, demonstrates the idealised pattern of land use zoning sought within centres where more intense use take place. Commercial activities are located in the centre, mixed use areas surrounding, and outside of the centre are low-density residential areas. Employment Centres are also to be located close to the centre with good transport connections. In addition, between the urban centres, buffer zones such as conserved natural area or wetlands are retained.

In terms of spatial density, the heights of the buildings and floor area ratios should be higher in the centre and gradually reducing in the surroundings. This assures higher commercial and business activities in the centre, high-density apartment type of residences located around the centre, and calm low-density residential areas in the surroundings. Population density will also follow this spatial density.

In order to develop ideas for the Transport Master Plan, an efficient transport network should be proposed together with appropriate land use models. The transport network should mutually support this land use model, then the sustainable model of future development will be realised.



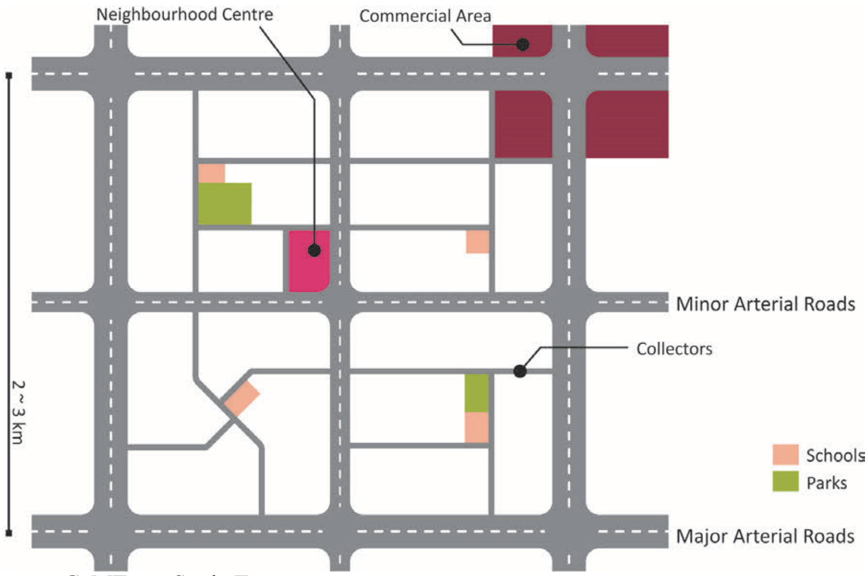
Source: Township Development Component- Local Area Development Plans, modified by CoMTrans Study Team

Figure 4.3.7 Conceptual Model of Land Use Zoning

4.3.4 Area Development Structure Model

The inside of CMA is supposed to be increasing in density in terms of population as well as urban activities. To support this increase with the land use model mentioned above, a road structure is one of the essential elements. In urban planning history, simple grid systems with urban facilities have been proposed such as "Neighbourhood Unit" by Clarence Perry. In this idea, the road structure is composed of major arterial roads, minor arterial roads and collectors, and this provides area development structure on a neighbourhood scale.

This area development structure can be applied to the urbanised area in CMA with some adjustments. At present, there are not enough road networks in the Suburban Area of Colombo. CMA is expected to be more urbanised. In order to support the urbanisation, an effective transportation system is required. Then, the traditional urban planning idea can be adjusted to the conceptual model for CMA. This is shown in Figure 4.3.8



Source: CoMTrans Study Team

Figure 4.3.8 Conceptual Area Development Structure Model

Major arterial roads are composed of a grid system. In this case, a 2 to 3km grid is applied for typical suburban areas. The major arterial roads are the main links between urban centres, and serve inter-regional traffic. The areas around junctions will be the hearts of urban centres with commercial and business functions. At the same time, the roads can be public transport corridors with a BRT system or major bus route.

Minor arterial roads are set between the major arterial roads, and compose a 1 to 1.5km grid. This grid creates urban blocks of 1 to 2km^2, which embraces a population of 6,000 to 8,000. Theoretically, the urban block is considered as a community unit. And junctions of the minor arterial roads have neighbourhood centres providing local commercial functions within a walkable distance from anywhere in the block. The minor arterial roads link between the service centres and urban centres or major arterial roads.

Collectors serve local traffic to connect to the arterial roads inside a community.

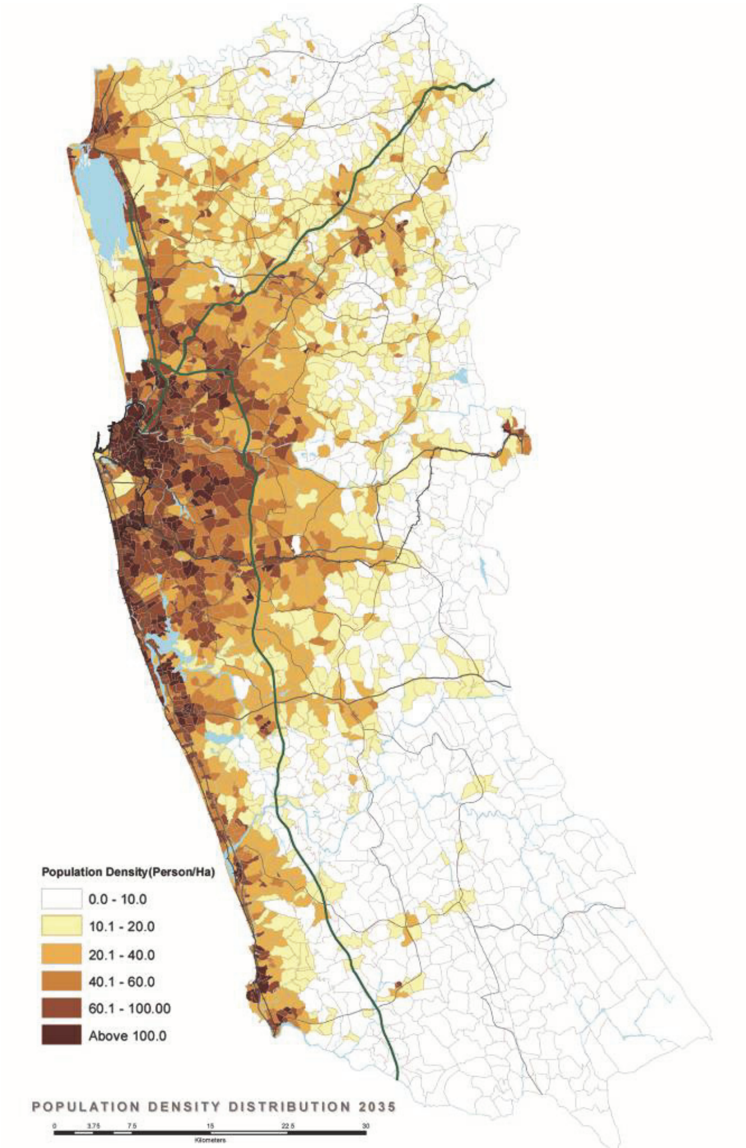
Inside the block, community facilities, such as schools, parks, and commercial facilities are placed to provide community services.

Although this area development structure model is a theoretical idea in order to separate through traffic and community lives, it can direct urban planning concepts in CMA. At present, the Western Province has only major radial corridors and minor roads in low density suburbs. However, traffic problems are becoming a serious issue. Therefore, an effective road network has to be adapted to CMA enforcing the rapid urban growth. The area development structure model can be a sustainable framework for this master plan.

4.4 Population Distribution and Zonal Parameters

4.4.1 Future Population Distribution by GND

The population is distributed by considering the factors described in Chapter 4.1 and the future urban structure described in Chapter 4.3. The typical factors are the road and public transport networks, the interchanges of Expressways, the urban centres, the employment centres or industrial estates, the proposed and on-going projects, and a sustainable land use pattern. In the case of the medium population growth scenario, the population density map for 2035 is shown in Figure 4.4.1.



Note: Calculated by CoMTrans Study Team
Expressways/Highways are shown on the map as reference.

Figure 4.4.1 Projected Population Densities 2035

According to the density maps, the Combo Metropolitan Area will have higher population density. The suburbs of Colombo would be more populated areas, especially the Battaramulla area will attract more population. In the Gampaha District, population would concentrate along the Kandy Road, the Main Railway Line, and Negombo Road. In Kalutara District, the populated area will be along the coast. While rural conditions will remain in the south-eastern part, small rural centres will be populated such as Matugama.

4.4.2 Zonal Parametres

As mentioned above, the projected population is distributed to the GNDs. For further analysis and projections, the detailed results of the CoMTrans Home Visit Survey by TAZ are used for the zonal parametres.

(1) Population by Income according to TAZ

The population by income according to TAZ is estimated from the result of the CoMTrans Home Visit Survey. And also the projected population by income level are divided into TAZ by considering the proportion of income levels and GRDP growth Table 4.4.1 shows the population in the CMA by income in 2013 according to the DSD.

Table 4.4.1 Population by Income in CMA and the Western Province (2035)

			Population			*Share*		
	District	**DSD**	**Group C**	**Group B**	**Group A**	***Group C***	***Group B***	***Group A***
CMA	**Colombo**	Colombo	33,000	76,700	128,400	*13.9%*	*32.2%*	*53.9%*
		Dehiwala-Mt.Lavinia	6,700	18,700	50,200	*8.9%*	*24.7%*	*66.4%*
		Homagama	52,800	126,900	236,900	*12.7%*	*30.5%*	*56.9%*
		Kaduwela	53,200	130,600	321,700	*10.5%*	*25.8%*	*63.6%*
		Kesbewa	38,100	95,800	201,400	*11.4%*	*28.6%*	*60.1%*
		Kolonnawa	34,200	86,400	181,300	*11.3%*	*28.6%*	*60.1%*
		Maharagama	27,900	70,700	166,700	*10.5%*	*26.6%*	*62.8%*
		Moratuwa	18,800	47,500	102,400	*11.1%*	*28.2%*	*60.7%*
		Rathmalana	11,100	28,600	66,800	*10.4%*	*26.8%*	*62.7%*
		Kotte *	12,200	31,800	87,400	*9.3%*	*24.2%*	*66.5%*
		Thimbirigasyaya	20,700	53,700	122,000	*10.5%*	*27.3%*	*62.1%*
	Gampaha	Biyagama	38,300	94,700	190,800	*11.8%*	*29.2%*	*58.9%*
		Gampaha	35,000	86,700	175,000	*11.8%*	*29.2%*	*59.0%*
		Ja-Ela	38,900	93,000	179,800	*12.5%*	*29.8%*	*57.7%*
		Kelaniya	21,800	53,800	104,200	*12.1%*	*29.9%*	*58.0%*
		Mahara	38,500	93,400	184,100	*12.2%*	*29.6%*	*58.3%*
		Wattala	30,200	71,200	134,800	*12.8%*	*30.1%*	*57.1%*
	Kalutara	Bandaragama	26,000	59,000	95,400	*14.4%*	*32.7%*	*52.9%*
		Kalutara	35,000	80,500	136,800	*13.9%*	*31.9%*	*54.2%*
		Panadura	38,000	90,800	162,200	*13.1%*	*31.2%*	*55.7%*
	Total		**610,300**	**1,490,800**	**3,028,400**	***11.9%***	***29.1%***	***59.0%***
Outside of CMA			**384,900**	**895,000**	**1,530,700**	***13.7%***	***31.8%***	***54.5%***
Western Province			**995,200**	**2,385,800**	**4,559,200**	***12.5%***	***30.0%***	***57.4%***

Note: * Sri Jayawardanapura Kotte

Classification of income - Group C: <40,000Rs./HH/Month; Group B: 40,000-79,999Rs./HH/Month;

Group A: 80,000 Rs/HH/Month and over

Source: CoMTrans Study Team

(2) Employed Population by Industrial Sector and Income according to TAZ

The estimated employed population in residential areas, or night time employed population, in 2013 are distributed to each TAZ using the result of the CoMTrans Home Visit Survey. In the same way, the projected population is also distributed following the ratio of the industrial sector.

The employed population in working places, or the day time population, in 2013 is estimated from the CoMTrans Home Visit Survey by TAZ. For future distribution, the following factors also need to be considered:

1) **Population Employed in the Primary Sector:** It is assumed that the population employed in the primary sector within CMA will decrease at a rate greater than that outside of CMA. Annually there is a 1.6% decrease in CMA, and a 0.4% decrease outside of CMA.

2) **Population Employed in the Tertiary Sector (CMA)**: It is assumed that the population employed in the tertiary sector within CMA will increase at a rate greater than that outside of CMA Annually there is a 1.7 % increase in CMA, and 1.5% increase outside of CMA.

3) **Compact City Model of Urban Structure (Sub Centre Model):** By considering placing residences and work places closer together as a target of the urban structure, more employment centres will be located around the urban centres, not only in Colombo. As a result, the commuting demand would be minimised.

   <u>TOD Model:</u> More developments, such as “TOD” should be encouraged in the urban centres in the suburbs, and more job opportunities will be created around these urban centres. The TODs should be developed with the improved transport system gradually. Generally, twice the number of those employed in the tertiary sector should be concentrated around the TOD by 2035.

   <u>3K Area:</u> OCH will be opened up to Kadawatha in 2014. The areas will become sub centres earlier than the other centres. Concentration of the employed population will be seen from 2015. The employed population in the tertiary sector in 2035 will increase to be 2.5 times larger than in 2012.

   <u>Administrative Centre:</u> The Sri Jayawardanapura Kotte and Battaramulla areas will be the administrative centre of Sri Lanka due to the relocation of government institutions. Urban development would be accelerated and the area would have a role as capital. Thrice the number of the employed population will be attracted to this area.

   <u>Since the sub centre structure is proposed and employed population would follow the structure,</u> concentration in the CMC would be slowed.

4) **Urban Development Projects:** There are almost 100 on-going and proposed projects by the Public and Private Sectors in the Western Province. They include many mixed development projects which will provide offices or other employment opportunities.

Zonal parametres of the employed populations for both night time and day time by the industrial sector and income level are estimated for each TAZ. The employed population of CMA and Western Province by industry sector in 2035 are shown in the following tables. Table 4.4.2 shows the night time employed population, or the employed population at their residential places, and Table 4.4.3 shows the day time employed population, or the employed population at their working places.

Table 4.4.2 Night Time Employed Population by Industrial Sector in CMA and Western Province (2035)

			Night Time Employed Population				*Share*		
	District	**DSD**	**Primary Industry**	**Secondary Industry**	**Tertiary Industry**	**Total**	***Primary Industry***	***Secondary Industry***	***Tertiary Industry***
CMA	**Colombo**	Colombo	500	13,200	56,700	70,500	*0.7%*	*18.7%*	*80.4%*
		Dehiwala-Mt.Lavinia	100	5,200	20,300	25,600	*0.4%*	*20.3%*	*79.3%*
		Homagama	2,600	44,600	118,100	165,300	*1.6%*	*27.0%*	*71.4%*
		Kaduwela	2,200	54,400	146,700	203,300	*1.1%*	*26.8%*	*72.2%*
		Kesbewa	1,300	31,400	95,100	127,800	*1.0%*	*24.6%*	*74.4%*
		Kolonnawa	600	20,200	90,700	111,500	*0.5%*	*18.1%*	*81.3%*
		Maharagama	700	26,200	78,000	105,000	*0.7%*	*25.0%*	*74.3%*
		Moratuwa	500	21,600	38,500	60,600	*0.8%*	*35.6%*	*63.5%*
		Rathmalana	600	10,100	31,600	42,300	*1.4%*	*23.9%*	*74.7%*
		Kotte*	300	9,300	37,800	47,400	*0.6%*	*19.6%*	*79.7%*
		Thimbirigasyaya	300	12,300	56,900	69,500	*0.4%*	*17.7%*	*81.9%*
	Gampaha	Biyagama	1,600	51,200	70,000	122,800	*1.3%*	*41.7%*	*57.0%*
		Gampaha	2,400	31,900	68,000	102,300	*2.3%*	*31.2%*	*66.5%*
		Ja-Ela	1,900	41,700	67,100	110,800	*1.7%*	*37.6%*	*60.6%*
		Kelaniya	900	23,000	40,500	64,400	*1.4%*	*35.7%*	*62.9%*
		Mahara	2,800	40,100	65,600	108,400	*2.6%*	*37.0%*	*60.5%*
		Wattala	1,900	30,600	47,900	80,300	*2.4%*	*38.1%*	*59.7%*
	Kalutara	Bandaragama	5,500	21,300	39,800	66,700	*8.2%*	*31.9%*	*59.7%*
		Kalutara	3,900	20,800	64,500	89,200	*4.4%*	*23.3%*	*72.3%*
		Panadura	3,800	41,900	61,500	107,200	*3.5%*	*39.1%*	*57.4%*
	Total		**34,300**	**551,100**	**1,295,200**	**1,880,700**	***1.8%***	***29.3%***	***68.9%***
Outside of CMA			**63,100**	**346,000**	**596,400**	**1,005,600**	***6.3%***	***34.4%***	***59.3%***
Western Province			**97,400**	**897,200**	**1,891,700**	**2,886,300**	***3.4%***	***31.1%***	***65.5%***

Note: * Sri Jayawardanapura Kotte
Source: CoMTrans Study Team

Table 4.4.3 Day Time Employed Population by industrial Sector in CMA and Western Province (2035)

2035			Employed Population (Day Time)				*Share*		
	District	DSD	Primary Industry	Secondary Industry	Tertiary Industry	Total	*Primary Industry*	*Secondary Industry*	*Tertiary Industry*
CMA	Colombo	Colombo	1,400	68,300	288,600	358,400	*0.4%*	*19.1%*	*80.5%*
		Dehiwala-Mt.Lavinia	100	12,400	28,600	41,100	*0.2%*	*30.2%*	*69.6%*
		Homagama	1,400	37,300	69,000	107,700	*1.3%*	*34.6%*	*64.1%*
		Kaduwela	1,200	32,800	143,100	177,200	*0.7%*	*18.5%*	*80.8%*
		Kesbewa	1,100	33,000	48,600	82,700	*1.3%*	*39.9%*	*58.8%*
		Kolonnawa	400	15,700	48,900	65,000	*0.6%*	*24.2%*	*75.2%*
		Maharagama	600	29,600	101,400	131,700	*0.5%*	*22.5%*	*77.0%*
		Moratuwa	500	37,200	54,000	91,700	*0.5%*	*40.6%*	*58.9%*
		Rathmalana	400	23,800	58,600	82,800	*0.5%*	*28.7%*	*70.8%*
		Kotte*	300	17,700	79,500	97,400	*0.3%*	*18.2%*	*81.6%*
		Thimbirigasyaya	600	52,500	220,900	274,000	*0.2%*	*19.2%*	*80.6%*
	Gampaha	Biyagama	700	52,800	39,500	92,900	*0.8%*	*56.8%*	*42.5%*
		Gampaha	1,900	20,600	64,000	86,500	*2.2%*	*23.8%*	*74.0%*
		Ja-Ela	800	33,400	56,600	90,700	*0.9%*	*36.8%*	*62.4%*
		Kelaniya	1,900	28,700	67,600	98,200	*1.9%*	*29.2%*	*68.8%*
		Mahara	1,900	16,200	32,100	50,200	*3.8%*	*32.3%*	*63.9%*
		Wattala	1,700	26,900	60,000	88,500	*1.9%*	*30.4%*	*67.8%*
	Kalutara	Bandaragama	2,000	12,400	14,400	28,800	*6.9%*	*43.1%*	*50.0%*
		Kalutara	3,600	9,100	57,200	69,900	*5.2%*	*13.0%*	*81.8%*
		Panadura	3,600	30,600	36,900	71,000	*5.1%*	*43.1%*	*52.0%*
	Total		**26,000**	**591,000**	**1,569,600**	**2,186,600**	***1.2%***	***27.0%***	***71.8%***
Outside of CMA			**70,100**	**298,300**	**304,900**	**673,200**	***10.4%***	***44.3%***	***45.3%***
Western Province			**96,100**	**889,300**	**1,874,500**	**2,859,800**	***3.4%***	***31.1%***	***65.5%***

Note: * Sri Jayawardanapura Kotte
Source: CoMTrans Study Team

(3) Student Population by Income according to TAZ

Similarly, by using the result of the CoMTrans Home Visit Survey, the estimated night time student populations in 2012 and projected populations are also subdivided into income level and distributed to the TAZ.

The day time student populations are also distributed to TAZ by using the results of the CoMTrans Home Visit Survey. Public schools of elementary level are equally distributed. Only some private schools will be built in Colombo and some urban centres. Basically, future daytime student populations are simply distributed into the TAZ, with little change in the location of schools and university and their number of students.

Thus the zonal parametres of student populations of both night time and day time by income level are obtained for each TAZ.

The following table shows the student population of CMA and the Western Province by school type in 2035. Table 4.4.4 shows the student population at their residential places (night time student population) and Table 4.4.5 shows the student population at their school places (day time student populations)

Table 4.4.4 Night Time Student Population in CMA and Western Province (2035)

2035			Night Time Student Population				Share		
	District	DSD	Kindergarten & Student (Grade 1-5)	Student (Grade 6-10, G.C.E.(O/L) & (A/L))	University and Others	Total	Kindergarten & Student (Grade 1-5)	Student (Grade 6-10, G.C.E.(O/L) & (A/L))	University and Others
CMA	Colombo	Colombo	34,600	54,000	4,400	93,000	37.2%	58.1%	4.7%
		Dehiwala-Mt.Lavinia	6,700	16,500	4,100	27,300	24.5%	60.4%	15.0%
		Homagama	19,600	43,400	6,000	69,000	28.4%	62.9%	8.7%
		Kaduwela	24,300	51,800	8,000	84,100	28.9%	61.6%	9.5%
		Kesbewa	17,300	45,400	7,300	70,000	24.7%	64.9%	10.4%
		Kolonnawa	17,600	37,900	5,300	60,800	28.9%	62.3%	8.7%
		Maharagama	16,100	35,200	8,400	59,700	27.0%	59.0%	14.1%
		Moratuwa	17,600	27,700	3,600	48,900	36.0%	56.6%	7.4%
		Rathmalana	8,700	15,400	2,800	26,900	32.3%	57.2%	10.4%
		Kotte*	9,900	18,600	4,600	33,100	29.9%	56.2%	13.9%
		Thimbirigasyaya	19,200	33,900	4,400	57,500	33.4%	59.0%	7.7%
	Gampaha	Biyagama	16,400	38,700	4,700	59,800	27.4%	64.7%	7.9%
		Gampaha	17,600	36,200	6,900	60,700	29.0%	59.6%	11.4%
		Ja-Ela	20,000	33,200	6,100	59,300	33.7%	56.0%	10.3%
		Kelaniya	11,300	24,000	6,600	41,900	27.0%	57.3%	15.8%
		Mahara	20,000	35,200	6,600	61,800	32.4%	57.0%	10.7%
		Wattala	16,400	34,400	3,000	53,800	30.5%	63.9%	5.6%
	Kalutara	Bandaragama	10,500	22,800	4,600	37,900	27.7%	60.2%	12.1%
		Kalutara	17,800	32,000	5,000	54,800	32.5%	58.4%	9.1%
		Panadura	16,300	42,800	8,800	67,900	24.0%	63.0%	13.0%
	Total		337,700	679,200	111,100	1,128,000	29.9%	60.2%	9.8%
Outside of CMA			217,300	375,300	57,300	649,900	33.4%	57.7%	8.8%
Western Province			555,000	1,054,500	168,300	1,777,800	31.2%	59.3%	9.5%

Note: * Sri Jayawardanapura Kotte
Source: CoMTrans Study Team

Table 4.4.5 Day Time Student Population in CMA and Western Province (2035)

2035			Day Time Student Population				Share		
	District	DSD	Kindergarten & Student (Grade 1-5)	Student (Grade 6-10, G.C.E.(O/L) & (A/L))	University and Others	Total	Kindergarten & Student (Grade 1-5)	Student (Grade 6-10, G.C.E.(O/L) & (A/L))	University and Others
CMA	Colombo	Colombo	33,600	60,400	11,000	105,000	32.0%	57.5%	10.5%
		Dehiwala-Mt.Lavinia	8,700	20,700	3,700	33,100	26.3%	62.5%	11.2%
		Homagama	14,600	22,800	1,500	38,900	37.5%	58.6%	3.9%
		Kaduwela	15,200	31,400	7,800	54,400	27.9%	57.7%	14.3%
		Kesbewa	15,500	29,500	2,400	47,400	32.7%	62.2%	5.1%
		Kolonnawa	8,900	18,100	1,500	28,500	31.2%	63.5%	5.3%
		Maharagama	12,600	29,000	19,000	60,600	20.8%	47.9%	31.4%
		Moratuwa	13,900	25,800	9,900	49,600	28.0%	52.0%	20.0%
		Rathmalana	6,200	17,000	5,100	28,300	21.9%	60.1%	18.0%
		Kotte*	16,100	34,600	9,900	60,600	26.6%	57.1%	16.3%
		Thimbirigasyaya	57,000	157,800	50,500	265,300	21.5%	59.5%	19.0%
	Gampaha	Biyagama	12,300	23,300	700	36,300	33.9%	64.2%	1.9%
		Gampaha	23,000	56,500	3,300	82,800	27.8%	68.2%	4.0%
		Ja-Ela	17,300	27,700	2,800	47,800	36.2%	57.9%	5.9%
		Kelaniya	14,300	32,600	22,200	69,100	20.7%	47.2%	32.1%
		Mahara	14,900	24,700	300	39,900	37.3%	61.9%	0.8%
		Wattala	17,100	32,600	1,100	50,800	33.7%	64.2%	2.2%
	Kalutara	Bandaragama	7,500	12,400	0	19,900	37.7%	62.3%	0.0%
		Kalutara	16,200	29,600	1,400	47,200	34.3%	62.7%	3.0%
		Panadura	21,200	40,100	700	62,000	34.2%	64.7%	1.1%
	Total		346,200	726,800	154,900	1,227,900	28.2%	59.2%	12.6%
Outside of CMA			208,800	327,700	13,400	549,900	38.0%	59.6%	2.4%
Western Province			555,000	1,054,500	168,300	1,777,800	31.2%	59.3%	9.5%

Note: * Sri Jayawardanapura Kotte
Source: CoMTrans Study Team

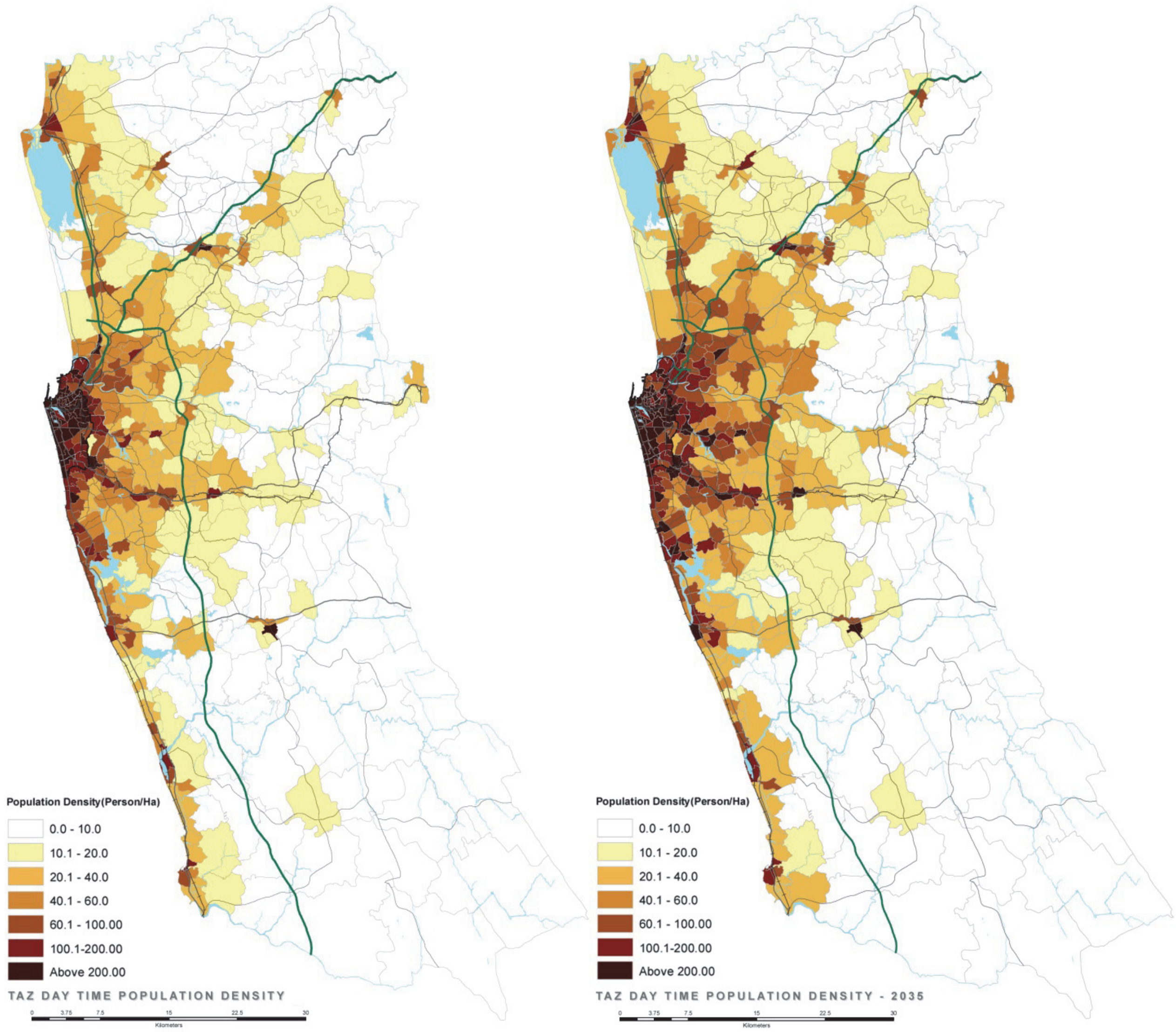
4.4.3 Daytime Population

From the above mentioned the day time and night time populations of employed workers and students, the total daytime populations are calculated by TAZ. This is shown by the DSDs in CMA in Table 4.4.6. And densities of the daytime populations in 2013 and 2035 are shown in Figure 4.4.2.

Table 4.4.6 Estimated and Projected Daytime and Night time population by DSD

	District	DSD	2013			2035		
			Night Time Population	Day Time Population	*Day / Night*	Night Time Population	Day Time Population	*Day / Night*
CMA	Colombo	Colombo	318,400	532,700	*1.67*	238,200	538,300	*2.26*
		Dehiwala-Mt.Lavinia	87,800	91,500	*1.04*	75,600	96,900	*1.28*
		Homagama	236,300	192,800	*0.82*	416,700	329,000	*0.79*
		Kaduwela	252,200	213,100	*0.84*	505,500	449,800	*0.89*
		Kesbewa	243,900	191,500	*0.79*	335,300	267,600	*0.80*
		Kolonnawa	190,900	143,800	*0.75*	301,900	223,200	*0.74*
		Maharagama	195,300	182,600	*0.93*	265,400	293,000	*1.10*
		Moratuwa	167,300	162,400	*0.97*	168,700	200,500	*1.19*
		Rathmalana	95,000	104,200	*1.10*	106,500	148,400	*1.39*
		Kotte*	107,200	148,800	*1.39*	131,500	208,900	*1.59*
		Thimbirigasyaya	236,900	515,300	*2.18*	196,400	608,800	*3.10*
	Gampaha	Biyagama	186,700	169,100	*0.91*	323,800	270,400	*0.84*
		Gampaha	196,300	200,100	*1.02*	296,700	303,000	*1.02*
		Ja-Ela	201,200	184,900	*0.92*	311,700	280,200	*0.90*
		Kelaniya	136,000	158,700	*1.17*	179,800	240,800	*1.34*
		Mahara	207,100	156,200	*0.75*	316,000	236,000	*0.75*
		Wattala	174,300	165,100	*0.95*	236,200	241,400	*1.02*
	Kalutara	Bandaragama	108,900	82,100	*0.75*	180,400	124,600	*0.69*
		Kalutara	159,200	145,400	*0.91*	252,400	225,500	*0.89*
		Panadura	181,700	168,400	*0.93*	291,000	249,100	*0.86*
	Total		**3,682,500**	**3,908,700**	***1.06***	**5,129,600**	**5,535,400**	***1.08***
Outside of CMA			**2,139,200**	**1,913,000**	***0.89***	**2,810,600**	**2,404,900**	***0.86***
Western Province			**5,821,700**	**5,821,700**	***1.00***	**7,940,200**	**7,940,200**	***1.00***

Note: * Sri Jayawardanapura Kotte
Source: CoMTrans Study Team



Note: Calculated by the Traffic Analysis Zone (TAZ), CoMTrans Study Team.

Figure 4.4.2 Daytime Population Densities 2013 and 2035

CHAPTER 5 CoMTrans Urban Transport Master Plan

5.1 Procedure to Establish CoMTrans Urban Transport Master Plan

5.1.1 Procedure of Master Plan Development

In Chapter 5, an integrated urban transport Master Plan shall be developed. The process of preparing the master plan is shown in Figure 5.1.1.

(1) Present Urban Transport Problems in Colombo Metropolitan Area

Present urban transport problems have been identified by transport subsector and summarised in Chapter 3. In the process of formulating an urban transport master plan, countermeasures for the identified transport problems should be incorporated.

(2) Future Perspective of Colombo Metropolitan Area (see Sub-section 5.2)

Future perspective of the Colombo Metropolitan Area has been discussed in Chapter 4. It sets out the socio-economic framework of the Colombo Metropolitan Area. This framework indicates the future population, employed population and the number of pupils/students. It also estimates growth of household income in the future. Transport demand is projected based on the socio-economic framework.

Although the structure plan for the Colombo Metropolitan Area is not included in the scope of the Study, the future urban structure is studied from the viewpoint of integration between transport system and urban structure. The urban structure with sub-centre development is proposed to reduce excessive concentration of traffic flows in the city centre of Colombo. Compared to the present urban structure of mono-polar concentration in Colombo, it is proposed to decentralise business and commercial functions to sub-centres.

(3) Planning Issues for Urban Transport System in CMA (see Sub-section 5.3)

Based on the analysis on present urban transport problems and the understanding of future perspective of the Colombo Metropolitan Area, planning issues have been identified. The planning issues include not merely the present transport problems to be dealt with but also anticipated problems which can be considered based on the understanding on the future perspective. For instance, based on the growth of population and suburbanisation, increase in real household income, it is anticipated to see problems such as an increase of car ownership and modal shift to private modes of transport.

(4) Objectives for Urban Transport System Development (see Sub-section 5.4)

The present problems and planning issues of urban transport suggest the fields in which improvements are required to fulfil the gap between the present situation and an ideal state. Consolidations of the problems and issues have led to identify four major objectives for urban transport system development. The objectives includes 1) Equity in transport to all the members in society, 2) Efficiency in transport systems to support economic activities, 3) Environmental improvement and health promotion related to transport and 4) Traffic safety and security in transport.

(5) Urban Transport Policy (see Sub-section 5.5)

In order to achieve the four objectives of urban transport system development, four urban transport policies have been selected. The urban transport policies are composed of urban transport system development programmes and the programmes include a variety of projects. Four urban transport policies include 1) Promotion of public transport use, 2) Alleviation of traffic congestion, 3) Reduction of air pollutants/traffic noise and promotion of health and 4) Reduction of transport accidents and improvement of security.

(6) Policy Measures for Respective Urban Transport Policy (see Sub-section 5.6)

Based on the analysis on the present transport condition and anticipated perspectives of the Colombo Metropolitan Area, general policy measures have been listed up by policy.

(7) Major Transport Corridor Analysis (see Sub-section 5.7)

Prior to formulating an urban transport system development scenario, transport demands on the major corridors were projected and candidate modes of transport were selected by a screening process. Then the most appropriate modes of transport by corridor are selected through evaluation from various aspects. The evaluation results were utilised as a Base Case to formulate urban transport system development scenarios for the metropolitan area.

(8) Phasing of Urban Transport Projects (see Sub-section 5.8)

The policy measures can be regarded as a long list of projects to improve the transport situation. Among the policy measures, sequential order can be put in general with various factors. Sub-section 5.8 explains the points which are taken into account for prioritising projects.

(9) Urban Transport System Development Scenarios (see Sub-section 5.9)

Urban transport systems which cover the whole metropolitan area were prepared based on the evaluation results in the corridor analysis, review of the existing development plans and new project ideas made by the Study team. In order to examine the direction of transport system development for the Colombo Metropolitan Area, three development scenarios were formulated for comparison with the Base Case scenario; those are 1) Intensive public transport system development scenario, 2) Mixed development of public transport system and road network scenario and 3) Intensive road network development scenario.

First of all, the selected modes and routes in the corridor analysis are regarded as a core transport system in particular for public transport. In addition several public transport systems and road networks are added to the transport network. Intensive public transport system development scenario includes more public transport system; on the other hand the intensive road network development scenario obviously includes more highway network.

(10) Evaluation of Development Scenario Alternatives (see Sub-section 5.10)

The evaluation has been examined from various aspects such as travel speed of vehicles, accessibility to public transport, traffic safety and air pollutant and CO_2 emission.

(11) Selected Major Projects by Urban Transport Policy (see Sub-section 5.13)

Major projects of the CoMTrans master plan have been identified. A general description of the selected projects is provided to explain what kinds of projects shall be executed.

(12) CoMTrans Urban Transport Master Plan (see Sub-section 5.14)

The urban transport master plan is divided into stages. The projects are allocated into short-term, intermediate term and long term development plans, taking logical sequences among the projects.

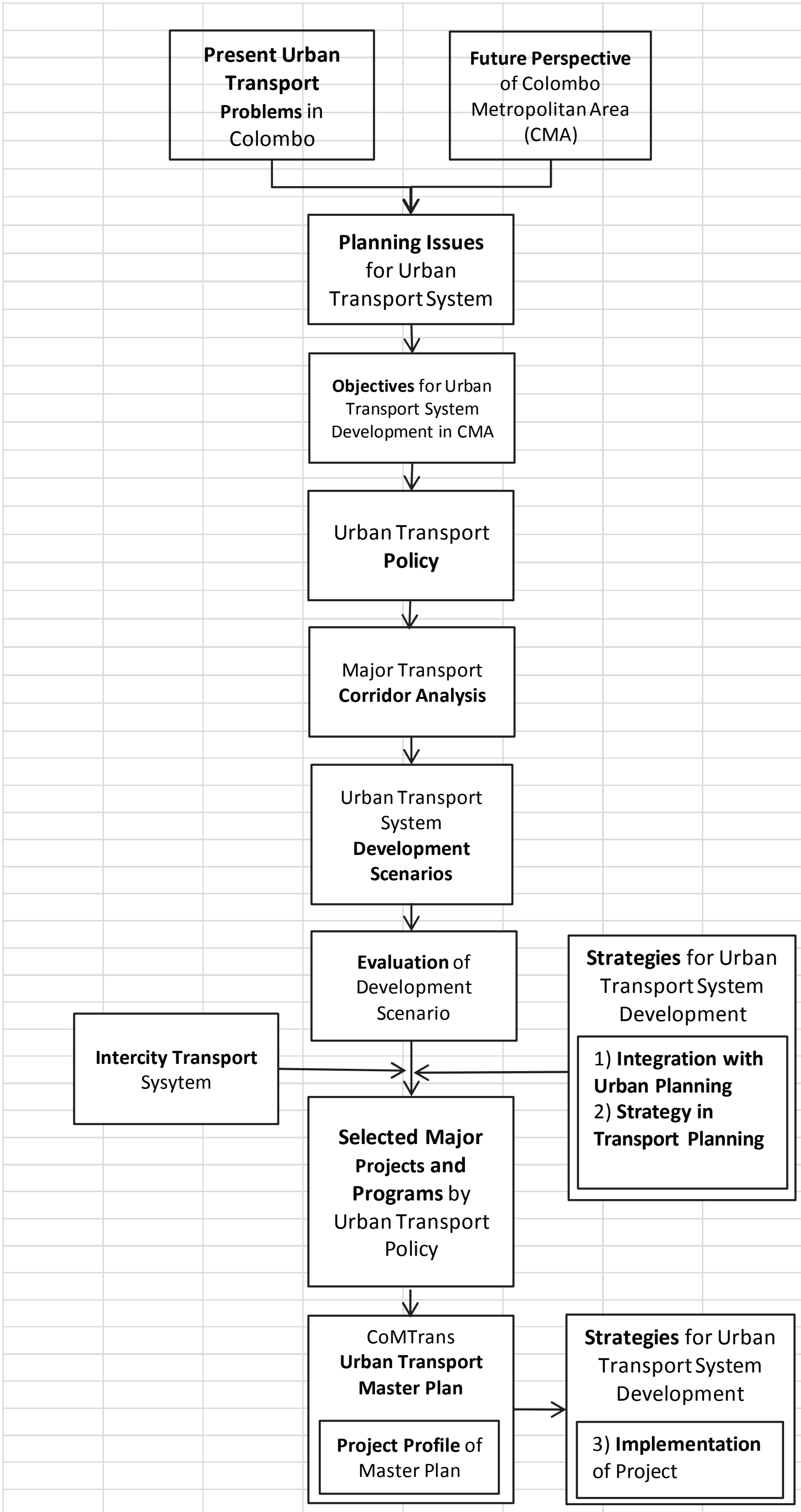
(13) Strategies for Urban Transport System Development (see Sub-section 5.11)

The strategies for urban transport system development can be divided into two groups. One is strategy in planning stage and the other is that for implementation.

(14) Intercity Transport System (see Sub-section 5.12)

An intercity transport system and an urban transport system should be separated since characteristics of intercity travel and travel in urban areas are different. However if these systems are not integrated, it causes inconvenience to the users. In establishing an urban transport master plan, taking the future intercity transport system into consideration, connection between the two systems should be incorporated. In particular the role and function of the intercity terminal should be studied carefully.

People coming to the Colombo Metropolitan Area first arrive at major railway stations and intercity bus terminals and go further to their final destinations. An urban transport system should be developed to support such travel needs from these railway stations and intercity bus terminals to the final destinations within the urban area



Source: CoMTrans Study Team

Figure 5.1.1 Flowchart of Establishing Integrated Urban Transport Master Plan

5.2 Future Perspective of Colombo Metropolitan Area

5.2.1 Perspective of Socio-Economic Aspect and Urban Structure

(1) Population Growth and Suburbanisation

Population will grow in the Western Province. It is projected to increase from 5.8 million people in 2012 to 7.9 million in the target year of 2035 as shown in Sub Section 4.2.1(5) Projected Population to 2035. The population of the Colombo Metropolitan Area will increase more rapidly since the metropolitan area is the main urban area of the province. Recently the population in CMC has been decreasing, while the population in the suburbs has been increasing rapidly. This suburbanisation continues and expands the urbanised area outward from the city centre.

(2) Urban Development in the City Centre

Urban development projects are planned mainly in the city centre and job opportunities will increase in the central area. Since the residential area will disperse and the urban area will be expanded to the suburb, it implies that commuter trips to the city centre will increase and the travel distance of commuters will be longer due to the dispersion of the residences of the population.

(3) Increase in Real Household Income

As high economic growth is expected in the nation, real term household income will increase. In accordance with GRDP growth, real household income would also increase proportionally. As shown in 4.2.5 Forecast of Population by household income group[1], it is estimated that the composition of Group C households, of which the monthly income is lower than Rs 40,000, would decrease from 67.8 % in 2012 to 12.5 % in 2035. In contrast the composition of Group A households would increase from 7.6% in 2012 to 56.3% in 2035.

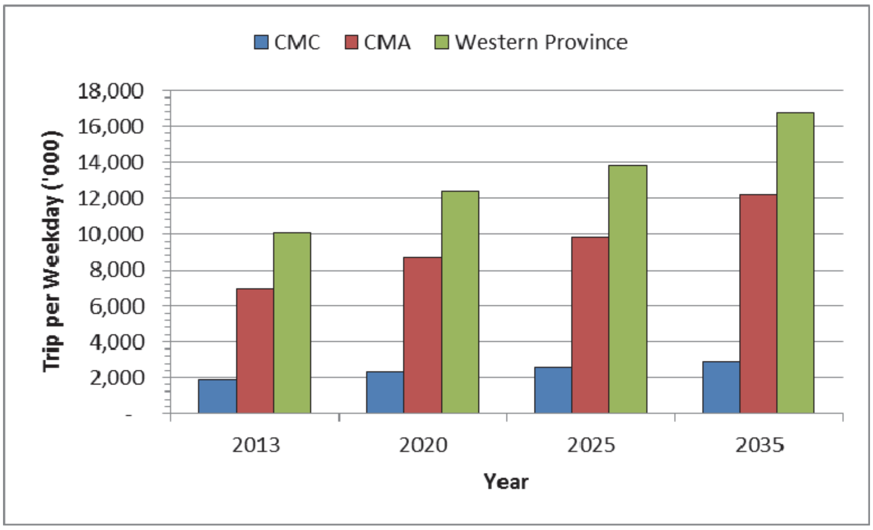
(4) Increase in Ownership of Private Modes of Transport

The increase of household income would bring about an increase of ownership of private passenger cars and motorcycles. The increase of private modes of transport naturally increases traffic demand on the roads and would cause serious traffic congestion without the development of public transport systems and the intervention of government by countermeasures for transport demand management.

5.2.2 Projected Transport Demand

In 2035 the total person trip production in the Colombo Metropolitan Area would increase to almost 12.2 million person trips per day and this is 1.75 times of the present person trip demand of 6.9 million person trips per day as indicated in Figure 5.2.1.

[1] Group C: Less than Rs. 40,000 / Group B: Rs.40,000 – Rs. 79,999 / Group A: Rs. 80,000 and above

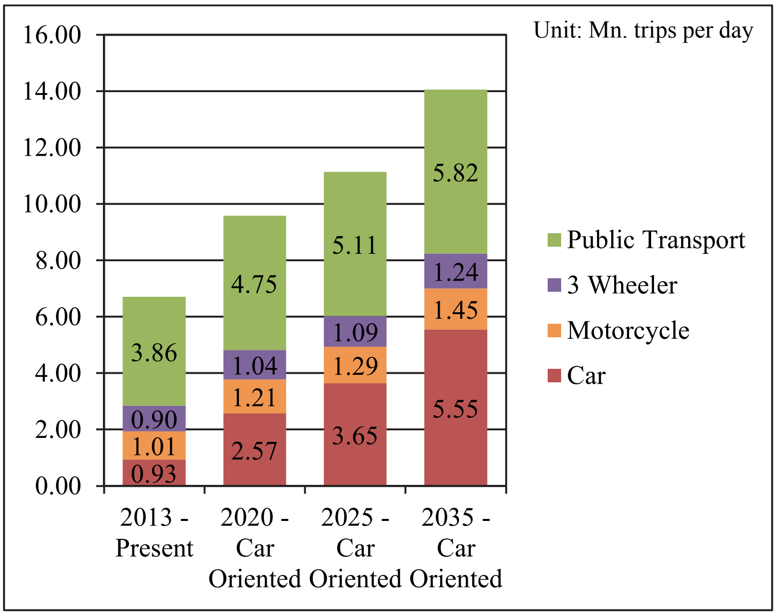


Source: CoMTrans Estimate

Figure 5.2.1 Increase of Person Trip Demand by Region: 2013 – 2035

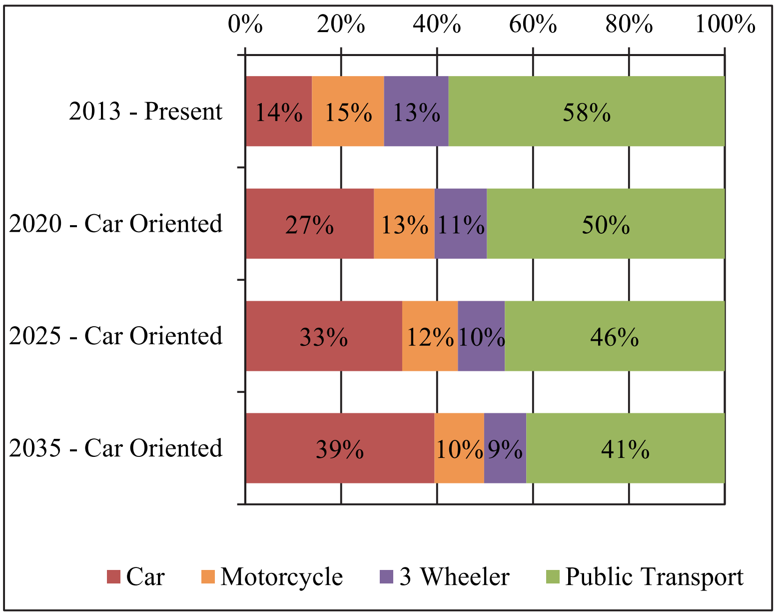
Total person trip demand would increase by 1.75 times from 2013 to 2035 however it should be noted that the trips made by private cars would increase from 0.93 million trips in 2013 to 5.55 million trips in 2035, which implies that the growth of trips by cars accounts for almost six times of the increase during the period as illustrated in Figure 5.2.2.

In 2013 the share of public transport in the Western Province is 58%; however, the share of public transport would fall to 41% in 2035 if no improvement of public transport was undertaken as shown in Figure 5.2.3.



Source: CoMTrans Estimate, Car Oriented Scenario, Excluding non-motorised transport

Figure 5.2.2 Increase of Person Trips by Mode of Transport: 2013 - 2035



Source: CoMTrans Estimate, Car Oriented Scenario, Excluding non-motorised transport

Figure 5.2.3 Change of Modal Share for Car Oriented Scenario: 2013 -2035

5.3 Planning Issues for Urban Transport System Development

Person trip demand would increase significantly as described above. Shift to private modes of transport is expected due to the increasing ownership of passenger cars, three wheelers and motorcycles. It is anticipated that traffic congestion will continue getting worse and worse without efforts on the improvement of public transport systems and the restriction of private modes of transport by the government. Planning issues in urban transport system development are identified as follows:

5.3.1 Dealing with Peak Transport Demand and Concentration of Traffic in the City Centre

Traffic congestion is brought about by peak traffic demand in time and spatial concentration of vehicular traffic in the city centre as analysed in Subsection 3.1.9 Hourly Fluctuation of Trips Generated and Attracted. To tackle the traffic congestion problem, one way is to flatten the peak demand by a staggered working hour system.

Another countermeasure is to distribute traffic concentration in the city centre to sub centres. This would be achieved by developing urban centres in suburban areas where a sufficient number of job opportunities should be provided. By distributing job opportunities in sub centres, these sub centres would attract the employed population from the surrounding areas and could reduce traffic concentration in the city centre.

5.3.2 Need to Shift from Private Modes of Transport to Public Transport

To deal with the traffic congestion problem in the city, the reduction of vehicular traffic demand is the main issue to pursue. Since the total travel demand in Colombo Metropolitan

Area would increase in the planning period, a shift to public transport from private modes of transport is a challenging task for the government. As traffic demand increases, traffic congestion on the road network would be worse and travel speed would be reduced in the future. The operation speed of ordinary buses will also be lower due to traffic congestion.

Public transport systems generally provide less convenient and longer travel time compared to private modes of transport, which can provide door-to-door service. Consequently, the public transport network to be introduced should be at a high level of service and congestion free by providing dedicated transport space in order to compete with private modes of transport.

In this regard, a heavy rail system, a medium-sized transit system and a bus rapid transit system can be regarded as public transport systems with a high level of service in terms of operational speed and punctuality. It is therefore recommended to formulate the public transport systems for the Colombo Metropolitan Area with these congestion free systems and cover the public transport service area as widely as possible.

5.3.3 Affordability of Public Modes of Transport

A rail-based transport system is better than a bus rapid transit (BRT) and other types of road-based public transport systems since a rail-based transport in general have a larger passenger transport capacity than ordinary bus transport. Usually, rail-based transport has a grade separated structure and is not disturbed by other modes of transport; consequently, it runs faster than BRT since BRT usually must stop at intersections. However, it requires a huge amount of investment as well as having a higher operation cost. This implies that the system needs to charge the passengers a higher transport fare. According to the Home Visit Survey, the Group C with a monthly income less than Rs 40,000 pays about Rs 4,000 for transport. This implies that about 10% of household income is consumed for transport. According to worldwide household expenditure statistics, the average transport expense is usually around 10% of household income and if it exceeds the 10%, households must sacrifice some other expense[2]. Most households therefore, cannot afford to pay more for transport than at the present level. If the fare of new or improved public transport system is much higher than the presently prevailing fare level, the majority of residents will not be willing to pay for a higher transport fare. Until their household income increases to a certain level, the government should provide financial support for developing the new transport systems and probably for operation costs in the beginning.

[2] Source: Jarvi Kauppila, Administrator TEN STYLISED FACTS ABOUT HOUSEHOLD SPENDING ON TRANSPORT 1 Joint Transport Research Centre of the OECD and the International Transport Forum No. 1/2011

5.4 Objectives for Urban Transport System Development

The analysis of the present urban transport problems and the planning issues in the Colombo Metropolitan Area have resulted in the identification of four major objectives which the urban transport system development needs to pursue as shown in Figure 5.4.1.

(1) Equity in Transport to All the Members in Society

A minimum level of transport service should be provided to all members of society. In the Colombo Metropolitan Area, the mobility of Group C is limited due to their insufficient income. The role of public transport is thus of great importance in providing affordable means of transport for the Group C people to access urban services.

At the same time, it is necessary to develop transport facilities for the physically challenged. Such facilities are seldom seen in the Colombo Metropolitan Area at the present time and the gradual improvement of transport facilities is needed.

(2) Efficiency in Transport Systems to Support Economic Activities

Traffic congestion has resulted in a considerable amount of economic loss to society because of longer travel times, lack of punctuality and the deterioration of the environment. Efficiency in transport can be achieved by balancing transport demand and transport network capacity. Alleviation of traffic congestion can be dealt with in the following three ways: 1) by increasing road capacity through the development and improvement of the road network; 2) by optimising the utilisation of the existing road capacity by using a traffic control system and providing traffic information; and 3) by decreasing excessive vehicular traffic demand through transport demand management and diverting private mode users to public modes of transport.

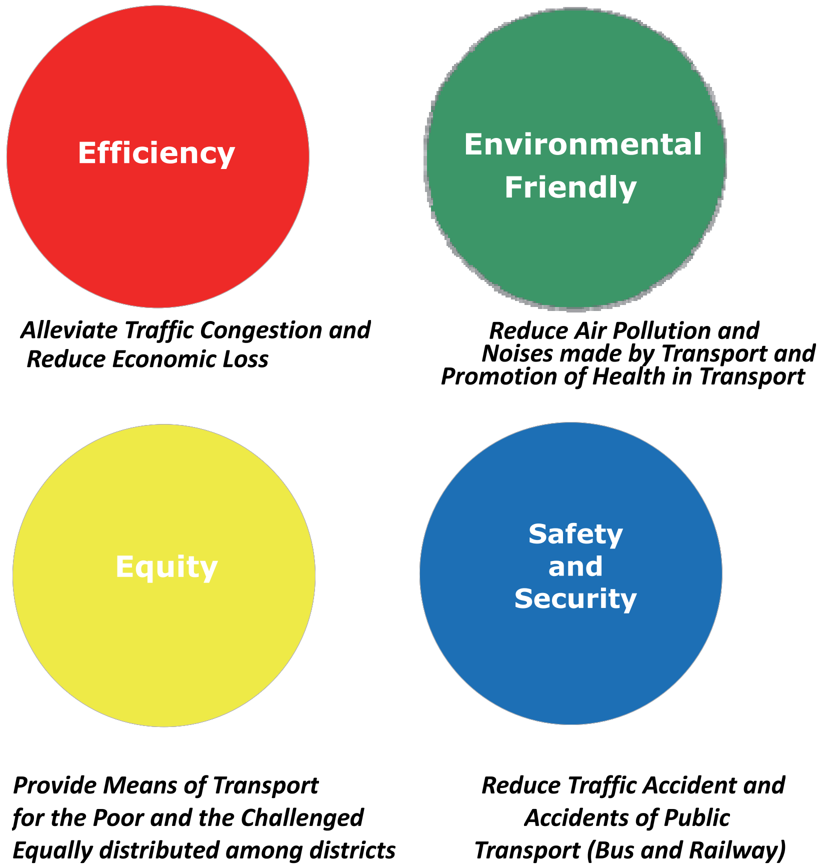
At the same time, the promotion of public transport usage would also contribute toward economic efficiency by reducing vehicular traffic demand on the congested urban road network. Mass transit systems have an advantage over private modes of transport in terms of travel costs and lower consumption of space in the context of an urban area. The combination of all the approaches mentioned above will create an efficient transport system.

(3) Environmental Improvement and Health Promotion related to Transport

Air pollution caused by motorised vehicles should be minimised through emission controls for automobiles, promotion of public transport and traffic demand control, especially in the congested areas. Countermeasures to reduce PM10 should be the main focus, particularly in the Colombo Metropolitan Area. In addition, aesthetics should also be considered for developing an urban transport system.

(4) Traffic Safety and Security in Transport

Since lives are invaluable and death and injury due to traffic accidents will bring great grief to family members and friends, traffic safety should be enhanced and the number of accident victims should be minimised through the enforcement of laws and regulations, intensive public campaigns, and training and education for drivers as well as the general public. Improvement of traffic facilities through engineering design would contribute to the reduction of traffic accidents. Furthermore the security of children and women in public transport should be improved and it would partly contribute to increase the use of public transport.



Source: CoMTrans Study Team

Figure 5.4.1 Objectives for Urban Transport System Development

5.5 Urban Transport Policy

To achieve the four different objectives for transport system development, the following transport policies are essential for the Colombo Metropolitan Area:

1) Promotion of Public Transport Use

2) Alleviation of Traffic Congestion

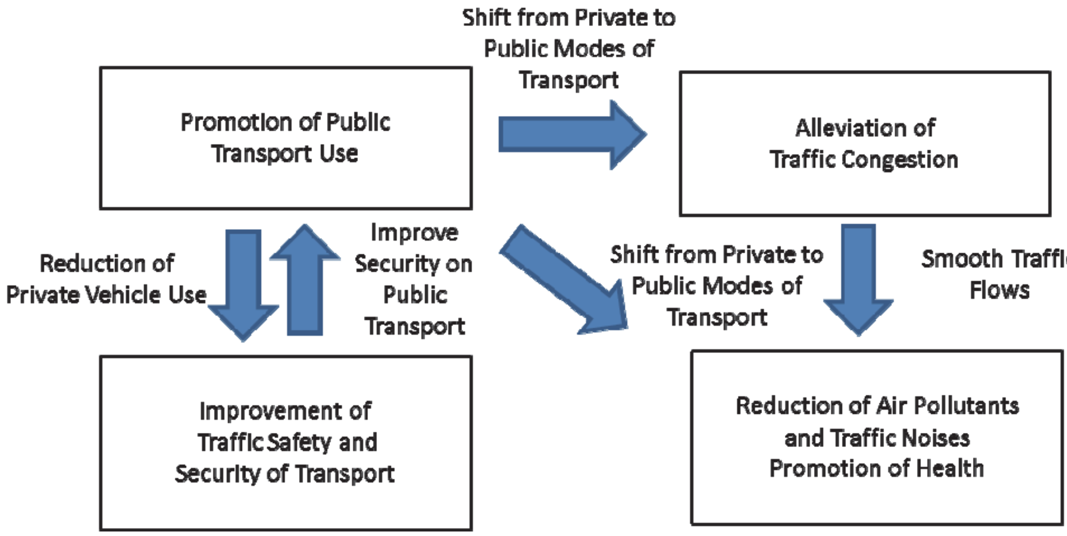
3) Reduction of Air Pollutants/Traffic Noise and Promotion of Health

4) Reduction of Transport Accidents and Improvement of Security

These four transport policies are inter-related as illustrated in Figure 5.5.1. The promotion of public transport is a principal measure to reduce dependence on private modes of transport. Mere improvement of public transport services, however, would not entice people who are accustomed to using private modes of transport to shift to public modes.

Traffic restraint policy measures would enhance the increase in public transport use if a sufficient level of public transport services is provided.

The reduction of private vehicle use would also lead to the reduction of air pollution and traffic noise caused by cars and motorcycles.



Source: CoMTrans Study Team

Figure 5.5.1 Relationship between Urban Transport Policies

5.6 Policy Measures for Respective Urban Transport Policy

Based on the analysis on the present transport condition and anticipated perspectives of the Colombo Metropolitan Area, countermeasures have been listed below:

(1) Policy Measures for Public Transportation Promotion

- Extensive Development of Quality of Public Transport Network (Sri Lanka Railway)
- Enhancement of Intermodality (Development of Multi-modal Transport Hub, Multi Modal Centre and Park and Ride Facility)
- Modernisation of Sri Lanka Railway Main Line, Coast Line and Puttam Line (Electrification, Direct Operation, Improvement of Existing Railway Facilities)
- Development of New Rail based Transit System

- Introducing Bus Rapid Transit (BRT) System
- Transit Oriented Development(TOD) in the Surrounding Area of Railway Stations[3]
- Construction of Arterial Roads to accommodate BRT
- Reformation of Bus Operation Regime
- Improvement of Management of Railway Operation

(2) Policy Measures for Traffic Congestion Alleviation

- Road Widening to Increase Road Traffic Capacity
- Construction of Flyovers and Underpasses at Bottleneck Intersections
- Arterial Road Development in Suburban Areas
- Urban Expressway Network Development
- Transport Demand Management (TDM)
- Traffic Control Improvement
- Secure Lands for Road Development (Road Network Master Plan)
- Separation of Heavy Vehicles from General Traffic (Port Access Road)

(3) Policy Measures for Air Pollution and Traffic Noise Reduction and Promotion of Health in Transport

- Establishment of Environmental Management Scheme
- Establishment and Enhancement of Air Pollutant/Noise Emission Standards
- Enhancement of Vehicle Inspection and Maintenance Programme
- Low Sulphur Diesel Programme
- Promotion of Hybrid Cars and Electric Vehicles
- Promotion of Natural Gas Vehicles
- Promotion of Walking and Bicycles for Health

(4) Policy Measures for Traffic Safety and Security Improvement:

- Education on Traffic Safety
- Rehabilitation and Installation of Traffic Signals
- Rehabilitation of Railway Signal System
- Analysis on Causes of Traffic Accidents
- Provision of Sidewalks and Pedestrian Crossing

[3] Please refer to 5.11.1 about TOD

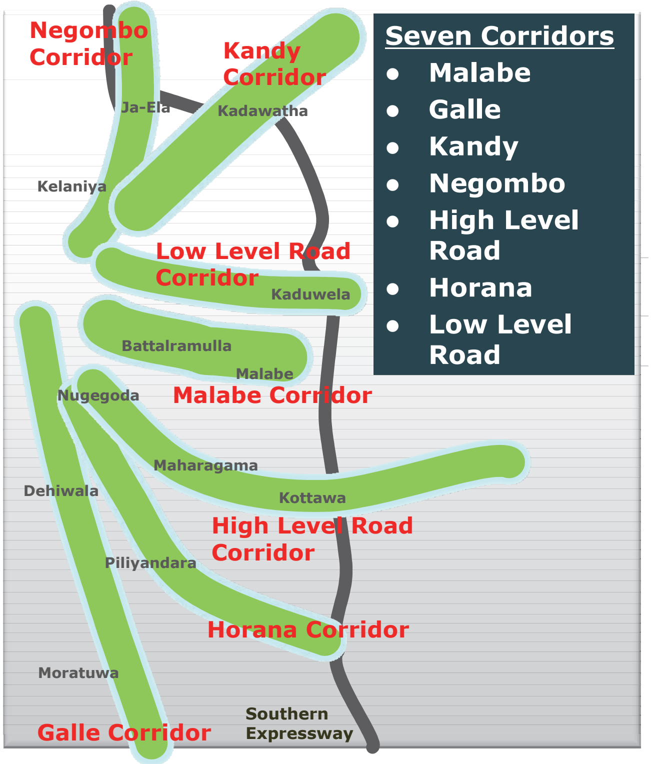
- Establishment of Urban Road Design Standard including Sidewalk
- Improvement of Security of Women and Children in Public Transport

5.7 Analysis on Major Transport Corridors

5.7.1 Seven Major Transport Corridors

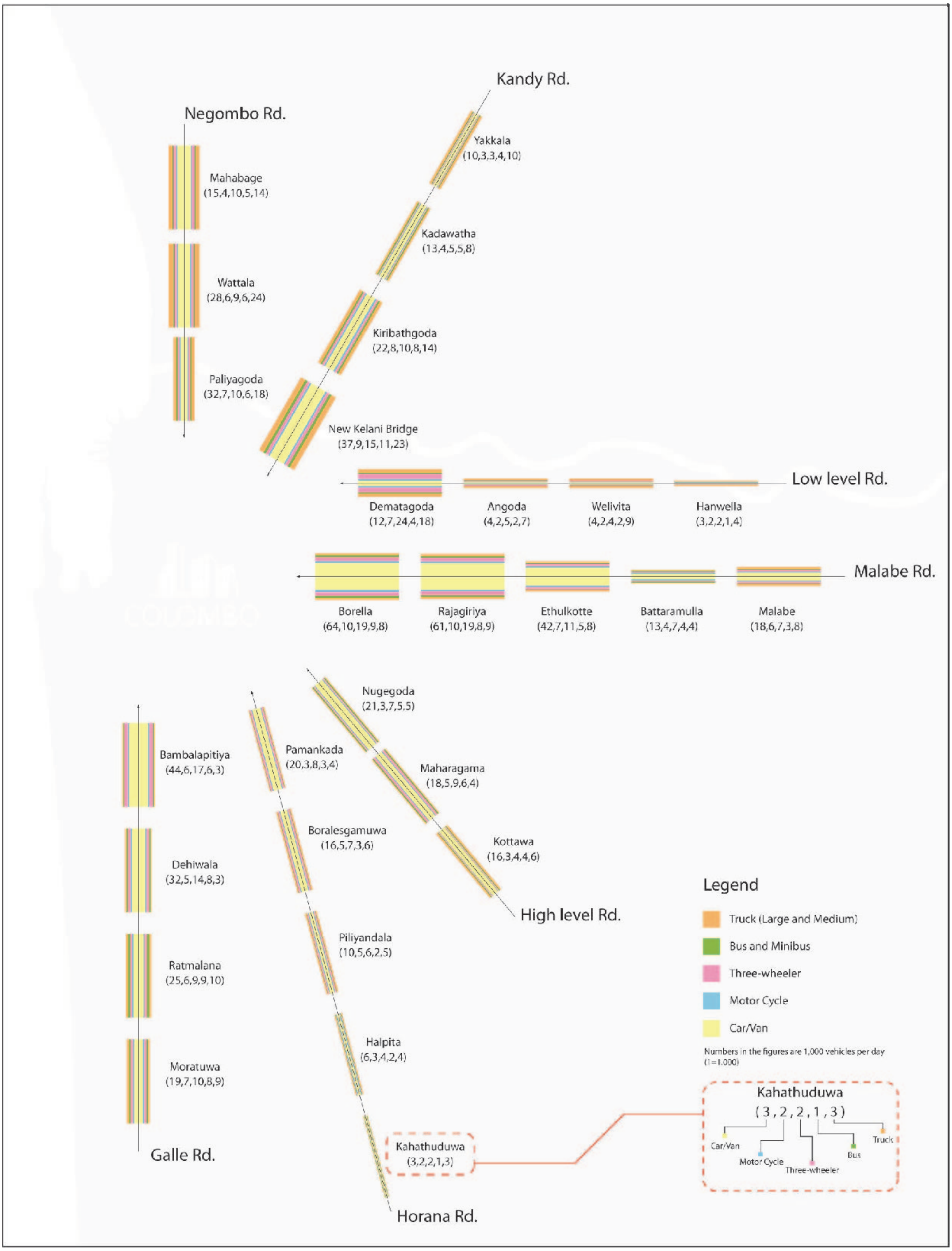
Prior to the evaluation on the urban transport system development scenarios, preliminary analysis on seven major radial transport corridors was undertaken to understand the potential transport demand in the target year 2035. Seven transport corridors have been identified as major radial corridors which connect the city centre of Colombo and major urban centres in CMA as illustrated in Figure 5.7.1 and Figure 5.7.2.

For transport system options, advantages and disadvantages of respective public modes of transport are compared. Options for pubic modes of transport include a Bus priority lane, Bus Rapid Transit (BRT), Automated Guided transit (AGT), Monorail, LRT at Ground and Elevated, MRT Elevated, MRT underground, Modernised Railway. Characteristics of these modes have been described as follows;



Source: CoMTrans Study Team

Figure 5.7.1 Seven Transport Corridors

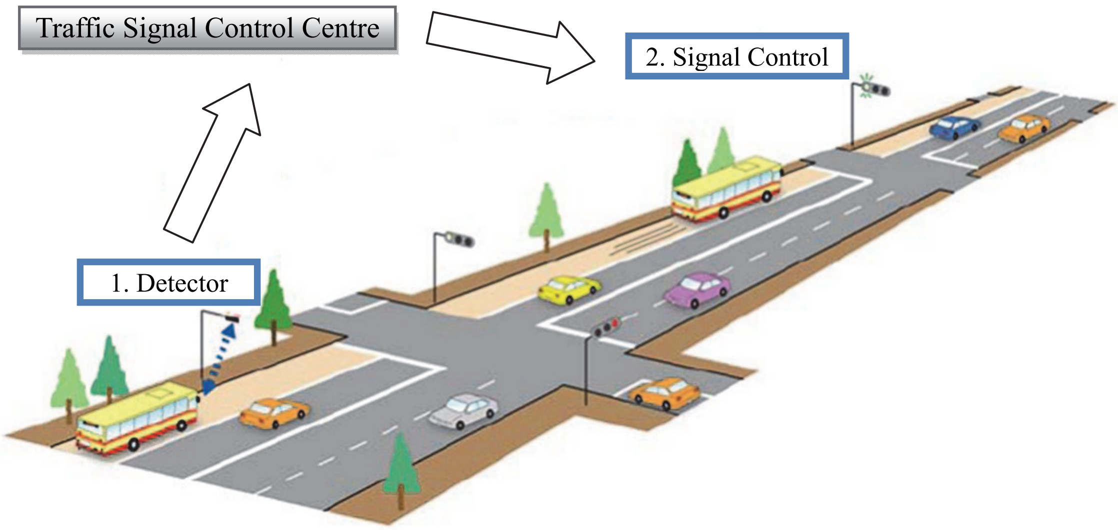


Source: CoMTrans Study Team

Figure 5.7.2 Traffic Demand on Seven Corridors

(1) Bus Priority System

While the bus priority system does not require additional vehicles for operation, bus priority lanes and/or bus priority signals give priority to the bus fleets. Non-bus vehicles are usually requested to give way to buses in the bus priority lane when buses are in the lane. The bus priority signalling minimises waiting time of buses at signalised intersections by giving a green light to the buses as shown in Figure 5.7.3 and Figure 5.7.4. Characteristics of the bus priority system are summarised in Table 5.7.1 and Table 5.7.2.



Source: CoMTrans Study Team

Figure 5.7.3 Image of Bus Priority Signalling System

Source: CoMTrans Study Team

Figure 5.7.4 Photos of Bus Priority Lanes

Table 5.7.1 Characteristics of Bus Priority System

Strengths	➢ Initial cost is considerably low. The required major initial investment is for the bus priority signalling system and pavement marking. ➢ The system can be implemented in a short time ➢ No land acquisition is required ➢ Operation is flexible depending on the demand ➢ There are neither aesthetic concerns nor daylight interference
Limitations	➢ Capacity is the least among the proposed options. (roughly 10,000 passengers per hour, per direction) ➢ Travel speed is lower compared with other public transport systems. ➢ Road capacity is slightly affected.
Difficulties to Implementation	➢ Implementation requires close coordination with the police, road development authority and local authorities

Table 5.7.2 Specifications of Bus Priority System

Capacity	10,000 PPHPD
Scheduled Speed	10-20km/h
Land Acquisition	No Acquisition
Stop Spacing	300m – 1 km
Initial Cost	Less than 1mn. USD/km
Operation and Maintenance Cost	Not Available
Daylight Interference	Not at all
Aesthetical	Not at all
Noise	Moderate due to diesel engines

Note: PPHPD stands for passengers per hour, per direction.

As mentioned in Table 5.7.1, the bus priority system can be implemented in a short time with a lower initial investment and without land acquisition. On the other hand, the maximum capacity of the system is the least among the proposed transport options. Improvement of travel speed is limited as well. Therefore, this system is appropriate for corridors with low demand to improve the service level of conventional bus services. It also should be noted that implementation of this system requires intensive coordination among relevant agencies as it might reduce road capacity for private vehicles.

(2) Bus Rapid Transit (BRT)

Application of Bus Rapid Transit (BRT) is drastically increasing in urban areas in developing countries, especially in rapidly growing emerging countries such as India, East Asian Countries and Latin American countries as shown in Figure 5.7.5. BRT utilises designated lanes of a road for buses. Specially designed high capacity bus fleets are often adopted. Characteristics of bus rapid transit are summarised in Table 5.7.3 and Table 5.7.4.

Source: Curitiba, Mario Roberto Duran Ortiz; Jakarta, Oriental Consultants; Ahmedabad, DeshGujarat.com

Figure 5.7.5 Photos of Bus Rapid Transit (BRT)

Table 5.7.3 Characteristics of Bus Rapid Transit (BRT)

Strengths	➢ Initial cost is considerably low. ➢ The system can be implemented in a short time ➢ Operation is flexible depending on the demand ➢ There is neither aesthetic concern nor daylight interference ➢ Medium passenger capacity (13,000 passengers per hour, per direction)
Limitations	➢ One lane per direction of the road will be occupied. ➢ Minimum right of way requirement is 25m to allocate two lanes per direction for passenger vehicles. ➢ Travel speed can be limited in the case of a non-elevated system due to delays at intersections.
Difficulties to Implementation	➢ Traffic arrangements at intersections should be scrutinised. ➢ Legal basis is required to exclude passenger cars in a BRT lane. ➢ Institutional arrangements for implementation are necessary ➢ Coordination with existing bus operators, taxis and paratransit operators is required. ➢ Implementation requires close coordination with the police, road development authority and local authorities.

Source: CoMTrans Study Team

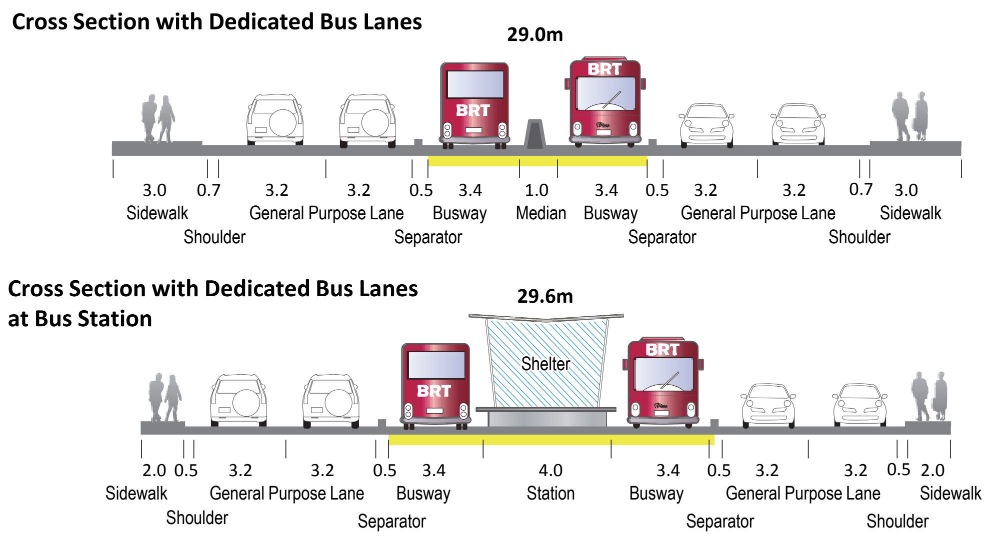
Table 5.7.4 Specifications of Bus Rapid Transit (BRT)

Capacity	3,000 – 13,000 PPHPD*
Scheduled Speed	15-25km/h
Land Acquisition	Requires road width of 20m
Stop Spacing	500m – 1 km
Initial Cost	2 mn. USD/km
Operation and Maintenance Cost	USD 2.0 / car-km ($0.04 per passenger)
Daylight Interference	Not at all
Aesthetical	Not at all
Noise	Moderate due to diesel engines

Note: PPHPD stands for passengers per hour, per direction. Capacity of 12,000 to 13,000 PPHPD is assuming normal BRT system with 1-lane per direction system with single stopping bay stations. The capacity can increase to 20,000 PPHPD with a 1-lane per direction configuration with multiple stopping bays and the platooning of vehicle movements according to the example in Porto Alegre, Brazil. In addition, Bogota Colombia's Trans-Milenio is carrying 45,000 passengers per direction per hour with 2 dedicated lanes, articulated buses, stations with multiple bays, multiple permutation of routes, at-level boarding, pre-board fare system and double doors. (Reference: Edited by Lloyd Wright and Walter Hook (2007) Bus Rapid Transit Planning Guide, Published by the Institute for Transportation and Development Policy.

https://go.itdp.org/display/live/Bus+Rapid+Transit+Planning+Guide+in+English

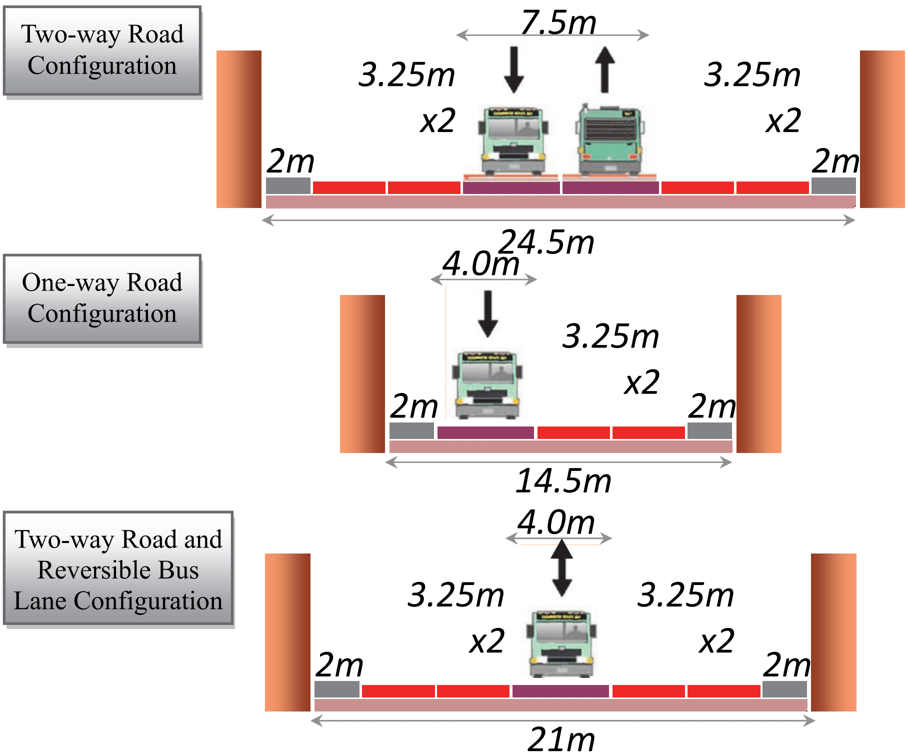
Although BRT is an inexpensive and high-capacity public mode of transport, it is essential to allocate one lane of the road for each direction. When it comes to its application in the Colombo Metropolitan Area, the limited availability of road space should be taken into account. Figure 5.7.6 shows typical cross-sections with median dedicated bus lanes of normal section and at BRT station sections. While a curb-side bus lane is another option, expected widths of the roads are more or less the same.



Source: CoMTrans Study Team

Figure 5.7.6 Typical Cross-Sections with Dedicated Bus Lanes (Median-BRT Lane Case)

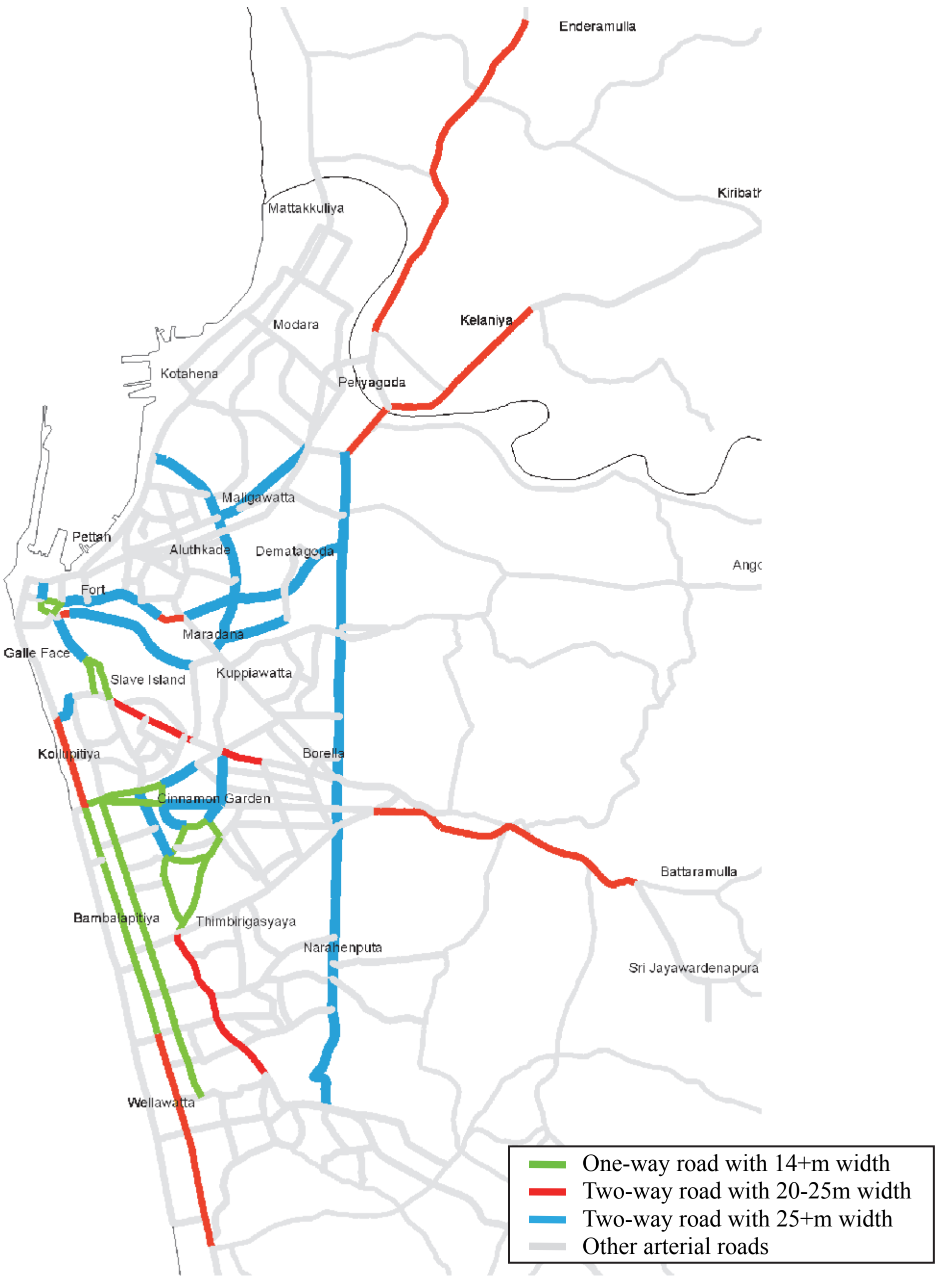
Unfortunately, only a few roads have a width of more than 29 m in the Colombo Metropolitan Area (CMA). This implies that the application of typical cross-sections might require a significant amount of land acquisition. However, compromises in the width of bus lanes and width of sidewalks can be proposed for CMA taking examples from other countries and bus operation in CMA. As shown in Figure 5.7.7, roads with approximately 25m width can be utilised for BRT keeping 2-lanes open for private vehicles by direction. In the case of one-way roads, approximately 15m is enough to accommodate dedicated lanes for a BRT system. In addition, a reversible bus lane system which can be used for one direction for morning peak hour and the opposite direction for evening peak hour can reduce the width to roughly 20-21m.



Source: CoMTrans Study Team

Figure 5.7.7 Compromise Cross-Sections with Dedicated Bus Lanes

Figure 5.7.8 shows roads which can accommodate a BRT system in the Colombo Metropolitan Area. While some roads such as Baseline Road, Kandy Road, Galle Road, Duplication Road and a part of Malabe Road have enough width to accommodate it, some sections of Malabe Road such as in the Borella Area, Battaramulla Area and Malabe Area require land acquisition to incorporate a BRT system without reducing the number of lanes for private modes of transport.



Source: CoMTrans Study Team

Figure 5.7.8 Current Road Width of Arterial Roads

(3) Automated Guideway Transit (AGT)

Automated Guideway Transit (AGT) is an automated grade-separated transit system with rubber tires as shown in Figure 5.7.9. The system is a comparatively new type of transport and is standardised in Japan. Most of the systems are fully automated and driverless systems. Characteristics of AGT are summarised in Table 5.7.5 and Table 5.7.6.

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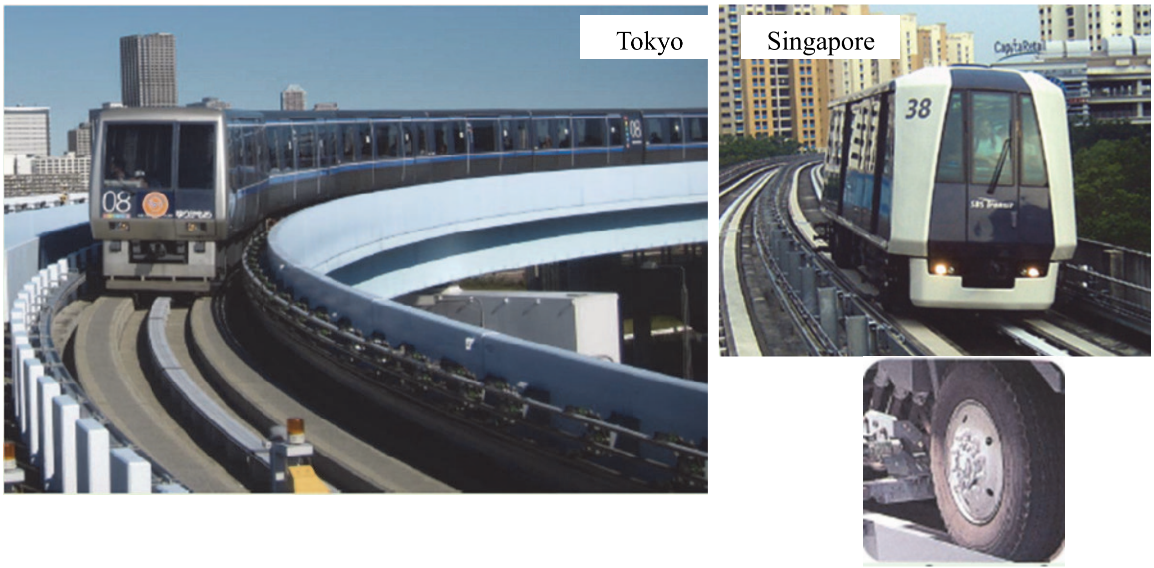


Source: Japan Transportation Planning Association (left and lower right) and Wikimedia Free License Pictures (Upper right)

Figure 5.7.9 Photos of Automated Guideway Transit (AGT)

Table 5.7.5 Characteristics of Automated Guideway Transit (AGT)

Strengths	➢ Flexibility in alignment due to minimum radius of 20m ➢ Driverless system can minimise human error and reduce operation and maintenance cost. ➢ Moderate passenger capacity (13,000 passengers per hour, per direction)
Limitations	➢ Daylight interference and aesthetic concern due to slab structure ➢ Higher cost compared with bus-based options
Difficulties to Implementation	➢ Legal regulations to permit the new mode of transport. ➢ Institutional arrangements for implementation ➢ Coordination with existing bus operators, taxis and paratransit operators is required.

Source: CoMTrans Study Team

Table 5.7.6 Specifications of Automated Guideway Transit (AGT)

Capacity	4,000 – 20,000 PPHPD
Scheduled Speed	20-30km/h
Land Acquisition	Required at station sections
Stop Spacing	500m – 1 km
Initial Cost	30 – 60 mn. USD/km
Operation and Maintenance Cost	USD 2.5 / car-km ($0.03 per passenger)
Daylight Interference	Pier and slab interfere with daylight.
Aesthetical	Pier and Slab can be an aesthetical concern.
Noise	Minimum due to rubber tire system without diesel engine

Note: PPHPD stands for passengers per hour, per direction.

While AGT is a technically sound and safe mode of transport considering the experience in Japan and other countries, the balance of cost and capacity should be examined and compared with other modes of public transport. It is also noted that the slab structure might interfere with the daylight and landscape of the city.

(4) Monorail

Straddled monorail is a transit system on a single concrete rail. The specially designed monorail vehicle can grasp the rail and run on the rail as well as shown in Figure 5.7.10. While a broader definition of monorail can include a variety of monorail systems such as steel rail-based AGT and suspended monorail, the straddled monorail system is discussed in this report as there have been many installations worldwide as a solution for urban transport problems. Characteristics of the monorail are summarised in Table 5.7.7 and Table 5.7.8.

Source: Oriental Consultants Co., Ltd. (Left) and Hitachi Ltd. (Right)

Figure 5.7.10 Photos of Monorail

Table 5.7.7 Characteristics of Monorail

Strengths	➢ Flexibility in alignment due to minimum radius of 60m ➢ Less daylight interference and less aesthetic concern due to simple beam structure ➢ High passenger capacity (30,000 passengers per hour, per direction)
Limitations	➢ Relatively higher initial cost of rolling stock due to complicated structure ➢ Difficulties in evacuation in case of machine trouble ➢ Complex switching system requires slab structure
Difficulties to Implementation	➢ Legal regulations to permit the new mode of transport. ➢ Institutional arrangements for implementation ➢ Coordination with existing bus operators, taxis and paratransit operators is required.

Source: CoMTrans Study Team

Table 5.7.8 Specifications of Monorail

Capacity	7,000 – 30,000 PPHPD
Scheduled Speed	20-40km/h
Land Acquisition	Required at station sections
Stop Spacing	500m – 1 km
Initial Cost	30 – 60 mn. USD/km
Operation and Maintenance Cost	USD 2.5 / car-km ($0.03 per passengers)
Daylight Interference	Pier and beam slightly interfere with daylight.
Aesthetical	Pier and beam can be a slight aesthetical concern.
Noise	Minimum due to rubber tyre system without diesel engine

Note: PPHPD stands for passengers per hour, per direction.

The monorail is a stable and technically sound system and there are a number of examples in the world. The system can be applied after an examination of passenger demand. Although there are some arguments that a monorail system has a drawback for evacuation in case of emergency, several counter measures are available. Passengers in a malfunctioned car can move to other trains by stopping alternate cars in front or side by side. Evacuation can be done by cherry picker and spiral chute as well. Slab structure at switching (turnout) section should be noted for route alignment analysis.

(5) Light Rail Transit (LRT) (Elevated / Ground)

The word “Light Rail Transit” (LRT) is mainly utilised to describe a steel rail transit system of smaller size compared with a conventional heavy railway as shown in Figure 5.7.11. The capacity can vary from 7,000 passengers per hour, per direction to roughly 30,000 passengers per hour, per direction as indicated in Table 5.7.10 Specifications of Light Rail Transit (LRT) Some definitions also include modernised tram car and street car systems. In some examples, LRT is a totally elevated system and the function is closer to that of the Mass Rapid Transit, which will be introduced in the following sub-section.

Source: Prof. Akimasa Fujiwara (Right)

Figure 5.7.11 Photos of Light Rail Transit (LRT)

Table 5.7.9 Characteristics of Light Rail Transit (LRT)

Strengths	➢ No daylight interference in the case of a ground level structure ➢ The system can be applied for both elevated and ground level structure. ➢ High passenger capacity (30,000 passengers per hour, per direction)
Limitations	➢ Low allowable gradient (3.5%) ➢ One lane per direction of road will be occupied (in the case of ground level structure). ➢ Minimum right of way requirement is 25m to allocate two lanes per direction for passenger vehicles (in the case of ground level structure). ➢ Travel speed can be limited in the case of a non-elevated system due to delay at intersections (in the case of ground level structure). ➢ Daylight interference and aesthetic concern (in the case of elevated structure)
Difficulties to Implementation	➢ Institutional arrangements for implementation ➢ Traffic arrangements at intersections should be scrutinised (in the case of ground level structure). ➢ Legal regulations are required to exclude passenger cars in an LRT lane (in the case of ground level structure). ➢ Coordination with existing bus operators, taxis and paratransit operators is required. ➢ Implementation requires close coordination with the police, road development authority and local authorities.

Source: CoMTrans Study Team

Table 5.7.10 Specifications of Light Rail Transit (LRT)

Capacity	7,000 – 30,000 PPHPD
Scheduled Speed	20-40km/h
Land Acquisition	Ground level section: 25m width of road is required Elevated section: Required at station sections
Stop Spacing	300m – 1 km
Initial Cost	35 – 60 mn. USD/km
Operation and Maintenance Cost	USD 4.0 / car-km ($0.04 per passengers)
Daylight Interference	Ground level section: None Elevated section: Pier and slab interfere with daylight.
Aesthetical	Ground level section: Electric feeder cables Elevated section: Pier and slab can be an aesthetic concern.
Noise	Medium due to steel tire system without diesel engine

Note: PPHPD stands for passengers per hour, per direction.

There are a number of LRT examples in both the developing and developed world. The largest merit of LRT is that it can be applied for both elevated and at grade sections as mentioned in Table 5.7.9. Ground level sections might reduce the initial cost. It also should be noted that a ground level LRT possesses characteristics similar to BRT which means that it requires ample width for LRT track installation. Several obstacles of both elevated and ground level sections should be taken into consideration for application in CMA.

(6) Mass Rapid Transit (MRT) (Elevated / Underground) and Modernised Railway

It is widely accepted that mass rapid transit (MRT) has the highest sectional passenger capacity among all modes of transport as shown in Figure 5.7.12. It is dependent on the system specifications, but, it reaches 60,000 passengers per hour, per direction (PPHPD). The system characteristics are generally the same as a conventional railway system, however the stop spacing is shorter and train operation is much more frequent. Therefore, electric trains are mainly used because electric trains have higher acceleration and deceleration capacity and are economically efficient for frequent operation. Comfortable air-conditioned trains are usually utilised to enhance the modal shift from the private mode of transport. Characteristics of MRT are summarised in Table 5.7.11and Table 5.7.12.

Source: Oriental Consultants (Upper Left and Lower Left); http;//ksweb.org/ (Upper Right); JR West (Lower Right)

Figure 5.7.12 Photos of Mass Rapid Transit (MRT) and Modernised Railway

Table 5.7.11 Characteristics of Mass Rapid Transit (MRT) and Modernised Railway

Strengths	➢ Highest passenger capacity (60,000 passengers per hour, per direction) ➢ No daylight interference in the case of underground structure High travel speed
Limitations	➢ Highest cost, especially for underground sections ➢ Daylight interference and aesthetic concerns (in the case of elevated structure) ➢ Risk of exposure to water when heavy rains and flood cases ➢ Low allowable gradient (3.5%)
Difficulties to Implementation	➢ Huge initial investment ➢ Lengthy construction duration ➢ Institutional arrangements for implementation ➢ Legal regulations needed for the utilisation of underground land (in the case of underground structure). ➢ Coordination with existing bus operators, taxis and paratransit operators is required.

Source: CoMTrans Study Team

Table 5.7.12 Specifications of Mass Rapid Transit (MRT) and Modernised Railway

Capacity	18,000 – 60,000 PPHPD
Scheduled Speed	30-40km/h
Land Acquisition	Elevated Section: Required at station sections and curve sections Underground Section: Only entrance, exits, sharp curve section and depot
Stop Spacing	1.5 – 2 km
Initial Cost	Elevated Section: 45 – 60 mn. USD/km Underground Section: 90 – 100 mn. USD/km
Operation and Maintenance Cost	USD 5.0 / car-km ($0.03 per passengers)
Daylight Interference	Elevate Section: Pier and slab interfere with daylight. Underground Section: None
Aesthetical	Elevated Section: Pier and slab can be an aesthetic concern. Underground Section: None
Noise	Medium due to steel tire system without diesel engine Underground Section: None

Source: CoMTrans Study Team

5.7.2 Comparison of Public Modes of Transport

Characteristics of various public modes of transport has been described above. Comparison of public modes of transport is listed in Table 5.7.13.

Table 5.7.13 Comparison of Public Transport Options

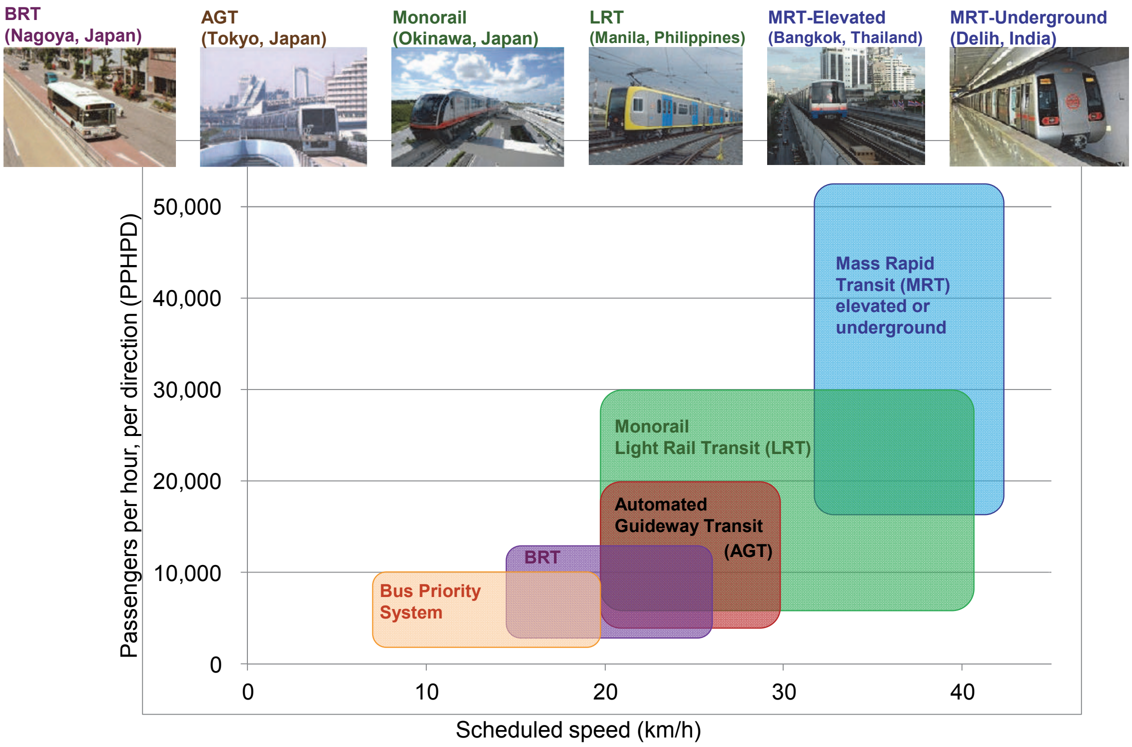
System	Bus Priority System	BRT	AGT	Monorail	LRT	MRT - Elevated	MRT - Underground
Capacity*	-10k	3-13k	4-20k	7-30k	7-30k	18-60k	18-60k
Scheduled Speed	10-20km/h	15-25m/h	20-30 km/h	20-40km/h	20-40km/h	30-40km/h	30-40km/h
Land Acquisition	no acquisition	along roads	only stations	only stations	station & some roads	station & curve sections	station exit only
Stop Spacing	0.3 – 1 km	0.5 – 1 km	0.5 – 1 km	0.5 – 1 km	0.3 – 1 km	1.5 – 2 km	1.5 – 2 km
Initial Cost	USD ~1 M/km	USD 2 M/km	USD 30-60 M/km	USD 30-60 M/km	USD 35-60 M/km	USD 45-60 M/km	USD 90-100 M/km
O&M Cost	N/A	USD 1.3 / car-km $0.03 per pax.	USD 2.0 / car-km $0.04 per pax.	USD 2.5 / car-km $0.03 per pax.	USD 4.0 / car-km $0.04 per pax.	USD 5.0 / car-km $0.03 per pax.	USD 5.0 / car-km $0.03 per pax.
Daylight Interference	Not at all	Not at all	Pier & Slab	Pier & Beam	Pier & Slab	Pier & Slab	Not at all
Aesthetic Concern	No Concern	Station only	Pier & Slab	Pier & Beam	Pier & Slab	Pier & Slab	Not at all
Noise	Rubber Tyre & Engine	Rubber Tyre & Engine	Rubber Tyre	Rubber Tyre	Steel Rail & Tyre	Steel Rail & Tyre	No noise to ground level

Note: * Capacities are in the number of passengers per hour, per direction. 1k means 1,000.

5.7.3 Aspects to be Considered for Mode Selection

(1) Capacity and Scheduled Speed

For the selection of transport mode, a variety of aspects must be taken into account. Conventionally, transport capacity and scheduled speed are key indicators for selecting the mode. Figure 5.7.13 illustrates the characteristics of each public transport mode in terms of transport capacity and scheduled speed. Needless to say, transport capacity must be higher than transport demand or it causes congestion. Scheduled speeds are also key indicators for mode selection which significantly affect mode choice behaviour. In addition to capacity and scheduled speed; economic, environmental and social aspects also are critical aspects for mode selection.



Source: CoMTrans Study Team

Figure 5.7.13 Passenger Capacity and Scheduled Speed of Public Transport Modes

(2) Land Acquisition

In Sri Lanka, land acquisition may cause delay in project implementation and increases cost of compensation. For the smooth implementation of a project, it is recommended to avoid land acquisition. As some transport modes require significant land area, it is virtually impossible for the government to implement the project considering the availability of human resources and budget constraints.

(3) Accessibility (Stop Spacing)

From the users' perspective, accessibility to transit stations significantly affects mode choice behaviours. It is also important for the government to improve accessibility to public transport for those who cannot afford to purchase private vehicles. On the other hand, short station intervals might reduce travel speed of the transit. In general, transit using steel tires and rails requires longer distance for acceleration and deceleration compared with rubber tire and concrete rail. These system characteristics, engine capacity and average travel speed determines optimum stop spacing by mode.

(4) Project Cost (Initial Cost and Operation and Maintenance Cost)

Transit systems usually require an enormous amount of initial investment as they require huge infrastructures and rolling stock. While the government can request a loan from several development partners, the long-term financial capability of the government of Sri

Lanka should be taken into account.

Even though the government could afford to fund the initial investment for a transit system, operation and maintenance costs can burden the government budget. To achieve financially sustainable transit modes, it is expected that fare revenue can cover operation and maintenance cost.

(5) Environmental Considerations (Daylight interference, aesthetical concerns and noise)

Colombo is known as the “Garden City” with a number of parks and trees. For instance, Viharamahadevi Park is located in front of the line from National Hospital to Kollupitiya. The section from Sethsiripaya to Rajagiriya passes the lake side of Diyawanna lake. To avoid a dark and covered pedestrian environment, daylight interference should be minimised.

Many historic buildings are located along the Malabe corridor such as in the Town Hall area and Fort area. Thus, special attention should be paid to minimise the impact on the landscape. Especially, the Town Hall intersection is surrounded by historic buildings of the national hospital and a church.

At the intersection of Borella, there is a Bo tree which is considered to be very important among the people in the area.

Other environmental impacts such as noise level and impact on water retention in the depot area can be additional criteria to be considered.

5.7.4 Selection of Appropriate Transport System for Seven Corridors

Options of an urban transport system have been selected for each corridor taking transport demand, speed and capacity of each mode of transport into consideration as shown in Figure 5.7.14.

Table 5.7.14 Transport Mode Options for Each Corridor

Corridor	Option 1	Option 2	Option 3	Option 4
Negombo Corridor	Modernised Railway Puttalam Line	Bus Priority in Negombo Road (A03)	-	-
Kandy Corridor	Modernised Railway to Veyangoda	Monorail on A01 to Kadawatha	BRT system on A01 to Kadawatha	-
Low Level Road Corridor	Bus Priority	-	-	-
Malabe Corridor	Monorail System Fort - Malabe	Urban Expressway Parallel to Malabe Corridor	-	-
High Level Road Corridor	Modernised Railway of KV line (single)	Monorail On KV line	Monorail On High level road	Urban Expressway along High level road
Horana Corridor	Bus Priority on Horana road (B84)	Urban Expressway via Battaramulla	Urban Expressway via Nugegoda	-
Galle Corridor	Modernised Railway to Panadura	BRT on A2 to Moratuwa	-	-

Source: CoMTrans Study Team

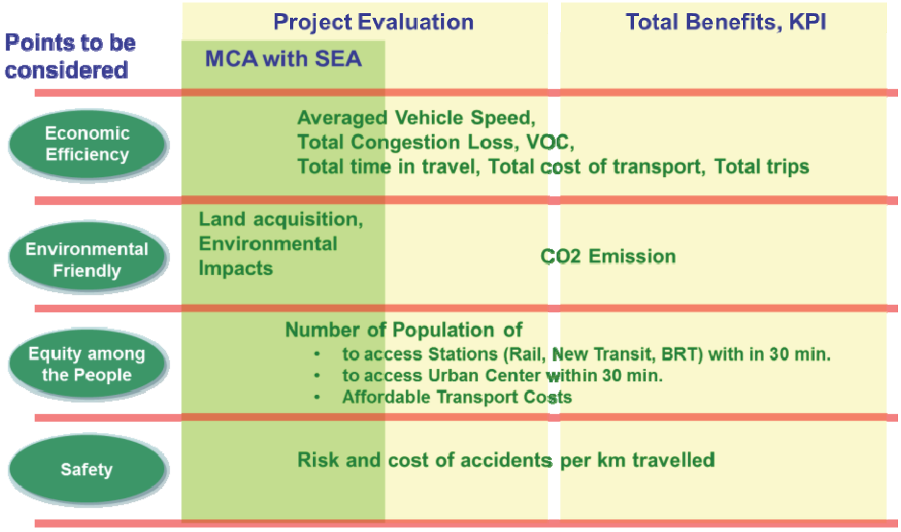
Each option is evaluated by key performance indicators for four objectives of urban transport system development as indicated in Table 5.7.15.

The results are compared by the key performance indicators (KPIs) of the four points to be considered, Economic efficiency, Environmentally friendly, Equity in society and Safety. The KPIs are set for the measurable indicators for describing the system benefit from the entire transport system development as well as evaluation criteria for selection of transport options. Figure 5.7.14 shows the idea of the KPIs. How the modes of transport have been selected for each corridor is described in Chapter 4 of Technical Report No. 6.

Table 5.7.15 Key Performance Indicators for Evaluation

No	Item	Key Performance Indicators (KPIs)
1	Economic efficiency:	Annual net benefit (billion Rs/year of 2035)
		Network averaged speed (km/h)
2	Environmentally friendly	CO_2 emission (million ton/year of 2035)
3	Equity in society	Accessibility to transit stations (million population)
4	Safety	Loss due to accidents (billion Rs./ year of 2035)

Source: CoMTrans Study Team



Source: CoMTrans Study Team

Figure 5.7.14 Key Performance Indicators (KPIs)

Annual Net Benefit in 2035 is defined as the difference in "total cost" between "Status Quo" and "Options". The "total cost" is the concept of the sum of "supply cost" and "Infrastructure cost". The supply cost consists of vehicle operation cost (VOC), travel time cost (TTC) and Operation and maintenance cost. The Infrastructure cost is to be the annual cost; therefore, it is divided by 20 years for the assumptions of life cycle.

Network averaged speed includes both public and private transport for all the Western Province trips.

Accessibility to transit stations is estimated by the number of population in areas within 800m from transit stations using the GIS.

(1) Preliminary Selection of Transport System for Negombo Corridor

Negombo corridor connects from Colombo central area to Negombo with the Negombo Road (A03) and the Puttalam Railway Line. Table 5.7.16 shows the evaluation results of possible transport systems for Negombo corridor.

Table 5.7.16 Evaluation of Possible Transport System Options for Negombo Corridor

		Status Quo in 2035	Modernised Railway Puttalam Line	Bus Priority in Negombo Road (A03)
Economic Efficiency	Annual Net Benefit (billion Rs./year of 2035)	-	69	36
	Network Average Speed (km/h)	7.4	7.8	7.7
Environmental Friendly	CO_2 Emission (million tone/year of 2035)	4.13	4.06	4.09
	Ref. Modal share of Public transport (%)	49.0	50.5	50.6
Equity in Society	Accessibility to Transit Stations (million population)	0.99	0.99	1.08
Safety	Loss by Accidents (billion Rs./year of 2035)	10.8	10.6	10.7

Note: Definitions are described in the 3.7.1

The evaluation results are summarised as follows;

- Regarding the “efficiency”, both options have some benefit with the comparison of the status quo in 2035.
- Even though the bus priority system has less benefit, it can improve all criteria of economic efficiency, environmentally friendly, equity in society and safety, so that it will remain as the option because of less investment cost.

Based on the results described above, both railway modernisation and the bus priority system will be the appropriate options to be implemented. The development proposal in Negombo Corridor is as follows:

- Modernisation of the Puttram Railway Line from Ragama to Negombo (12.6 km) as suburban railway connected with main railway line, with electrification, signal, telecommunication and track improvements. The two kilometre-airport connection from Katunayake South to the airport terminal will also create a more public transport oriented network.
- Bus priority system on Negombo road (A03)

It is also proposed that a BRT open system utilising CKE will be a more useful connection to Negombo and the international airport.

(2) Preliminary Selection of Transport System for Kandy Corridor

The Kandy Corridor connects from the Colombo central area to Kandy and various areas in the east and north of Sri Lanka with the national road A01, as well as the main line of the railway in parallel with A01. Table 5.7.17 shows the evaluation results of possible transport systems for the Kandy Corridor.

Table 5.7.17 Evaluation of Possible Transport System Options for Kandy Corridor

		Status Quo in 2035	Modernised Railway to Veyangoda	Monorail on A01 to Kadawatha	BRT system on A01 to Kadawatha
Economic Efficiency	Annual Net Benefit (billion Rs./year of 2035)	-	48	63	40
	Network Average Speed (km/h)	7.4	7.7	8.0	7.7
Environmentally Friendly	CO_2 Emission (million tone/year of 2035)	4.13	4.09	4.09	4.08
	Ref. Modal share of Public transport (%)	49.0	50.1	50.6	50.2
Equity in Society	Accessibility to Transit Stations (million population)	0.99	0.99	1.21	1.14
Safety	Loss of Accidents (billion Rs./year of 2035)	10.8	10.7	10.6	10.6

Note: Definitions are described in 3.7.1

The evaluation results are summarised as follows:

- Regarding the “efficiency”, simple calculation shows that the monorail system has the highest annual net benefit. However it should be discussed carefully because a monorail system requires a huge investment and should be implemented for enough networks, not only in the Kandy Corridor but also in others. In this context, the current railway transport infrastructure should be improved first.
- Even the BRT system may have several benefits and give more people access to the transit stations, so that railway modernisation and BRT are the adequate options for Kandy Corridor.

Based on the results described above, both railway modernisation and a BRT system will be the appropriate options to be implemented. The development proposal in Kandy Corridor is as follows:

- Modernisation of the Main Line from Fort to Veyangoda (38 km) as a suburban railway with electrification, signal, telecommunication and track improvements. Note that the Fort-Maradana section should be improved for the track arrangements.
- BRT system from Fort to Kadawatha (16.5 km) including several sections of road widening to secure BRT operation.

Re-routing of bus service is also proposed to connect to railway stations and BRT stations with the surrounding area.

If the BRT system stretches to Kadawatha, the Multi-modal centre will be a future option for connecting BRT system from centre of Colombo to Kadawatha with inter-provincial transport mode used by expressway network of OCH and Northern expressway.

(3) Preliminary Selection of Transport System for Low Level Road Corridor

The low level road corridor connects from the Colombo central area to Avissawella via Kaduwela with a low level road (B435). Results of the evaluation of possible transport systems are summarised as follows:

- Level of improvement is not significant, however, most of the indicators are positive and no negative impact exists.

Based on the results described above, the development proposal on the Low level road corridor is as follows:

- Bus priority system on the low level road (B435) with priority lane and signalling, it is based on the committed project of road widening for 4 lanes with redesigning.
- This priority lane should be well coordinated with the BRT system on Baseline road.

Table 5.7.18 Evaluation of Possible Transport System Options for Low Level Road Corridor

		Status Quo in 2035	Bus Priority on Low Level Road (B435)
Economic Efficiency	Annual Net Benefit (billion Rs./year of 2035)	-	12
	Network Average Speed (km/h)	7.4	7.5
Environmentally Friendly	CO_2 Emission (million tone/year of 2035)	4.13	4.12
	Ref. Modal share of Public transport (%)	49.0	49.4
Equity in Society	Accessibility to Transit Stations (million population)	0.99	0.99
Safety	Loss by Accidents (billion Rs./year of 2035)	10.8	10.8

Source: CoMTrans Study Team

(4) Preliminary Selection of Transport System for Malabe Corridor

The Malabe Corridor supports the connection from the Colombo central area to Malabe via the Battaramulla with the A0 road. Table 5.7.19 shows the evaluation results of possible transport systems for the Malabe Corridor.

Table 5.7.19 Evaluation of Possible Transport System Options for Malabe Corridor

		Status Quo in 2035	Monorail System Fort - Malabe	Urban Expressway Parallel to Malabe Corridor
Economic Efficiency	Annual Net Benefit (billion Rs./year of 2035)	-	94	38
	Network Average Speed (km/h)	7.4	8.2	7.9
Environmentally Friendly	CO_2 Emission (million tone/year of 2035)	4.13	4.05	4.21
	Ref. Modal share of Public transport (%)	49.0	50.9	48.3
Equity in Society	Accessibility to Transit Stations (million population)	0.99	1.12	0.99
Safety	Loss of Accidents (billion Rs./year of 2035)	10.8	10.5	11.1

Note: Definitions are described in the 3.7.1

The evaluation results are summarised as follows:

- Regarding the "efficiency", both options have a benefit with the comparison of status quo in 2035; the monorail has more beneficial options than the urban expressways in terms of annual net benefit. Network speed is improved with the monorail more than with urban expressway instalment.
- In terms of "Environmentally Friendly" and "Safety", monorail systems provide some improvements. However, expressways have more impact than the status quo.
- Monorail creates more "Accessibility" to transit stations.

In addition to the results described above, land acquisition for expressways is considered as a huge issue. Therefore, the development proposal in the Malabe Corridor is the monorail system development which runs from Battaramulla/ Malabe to Fort with the stretch of 14.5km.

It is also proposed that the monorail system is developed together with Transit Oriented Development (TOD).

(5) Preliminary Selection of Transport System for High Level Road Corridor

The High Level Road Corridor connects from the southern part of CMC, Kirulapone to Homagama via Kottawa with the High Level Road (A04) and the KV line. Table 5.7.20 shows the results of the evaluation of possible transport systems for High Level Road Corridor.

Table 5.7.20 Evaluation of Possible Transport System for High Level Road Corridor

		Status Quo in 2035	Modernised Railway of KV line (single)	Monorail on KV line	Monorail on High level road	Urban Expressway along High level road
Economic Efficiency	Annual Net Benefit (billion Rs./year of 2035)	-	63	36	100	12
	Network Average Speed (km/h)	7.4	7.8	7.7	8.2	7.7
Environmentally Friendly	CO_2 Emission (million tone/year of 2035)	4.13	4.07	4.09	4.05	4.22
	Ref. Modal share of Public transport (%)	49.0	50.0	50.6	50.8	48.1
Equity in Society	Accessibility to Transit Stations (million population)	0.99	0.99	1.08	1.07	0.99
Safety	Loss by Accidents (billion Rs./year of 2035)	10.8	10.7	10.7	10.5	11.1

Note: Definitions are described in Sub-section 3.7.1

The evaluation results are summarised as follows:

- With the evaluation criteria of "economic efficiency", a monorail on the High Level Road is the most suitable option among them. It also improves the accessibility to transit stations.
- An expressway is estimated to be worse than the status quo in terms of CO_2 emission and accidents due to foreseen induced private traffic along the road. In addition, there are difficulties regarding how to develop a 4-lane elevated road on the 4-lane road of the A04 as well as interchanges under the current land use condition and patterns.

Based on the results described above, the expressway along the A04 is dropped and will be treated in Horana Corridor's options. The development proposal in the High Level Road Corridor is as follows:

- A Monorail System from Borella to Homagama (20km) to connect with the Malabe Monorail System, as well as the connection to Wellawatta for the establishment of a monorail network

It is also proposed that the multi-modal centre at Makumbura (near Kottawa) be established to realise smooth transit after the development of the monorail system with secured capacity of passenger movement to the urban core centre from feeder buses as well as long distance buses using the OCH and Southern expressway.

(6) Preliminary Selection of Transport System for Horana Corridor

The Horana Corridor connects from the Colombo central area to Horana via Peliyandara Kalutara with the Horana road (B84). Table 5.7.21 shows the result of evaluation of possible transport systems for Horana corridor.

Table 5.7.21 Evaluation of Possible Transport System for Horana Corridor

		Status Quo in 2035	Bus Priority on Horana road (B84)	Urban Expressway via Battaramulla	Urban Expressway via Nugegoda
Economic Efficiency	Annual Net Benefit (billion Rs./year of 2035)	-	51	15	38
	Network Average Speed (km/h)	7.4	7.7	7.6	7.8
Environmentally Friendly	CO_2 Emission (million tone/year of 2035)	4.13	4.09	4.18	4.21
	Ref. Modal share of Public transport (%)	49.0	50.0	48.3	48.2
Equity in Society	Accessibility to Transit Stations (million population)	0.99	0.99	0.99	0.99
Safety	Loss by Accidents (billion Rs./year of 2035)	10.8	10.7	11.0	11.1

Note: Definitions are described in the 3.7.1

The evaluation results are summarised as follows:

- The bus priority system has the "economic efficiency" with low cost investment and produces some improvement.
- The urban expressway will produce some improvement of "economic efficiency". Other indexes show worse results due to the road oriented developments. It means that the reason to invest in this expressway to connect to CMC to Southern Expressway and Nugegoda route is that it is more effective than others, maybe because of capturing some traffic related to the B84 road.

Based on the results described above, the development proposal in Horana Corridor is as follows:

- Bus Priority System on Horana road (B84) with bus priority lane and signalling, it is based on the committed project of road widening for 4 lanes with redesigning. It is also effective if the feeder bus services will be able to connect with the high level road and stations of the monorail.

Urban expressways connect from CMC to B84 and to Hahathuduwa IC of the Southern expressway. This helps not only the Horana Corridor but also more long distance trips towards the southern direction from CMC.

(7) Preliminary Selection of Transport System for Galle Corridor

Galle Corridor connects from the Colombo central area to Kalutara via Moratuwa with the Galle Road (A02) and the Coast Line. Table 5.7.22 shows the evaluation results of possible transport systems for the Galle Corridor.

Table 5.7.22 Evaluation of Possible Transport System for Galle Corridor

		Status Quo in 2035	Modernised Railway to Panadura	BRT on A2 to Moratuwa
Economic Efficiency	Annual Net Benefit (billion Rs./year of 2035)	-	51	45
	Network Average Speed (km/h)	7.4	7.7	7.7
Environmentally Friendly	CO_2 Emission (million tone/year of 2035)	4.13	4.09	4.09
	Ref. Modal share of Public transport (%)	49.0	50.2	50.6
Equity in Society	Accessibility to Transit Stations (million population)	0.99	0.99	1.11
Safety	Loss of Accidents (billion Rs./year of 2035)	10.8	10.7	10.7

Note: Definitions are described in the 3.7.1

The evaluation results are summarised as follows;

- Regarding the "efficiency", both options have benefit with the comparison of status quo in 2035.
- In terms of "Environmentally Friendly" and "Safety", both options ensure the same level of improvement. BRT stations cover more people for improvement of accessibility.

Based on the results described above, both railway modernisation and the BRT system will be the appropriate options to be implemented. The development proposal in the Galle Corridor is as follows:

- Modernisation of the Coast Railway Line from Fort to Panadura (28 km) as a suburban railway, with electrification, signals, telecommunication and track improvements
- A BRT system from Fort to Moratuwa (20 km) together with Marine Drive extension (Dehiwala-Ratmalana) to secure enough capacity for the traffic volume on Galle Road (A02)

It is also proposed that the multi-modal centre at Moratuwa be established to realise smooth transit between railway, BRT and feeder buses.

5.7.5 Summary of Selected Transport System Development Options for Seven Corridors

Based on the evaluation, the most suitable options were identified for each transport corridor, which are indicated in Table 5.7.23. Note that these are results on a corridor basis so that it should be discussed in the view of network enhancement, especially the public transport network, such as monorail network, railway network and BRT network to link closely.

Table 5.7.23 Selected Development Options for Each Corridor

Corridor	Selected Development Options		
	Railway	New Transit System	BRT/Bus/Road
Negombo	Modernised	-	Bus Priority
Kandy	Modernised	-	BRT
Low Level Road	-	-	Bus Priority
Malabe	-	Monorail	-
High Level Road	-	Monorail	-
Horana	-	-	Bus Priority
Galle	Modernised	-	BRT supported by Marine Drive extension

Source: CoMTrans Study Team, Note: - indicates no appropriate option is selected. Detailed evaluation procedure is explained in the Technical Report : Master Plan Formulation.

5.8 Phasing of Urban Transport Projects

5.8.1 Points Considered for Prioritisation

The policy measures listed above can be regarded as a long list of projects to improve the transport situation. Among these policy measures, in general the following policy measures are planned to be implemented in short term.

(1) Extensive Public Transport Network Development

It is essential to develop an extensive network of quality public transport to alleviate traffic congestion in the Colombo Metropolitan Area; otherwise, people would shift from public transport to private modes and would bring about more serious traffic congestion.

(2) Rehabilitation and Repair of the Existing Transport Facilities

Rehabilitation and repair the existing transport facilities are regarded as short-term measures since it is usually economical to make most use of the functions and it is required for securing safety.

(3) Development of Flyovers and Underpasses at Bottleneck Intersections

Traffic congestion often occurs at intersections in urbanised areas where traffic capacity is reduced compared to a single road section since various traffic flows share the traffic capacity of the intersections. One of countermeasures to alleviate traffic congestion at intersections is to provide grade separation facilities such as flyovers and underpasses.

(4) Missing Link of Expressway Network

Colombo Natunayake Expressway has been in operation since November 2013 and the Outer Circular Highway, Kottawa - Kaduwela section was recently opened to the public in March 2014. Elevated roads around the new Kelaniya bridge with the connection to CKE will be developed in the short-term. If the end section of the elevated road is located in the middle of city centre, it is anticipated to cause serious traffic congestion at that exit point. From a transport engineering and planning point of view, dead ends should not be in the city centre but the expressway link should be extended to the south and should be connected to OCH or Southern Expressway to distribute traffic flows to various destinations. Furthermore these expressway developments would not serve the southern part of the CMC thus it should cover the southern part of CMC from spatial equity among districts.

(5) Logical Sequential Order of Infrastructure Development

Transport facility is usually composed of networks. Road and railway networks consists of several links in sequence. When developing a new road or railway line, logically the sequence of development is starting from the end of the road or the railway line, when it is long and has to be divided into several phases for development.

(6) Soft Measures

Soft measures such as the improvement of regulations on public transport operation, the improvement of the management of public transport operation, the establishment of technical standards, the establishment of a road network master plan and education on traffic safety and so forth are relatively easy to implement in terms of budget and time.

(7) Traffic Control

Traffic control including traffic signal installation can be implemented in the short term for certain areas to make smoother traffic flows at intersections. An area wide traffic control system would be the system for the city centre. The extension of the traffic signal system will be implemented in the following phase.

(8) Transport Demand Management

Transport demand management aims to control transport demand by various policy measures. This includes a car traffic restraint scheme in congested areas such as road pricing. The Electronic Road Pricing (ERP) has already been implemented in Singapore and London. Prerequisites for employing car traffic restraint is quality public transport system. Since car traffic restraint schemes force car drivers and passengers to shift from private car use to public modes of transport, if there is no reasonable public transport system, people are reluctant to switch their modes. In terms of timing this policy measures can be taken after the public transport system is developed extensively.

5.8.2 Initial Prioritisation of Urban Transport Projects

According to the criteria and conditions mentioned above, the projects are tentatively divided into three phases; namely, short-term, intermediate-term and long-term development plans. This phasing shall be reviewed after the evaluation is made and the budget constraint is also taken into consideration.

5.9 Urban Transport System Development Scenarios

5.9.1 Preparation of Urban Transport System Development Scenarios

The base case scenario and three urban transport system development scenarios are prepared to compare the advantages and disadvantages of each development scenario.

1) Base Case Scenario
2) Intensive public transport system development scenario
3) Mixed public transport and road network development scenario
4) Intensive road network development scenario

Base case scenario includes the transport system development identified in corridor analysis. Obviously the improvement consists of the selected option for each radial corridor. The other three cases include other facilities including transport facilities and services in the circumferential direction as well.

In addition, transport demand management (hereinafter referred to as “TDM”) such as electronic road pricing can be included as an option to reduce traffic congestion on the road network and to promote a modal shift from the private mode of transport to public transport.

5.9.2 Preparation of Public Transport Network and Road Network

The guiding principal for formulating a public transport network is to prepare a congestion free public transport network as much as possible to promote public transport use. Public modes of transport for a congestion-free network include 1) Railway 2) Monorail 3) Bus Rapid Transit.

(1) Alternatives for Public Transport Network

BRT is proposed on the roads with three lanes per direction. The roads include Base Line Road, Galle Road together with Marine Drive and Duplication Road. It is proposed to develop the Middle Ring Road with three lanes per direction to prepare for the future development of BRT.

Heavy rail basically focus on the rehabilitation and improvement of the existing railway system except for the short-distance airport access and the Dompe freight line.

In other areas and corridors where wide road space is not available, development of an elevated rail-based transit system is planned. Major components of this category include the Fort-Malabe corridor, High Level Road corridor and the North–South corridor in the city centre.

(2) Alternatives for Road Network

The expressway network is formulated taking the on-going road development projects and connection with the existing expressways such as the southern expressway as well as the outer circular highway into account. This includes the connection between the southern expressway and CKE and Pore - Malabe - Borella connection. The port access road is an extension of the elevated road connecting CKE and is also included in the expressway network.

The arterial road development scenario includes those for supporting public transport and major and minor arterial road development is proposed to formulate neighbourhood units in suburban areas.

Alternatives for the transport network are prepared by combining projects in public transport as well as the road network taking budget constraints into consideration. An intensive public transport system development scenario consists of more public transport options compared to that of an intensive road network development scenario. The most appropriate development scenarios will be selected based on the evaluation of the transport system development scenarios and then the urban transport master plan will be formulated.

Table 5.9.1 Alternatives for Transport System Development Scenario

Sub Transport Sector	Project ID	Project Name	Transport System Development Scenario						Note
			A1	A2	B1	B2	C1	C2	
			Intensive Highway Development	Intensive Highway Development & TDM	Combined Public Transport and Highway Development	Combined Public Transport and Highway Development & TDM	Public Transport Intensive	intensive Public Transport Development & TDM	
TDM	TM-ERP	Electronic Road Pricing (CMC)	-	√	-	√	-	√	
BRT	BRT-1	Fort-(Galle Road)-Moratuwa	√	√	√	√	√	√	
	BRT-1	Kelaniya-Fort-(Galle Road)-Wellawatta-Kirillapone-(Baseline)	√	√	√	√	√	√	
	BRT-1	Kelaniya-(Kandy Road)-Kadawata	-	-	√	√	√	√	
	BRT-2	Middle Ring Road	√	√	√	√	√	√	
	BRT-2	BRT Base Line Extension	-	-	√	√	√	√	
	BRT-2	BRT Moratuwa Extension	-	-	√	√	√	√	
Monorail	RT-NT1	Battaramulla Line(East West Line)	√	√	√	√	√	√	
	RT-NT2	North - South Line	√	√	√	√	√	√	
	RT-NT3 and 4	Borella-Kirillapone-Homagama	-	-	-	-	√	√	
	RT-NT5	Kirillapone – Wellawatta	-	-	-	-	√	√	

Note: √ indicates the project is included in the development scenario. – indicates that the project is not included in the scenario.

Sub Transport Sector	Project ID	Project Name	Transport System Development Scenario						Note
			Development Scenario						
			A1	A2	B1	B2	C1	C2	
			Intensive Highway Development	Intensive Highway Development & TDM	Combined Public Transport and Highway Development	Combined Public Transport & Highway Development & TDM	Intensive Public Transport Development	Intensive Public Transport Development & TDM	
Railway	RL-M1 to M5	Electrification, Signal improvement, Procurement of Electric Cars	-	-	√	√	√	√	
	RL-NR2	Dompe Line	-	-	-	-	√	√	Private investment
Arterial Roads	RD-RN3	Base Line Extension	√	√	√	√	√	√	required for BRT
	RD-RN4	Marine Drive Extension	√	√	√	√	√	√	required for BRT
	RD-RN2	Middle Ring Road	√	√	√	√	√	√	required for BRT
	RD-RN1,5,6,7and 8	Major Arterial Roads	4 lanes	4 lanes	2 lanes	2 lanes	2 lanes	2 lanes	
	RD-RN9,10	Minor Arterial Roads	√	√	√	√	√	√	
Urban Express ways	RD-EX1	Kelani-Borella-Kirillapone-	√	√	√	√	√	√	
	RD-EX2	Pore-Malabe-Borella	√	√	-	-	-	-	
	RD-EX3	Port Access	√	√	√	√	√	√	Port access is prerequisite for direct ramp to Fort MmTH
	RD-EX4	Direct Ramp to Fort MmTH	-	-	√	√	√	√	required for connecting to Intercity Bus Terminal in MmTH

5.10 Evaluation of Urban Transport Development Scenarios

Four urban transport system development scenarios were evaluated to find the most appropriate option for long term transport system development for the CMA.

The Base Case scenario consists of the modes of transport selected as a most suitable mode doe for each corridor in the corridor analysis. In the evaluation of the Base Case scenario, the total network capacity is examined for the year 2035. The Base Case scenario focuses on the enhancement of seven transport radial corridors, but does not focus on roads in the circumferential direction. Since it is expected to expand the urbanised area outward from the city centre, it examines the overall sufficiency of the transport network capacity against increasing transport demand. Comparison of simulation results between Base Case and Case C2 clearly indicates the significant traffic flows on the circumferential roads and traffic demand distributed more evenly. If ring roads are developed the traffic demand on the Base Line Road could be reduced as illustrated in Figure 5.10.1.

Base Case | **Case C2**

Source: CoMTrans Study Team

Figure 5.10.1 Comparison of Base Case and Development Scenario C2 in 2035

Alternative transport system development scenarios were prepared to analyse the future direction of the transport network; to determine whether an intensive road network is appropriate for the Colombo Metropolitan Area or a public transport network should be developed intensively to meet the future transport demand. Consequently, an intensive highway development scenario and intensive public transport development scenario were prepared and additionally the case between intensive highway and intensive public transport development scenarios was also prepared for comparison. The advantages and disadvantages of each development scenario were examined from various aspects.

In addition, if these cases will not be able to alleviate traffic congestion, a further option is also studied. Employment of transport demand management is this option and it includes car traffic restraint schemes such as ERP.

1) Base Case

2) Intensive Highway Network Development Scenario

3) Mixed Highway and Public Transport Development Scenario

4) Intensive Public Transport System development Scenario

Performance of each transport system development scenario is evaluated from the following aspects.

1) Efficiency: Economic Internal Rate of Return (EIRR) and NPV(Net Present Value)

2) Equity: Service area of quality public transport (railway, monorail and BRT)

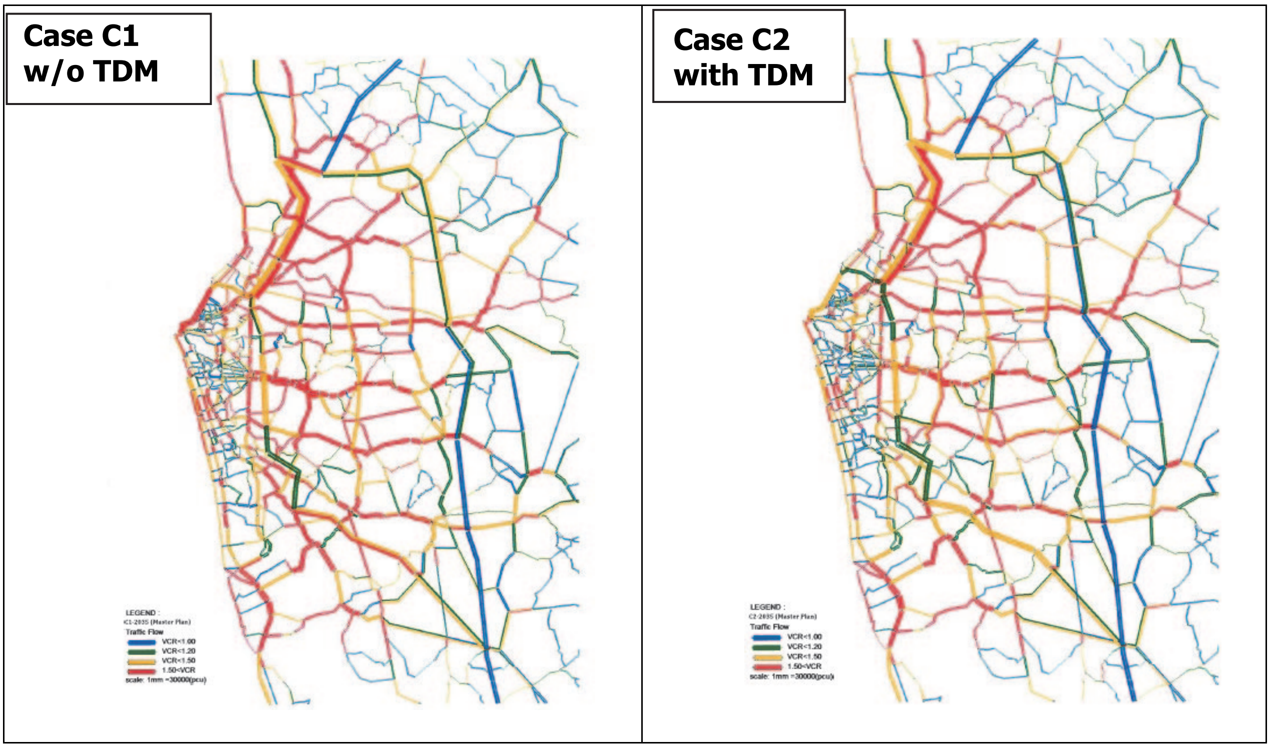
3) Environmentally Friendly: Global Warming: Emission of CO2

4) Traffic Safety: Economic loss due to traffic accidents

Traffic simulation results indicate that transport network capacity is not sufficient for the Base Case transport system development scenario. The transport capacity for in the radial corridors does not have a significant problem regarding a shortage of capacity based on the corridor analysis that has examined the required increase of capacity. However, a shortage of transport capacity in suburban areas is observed.

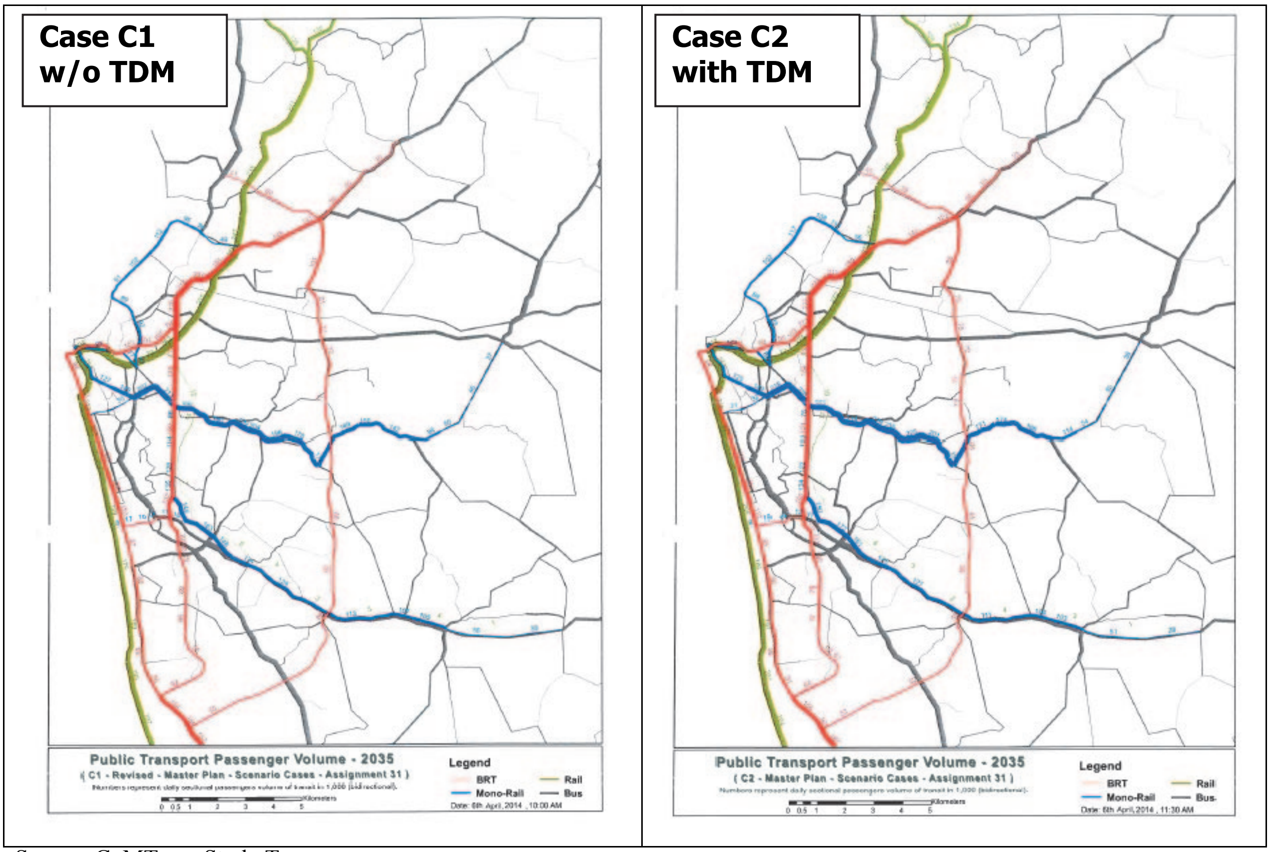
Then the performances of the three transport system developments scenarios were compared. The intensive public transport system development scenario indicates better performance compared to the intensive highway development scenario. Thus it is recommended to develop the public transport system intensively to formulate future transport systems for the Colombo Metropolitan Area. However, even though the public transport system is developed intensively, a shift to private modes of transport is inevitable due to the increase of in household income and increase in car ownership. As a result, the public transport share would not increase significantly; and it would not be easy to alleviate traffic congestion.

To deal with this problem, transport demand should be controlled. By employing traffic restraint schemes such as ERP, the traffic flows into the city centre could be reduced in peak hours and it this would lead to a shift to public transport. This can be observed by comparing Case C1 and Case C2. Traffic congestion would be alleviated with TDM as illustrated in Figure 5.10.2 and public transport demand would increase by shifting from private modes to public modes as shown in Figure 5.10.3. If the public transport system is developed intensively and furthermore transport demand management (TDM) is also employed, the performance of the transport system will be better than without TDM case.



Source: CoMTrans Study Team

Figure 5.10.2 V/C for Simulation of Cases C1 and C2 in 2035



Source: CoMTrans Study Team

Figure 5.10.3 Passenger Demand on Public Transport of Cases C1 and C2 in 2035

In conclusion, for the urban transport system development scenario it is recommended as an urban transport system development scenario, to develop the public transport system extensively and at the same time employ TDM to promote the shift to public transport.

Table 5.10.1 Evaluation of Urban Transport System Development Scenarios

Evaluation Item	A1	A2	B1	B2	C1	C2
	Intensive Highway Development	Intensive Highway Development & TDM	Combined Public Transport and Highway Development	Combined Public Transport and Highway Development & TDM	Intensive Public Transport	Intensive Public Transport Development & TDM
Economic Internal Rate of Return (%)	19.7%	21.2%	19.3%	22.7%	19.1%	22.9%
Net Present Value (billion Rs.)	622	765	564	779	541	797
Population in the Public Transport Service Area [1)]	1.26 million people		1.36 million people		1.40 million people	
Reduction of CO_2 Emission (million ton)	4.2	6.4	5.8	7.7	5.8	8.3
Reduction of Loss due to Traffic accident (million Rs.) [2)]	510	724	756	921	710	1066
Overall Evaluation	B-	B+	B-	A-	B-	A

Note:
1) Public transport service area is defined as the area within 800 meter radius from railway stations and BRT shelters.
2) Loss of traffic accidents are discounted value at 12%.
Source: CoMTrans Estimate

5.11 Strategies for Urban Transport System Development

The strategies for developing Urban Transport Systems in the Colombo Metropolitan Area can be divided into two stages; one is a strategy at the planning stage and the strategies should be taken into consideration when planning urban transport systems and land use. The other strategies are those related to project implementation.

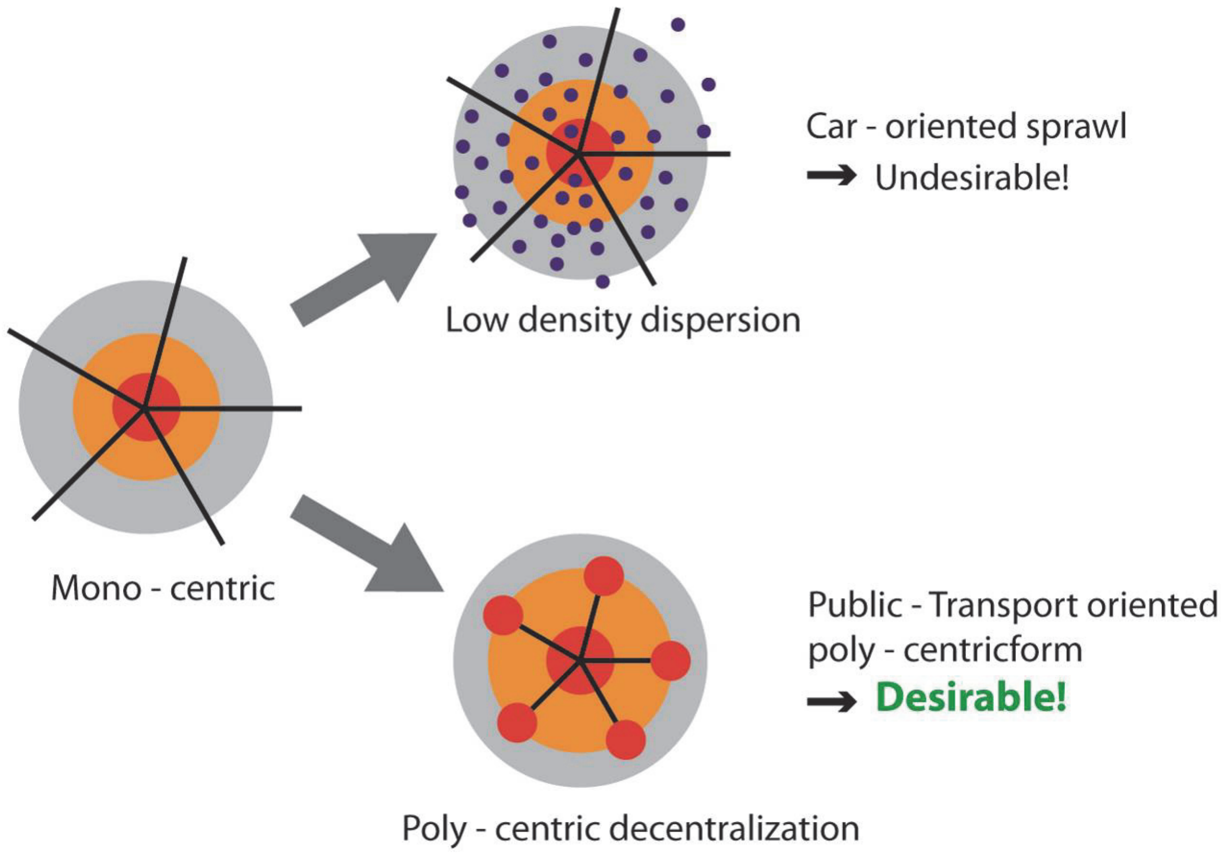
5.11.1 Strategies for Integration with Urban Planning

(1) Centre Development for Mass Transit Systems

Urban structure and transport systems should be integrated. For instance, a highway oriented transport network is suitable for low-density land use which can be seen in the suburbs of the United States. In contrast, a mass transit system is appropriate for high-density urban land use.

As mentioned in 5.2.1 as one of the planning issues, sub-centre development is one way to deal with traffic concentration in the city centre. In order to develop the sub centres, strong transport linkage is required between the city centre of Colombo and the sub centres. Mass transit systems should be installed between these centres to support the travel needs of the people and goods. Conceptually, to support the viability of public transport systems, it is preferable that a city grows compactly in a form of poly-centric decentralisation.

Guided urban development is essential to develop cities to be consistent with urban transport systems. In this regard, metropolitan-wide urban land use planning is also required.



Source: Shigeru Morichi and Surya Raj Acharya Editors; Transport Development in Asian Megacities A New Perspective, 2013

Figure 5.11.1 Spatial Pattern and Suitable Transport Options

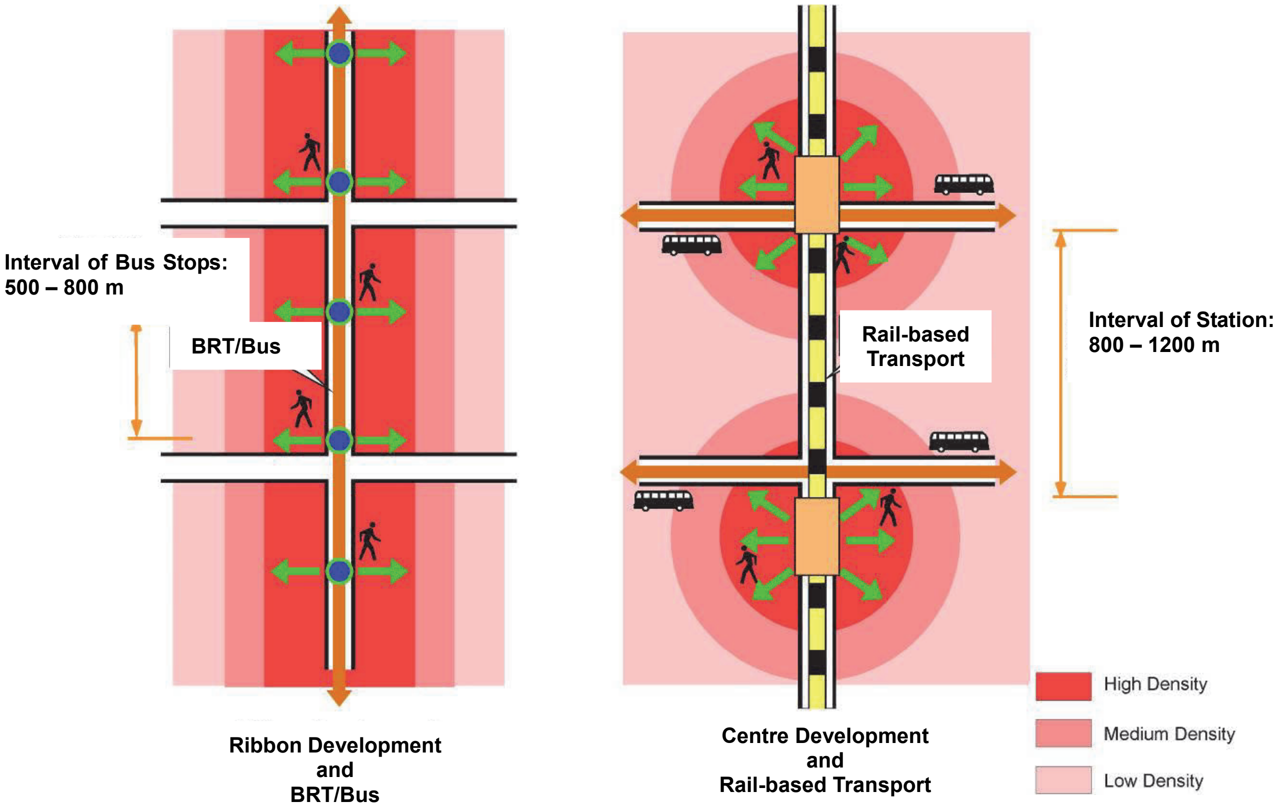
(2) Development of Public Transport Systems to be Synchronised with Urban Development

The Colombo Metropolitan area has expanded outward from the city centre. In suburban areas the population density has not been high and travel demand is not high in the area. In the future, as urbanisation continues, travel demand would increase and then mass transit systems might be required.

Mass transit systems should be developed in accordance with urban development. Travel demand along the corridor should be monitored to determine the development timing of the mass transit system. This phased development should be taken into account in particular for the BRT system to be developed along the planned Middle Ring road in the suburban area.

(3) Transit Oriented Development (TOD)

To make mass transit systems viable, high density urban development in the area surrounding rail-based transit system stations is preferable. In the city centre, high-rise office buildings and commercial facilities, such as shopping malls within walking distance from a station are desirable to increase passenger demand on the transit system. In suburban areas, high rise apartments near stations are a preferable form of land use for the mass transit system. To materialise these developments, high floor ratios should be promoted in the urban development plan. On the other hand, outside of the area surrounding the station the floor area ratios should be limited to prevent high density urban development.



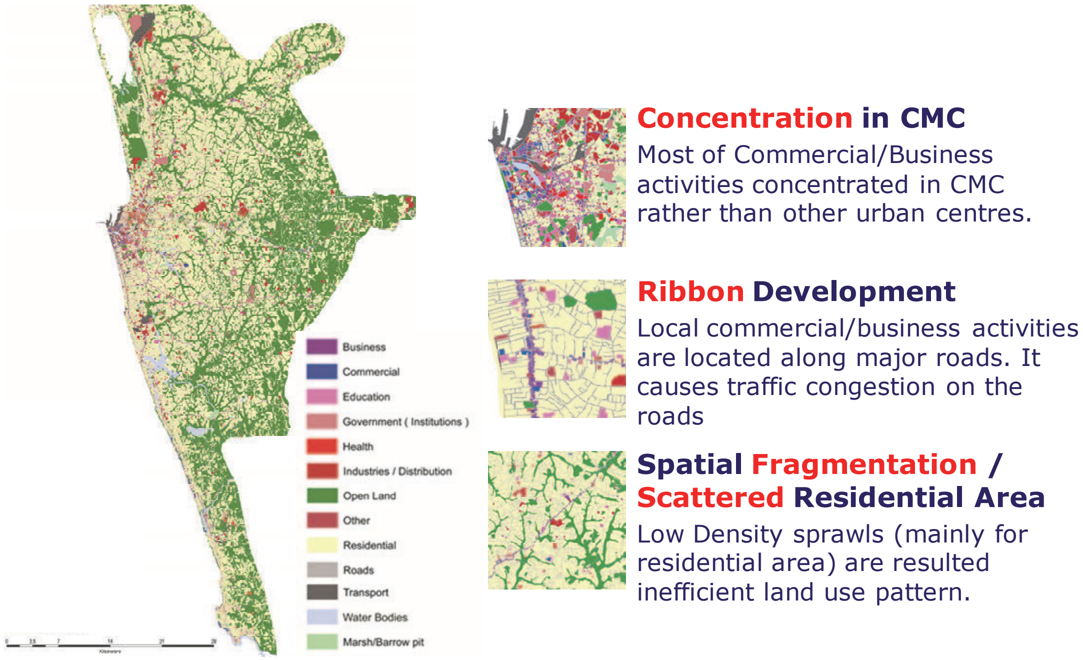
Source: CoMTrans Study Team

Figure 5.11.2 Transit Oriented Development

The CoMTrans land use survey found the following issues in the Colombo Metropolitan Area as described in Sub section 2.2.3 Urban Development Characteristics:

- Ribbon development along the major roads and
- Spatial fragmentation/scattered residential areas.

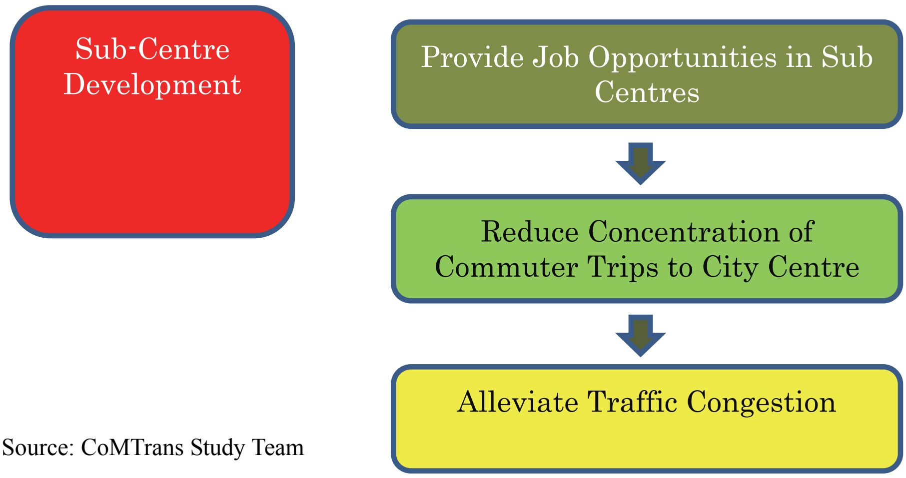
The urban transport master plan should take into consideration urban development structures.



Source: CoMTrans Land Use Survey, 2013

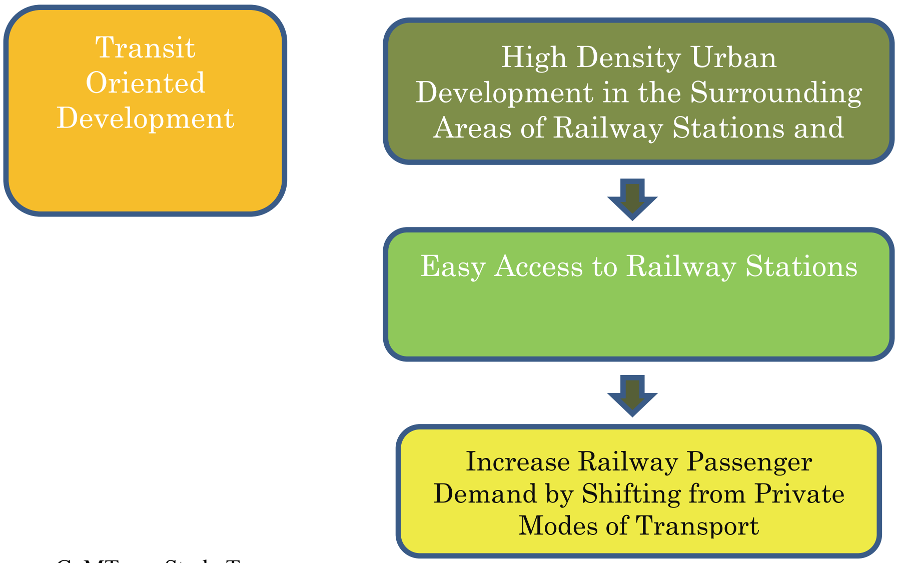
Figure 5.11.3 Present Land Use Patterns and Issues

Therefore, CoMTrans proposes that the integration of urban development with urban transport systems is of utmost importance. The strategy for the integration includes sub-centre development illustrated in Figure 5.11.4 and Transit Oriented Development in Figure 5.11.5.



Source: CoMTrans Study Team

Figure 5.11.4 Integration of Urban Development and Transport Systems: Sub-Centre



Source: CoMTrans Study Team

Figure 5.11.5 Integration of Urban Development and Transport Systems: Transit Oriented Development

5.11.2 Strategies for Transport Planning

(1) Development of Extensive Public Transport Networks

Public transport systems at a higher level of service should be developed in the form of networks so that people can reach their destinations within the system. A higher level of public transport service means a congestion free transport system; namely, heavy railway, medium-size transit systems and bus rapid transit (BRT).

A public transport network should consist of several trunk lines with feeder services and it should cover as wide an area as possible.

(2) Application of Transport Demand Management (TDM) and Car Traffic Restraint Scheme

Transport demand management (TDM) is necessary to alleviate traffic congestion in the CBD because new road construction, or even road widening is very difficult in the CBD and will be limited due to physical constraints such as the availability of land for the roads. Road pricing is a scheme to alleviate traffic congestion by charging vehicles entering congested areas in the city centre and it also raises funds for developing and improving the urban transport systems. Improvement of public transport is prerequisite for employing TDM.

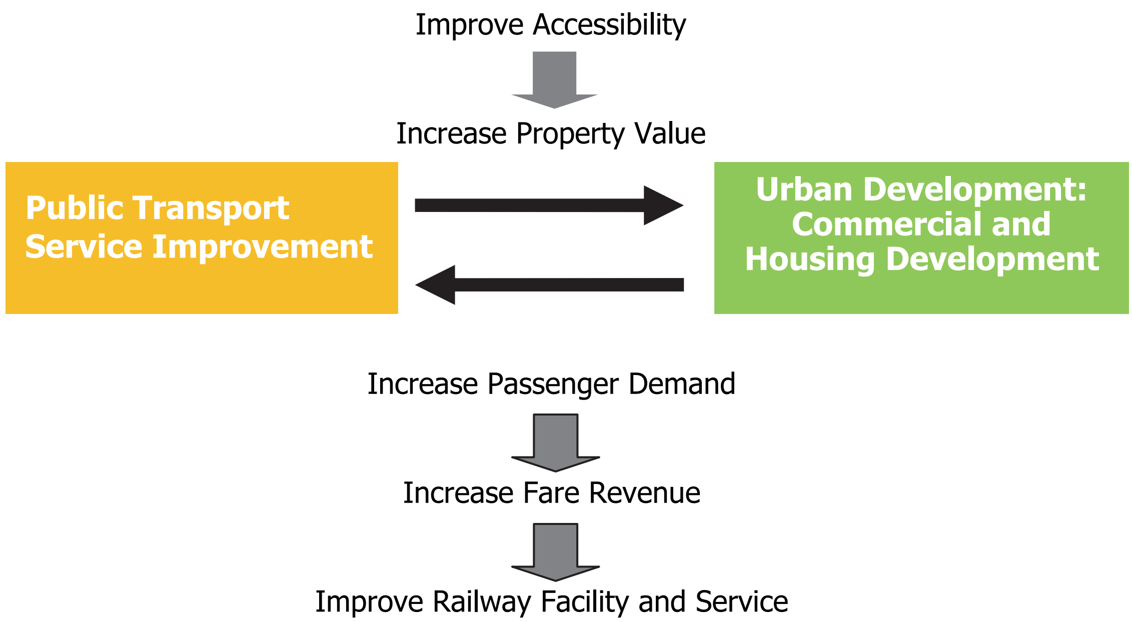
5.11.3 Strategies in Project Implementation

(1) Encouraging Private Sector Participation

This system reduces the government investment for transport infrastructure development replaced by private sector funding and encourages the participation of private organisations for operation and maintenance. It is common that urban highways are developed under BOT (Build Operate Transfer) scheme or PPP (Public Private Partnership) scheme in many cities; thus, when urban expressways are developed, it should encourage participation of the private sector in the form of BOT or PPP. However public transport system development is usually difficult to finance by only the private sector. In most common cases, public transport fares are regulated by the government at low levels since the government should provide means of transport for low income households. Therefore it seems difficult to make public transport projects financially profitable merely with passenger fare revenue. In many countries a common practice for financing public transport is to provide infrastructure by the public sector and provide operation by the private sector.

(2) Introduction of a Value-Capture System for Public Transport Development

Rail-based transport is not disturbed by ordinary traffic and this mode can provide fast speeds and large passenger capacity transport service. Railway passengers enjoy the fast and convenient railway service for travelling in the urban areas. In addition, railway service can increase the sales of department stores and shopping malls near stations and promote the values of land and housing along the railway corridor. However the railway company is not able to gain all the value added accrued from the railway development. Since a rail-based transport system requires huge initial investment cost, the methodology of cost recovery should be considered through value capture of development. In the case of private railway companies in Japan, they develop housing areas along the railway corridor. After they provide new railway service, the land values increase and they sell the housing at a higher price and get profits from the real estate business. They are also starting retail businesses as well by building shopping malls at the terminal stations. From this kind of commercial business they can profit in addition to passenger transport service. To support the rail-based transit development project financially it is recommended to take this kind of business model into consideration as illustrated in Figure 5.11.6.



Source: CoMTrans Study Team

Figure 5.11.6 Value Capture Mechanism for Public Transport Development

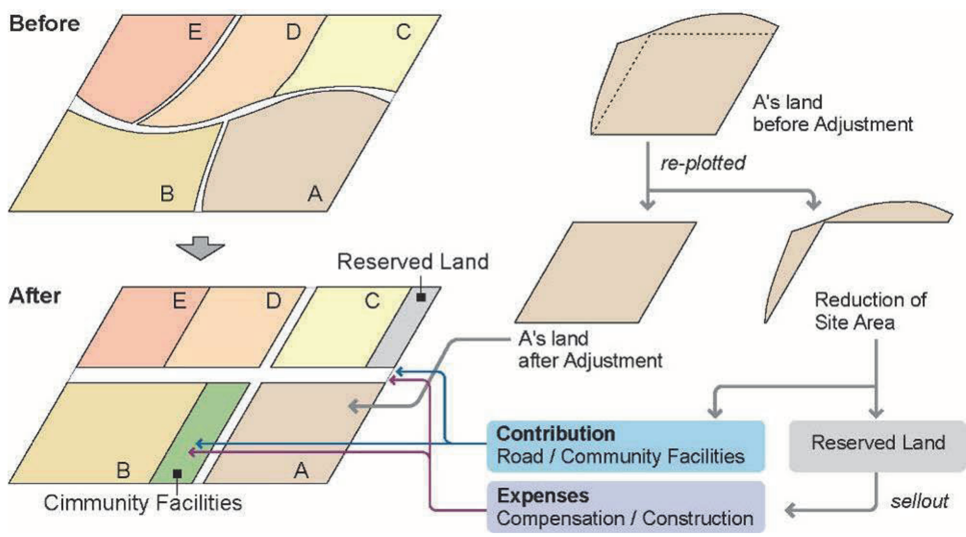
(3) Methodology of Space Preparation for Urban Development

To develop the desirable urban structure, sometimes land acquisition is required but it is not easy to implement; thus, new implementation methods should be introduced. There are two methodologies that can be applied in Sri Lanka.

Land Re-adjustment

This is a typical method of Japan's urban development to create a comfortable residential area. It is illustrated in Figure 5.11.7.

An irregular-shaped plot is re-plotted to a rectangular shape by reducing the site area. The reduced site area is provided for roads and sometimes parks or community facilities, and part of the land is sold to cover expenses for compensation and construction cost for road improvement. Then all lands are re-plotted and roads can be constructed. Although each land owner lost a part of the land, the land owners will gain more value since the land value will be increased as the road condition becomes much better than before.



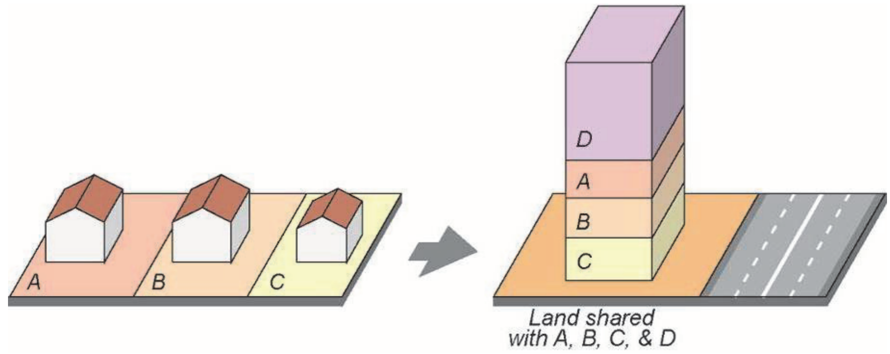
Source: CoMTrans Study Team

Figure 5.11.7 Conceptual Method of Land Re-plotting

<u>Urban Renewal Project</u>

This is also a typical method in the Japanese context to create urban centres within a commercial or business district. Figure 5.11.8 illustrates the simplified method of urban renewal.

Land owners can organise an urban renewal association. Often a developer coordinates to organise the association and the government is also involved. The lands are unified and shared with the owners and the developer. A part of the land is provided for public purposes, mainly roads. Thus, a building is constructed and all the members gain benefits by allocating the floors.



Source: CoMTrans Study Team

Figure 5.11.8 Conceptual Method of Urban Renewal

Actually, there is a practice of this kind of urban renewal method in the Slave Island Project by UDA and the private sector. A plot of land is being developed and some of the land owners are allocated floors in a newly built building.

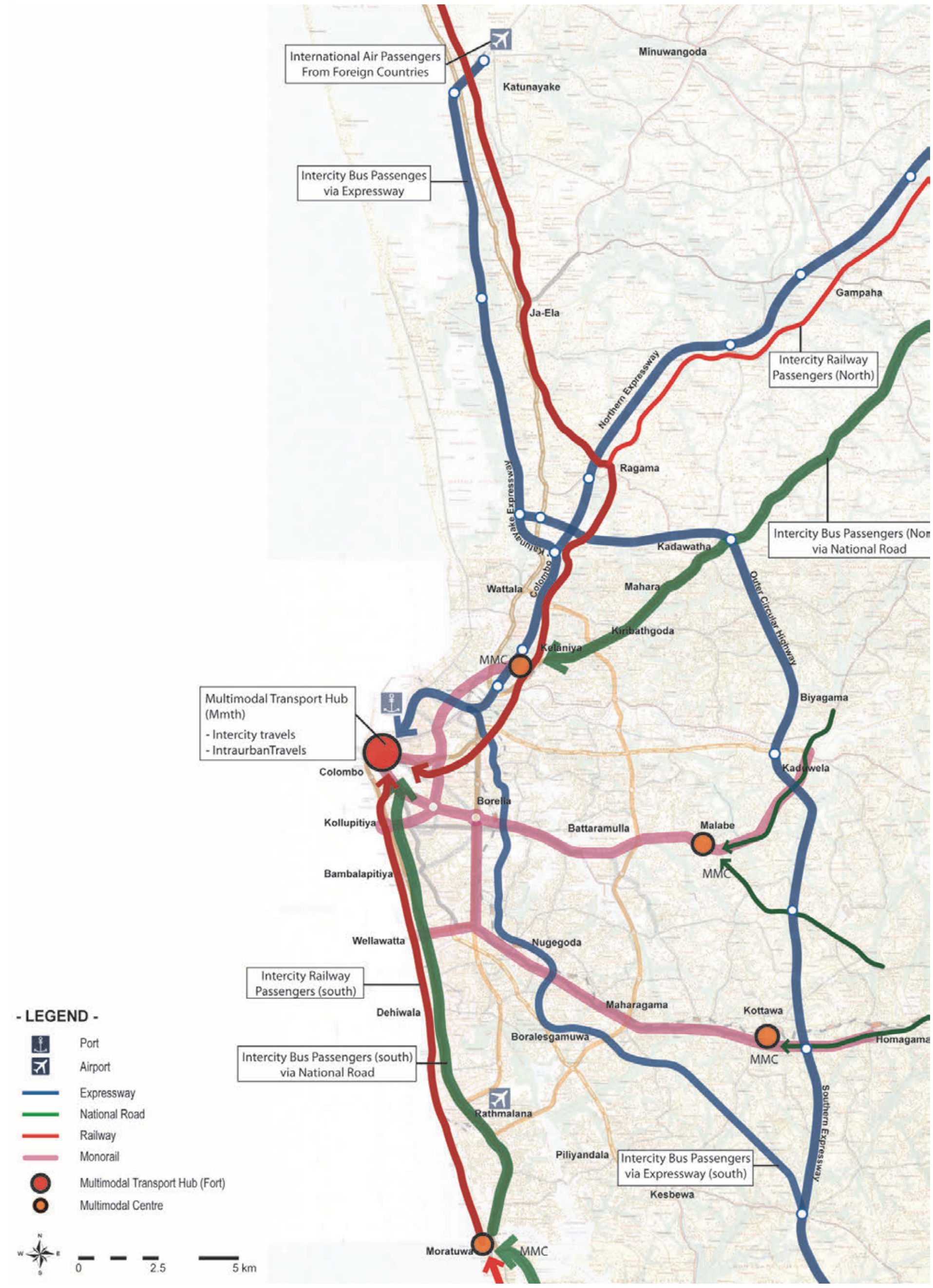
Although the above mentioned two methods are just theories, they would be a guide to some potential method for implementation. In order to carry this out, collaboration between the communities, land owners, the private sector such as developers, and the public sector such as the local government are required. They are still challenging methods for the Sri Lankan context. However, implementation methods are essential and should be recommended in order to achieve the Master Plan.

5.12 Inter-City Transport Systems

Transport systems are divided into Inter-city transport systems and urban transport systems. Inter-city transport systems provide transport services between cities. Before discussing urban transport system development, the development of inter-city transport systems is described.

5.12.1 Inter-city Passenger Transport Systems

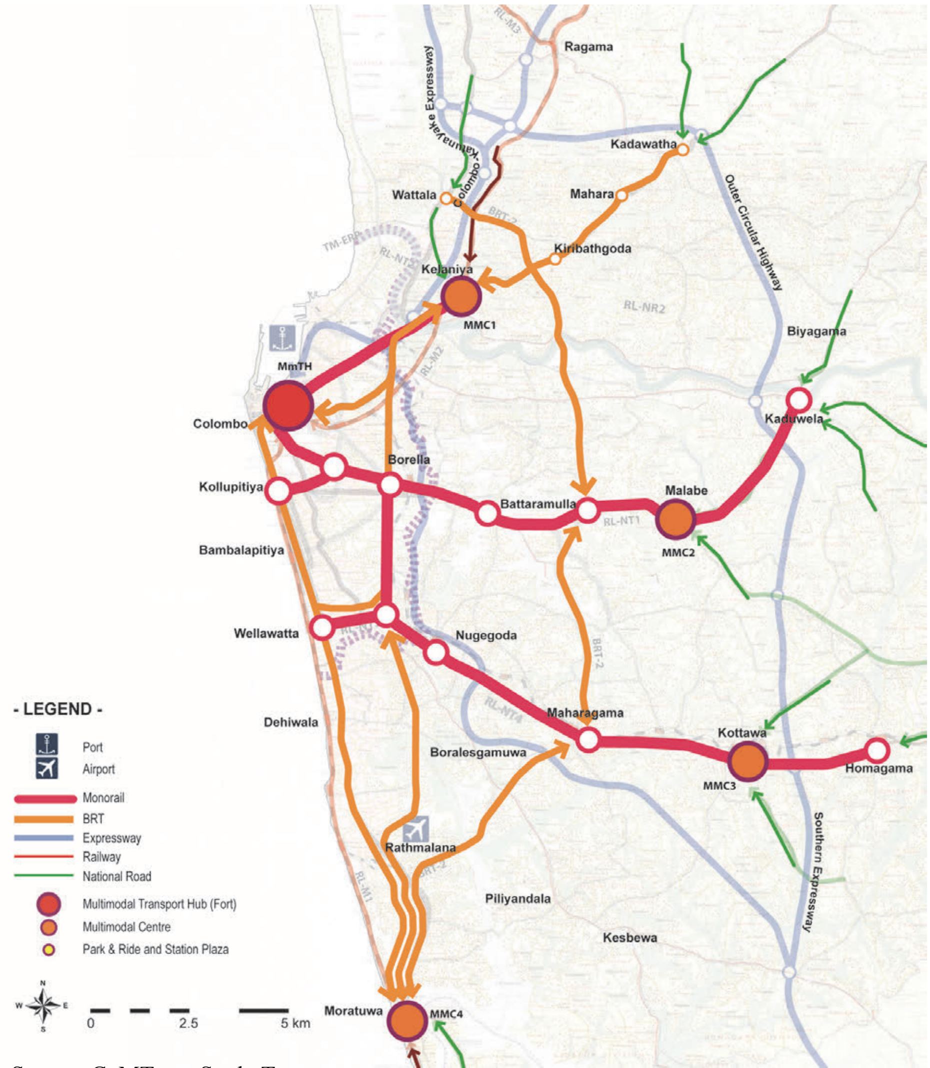
Currently, inter-city bus services are concentrated in Pettah bus terminals and most of the city bus services are also departing from and arriving at the Pettah bus terminals. Around 7400 intra provincial buses depart from and arrive at Pettah and some 3300 inter-provincial buses leave and arrive at Pettah. The number of passengers departing from the Pettah bus terminal is estimated to be about 38,000 passengers per day for intercity bus services and some 14,000 passengers per day for intracity bus services. This concentration of bus operation causes traffic congestion in the Pettah area. On the other hand, the majority of inter-city railway passengers depart from and arrive at the Fort railway station. In terms of inter-regional passenger movement, the Fort and Pettah areas are the hubs of the inter-regional transport systems. People travelling from the northern part, eastern part and southern part of the country can change their mode of transport at these transport hubs. The Multi-modal transport hub is an interchange point of inter-regional transport and intra-regional transport as shown in Figure 5.12.1.



Source: CoMTrans Study Team

Figure 5.12.1 Inter-city Passenger Public Transport Systems

The intercity passenger public transport system is connected with the urban transport system at Multi-modal Transport Hubs and Multi Modal Centres. Passengers from outside of the metropolitan area transfer at these transport nodes and go to final destinations by urban transport systems in the metropolitan area as shown in Figure 5.12.2.



Source: CoMTrans Study Team

Figure 5.12.2 Urban Passenger Public Transport System

5.12.2 Inter-city Cargo Transport System

Major inter-city cargo trip demands are to/from the Colombo port. According to the Truck OD interview survey at Colombo port, the destinations of the trucks are the Puttalam District 27%, the Gampaha District 23%, CMC 17% and the Colombo District 12%, thus 50% of the destinations are located in the north. The other major cargo flows are generated and attracted in industrial estates and EPZs. At present, heavy vehicles to/from the Colombo port are passing through the northern part of CMC and this causes traffic congestion in the city centre. To reduce the burden of cargo traffic flows in the city centre, a truck ban in daytime is a countermeasure and the other way is a provision of direct access to the port by an expressway network. If the Port Access Road could be inter-connected with the inter-regional expressway network, the port-related cargo could be easily transported to outside of the region. Trucks can avoid passing through the business district thus they would not disturb traffic flows in the city centre.

5.13 Urban Transport System Development Programmes

5.13.1 Urban Transport System Development Programme (1) for Promotion of Public Transport Use

Urban transport system development programme (1) consists of the projects for the urban transport policy 1: ***Promotion of Public Transport Use.***

(1) Monorail Systems

Based on the corridor analysis, the Malabe corridor has 60,000 vehicles entering the city and it is the highest compared to the other six corridors. Besides, the Malabe corridor is the only major corridor without rail-based public transport, excluding Low level road corridor and Horana corridor. Fort-Malabe corridor has been identified as the corridor which requires a rail-based transport system urgently. To make the most use of a monorail system on the Malabe corridor, which serves east-west direction travel in the metropolitan area, a north south monorail line should be added to serve other major destinations in the city.

Multi-Modal Transport Hub and Multi-Modal Centre

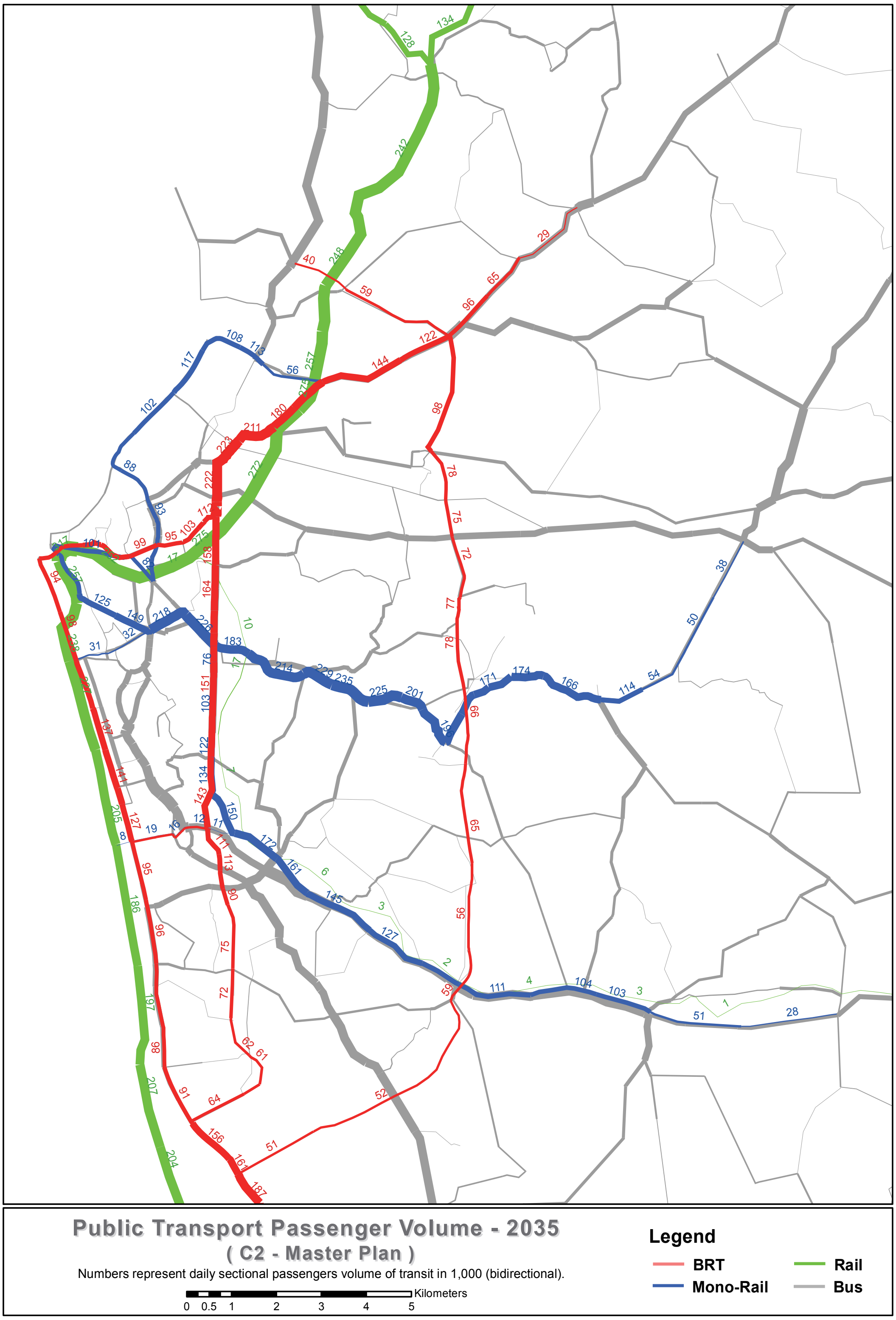
Each mode of public transport should be connected to function as a network. Public transport modes, including railways, inter-provincial buses, intra-province buses and new transit modes such as bus rapid transit (BRT) and monorail should be integrated. Railway, Monorail, and BRT as well as inter-provincial and city buses come to Fort station and the Pettah terminal. However the present station and three bus terminals are located separately and it is not convenient for passengers. Interchange facilities should be integrated and located at one place. The Multimodal Transport Hub shall function as an interchange facility for railway passengers, monorail passengers, and BRT passengers as well as ordinary bus passengers. The estimated number of passengers at Multi-modal Transport Hub is listed in Table 5.13.1. This indicates that a significant number of passengers would utilise the multi-modal transport hub. This means that the potential for urban development is also high. The urban development further increases the number of users of the hub.

Table 5.13.1 Estimated Passenger Demand at Multi-modal Transport Hub in 2035

	Passenger Demand (day ,both ways)	Peak Ratio (both ways)	Peak Demand (one way)
Railway	145,000 person/day	20%	14,500 person/h
Monorail	42,000 person/day	18%	3,800 person/h
BRT	5,000 person/day	10%	250 person/h
Total	184,000 person/day	—	18,550 person/h

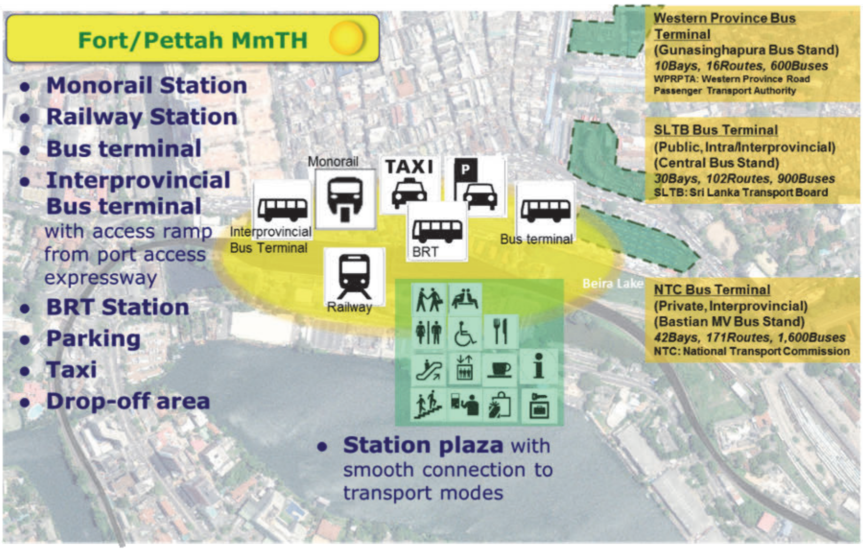
Source: CoMTrans Study Team

Passenger demand on the monorail system by section is illustrated in Figure 5.13.1.



Source: CoMTrans Study Team

Figure 5.13.1 Passenger Demand on Public Transport System in 2035



Source: CoMTrans Study Team

Figure 5.13.2 Concept of Multi-modal Transport Hub

Multi-modal Centre (MMC) and Park & Ride (P&R)

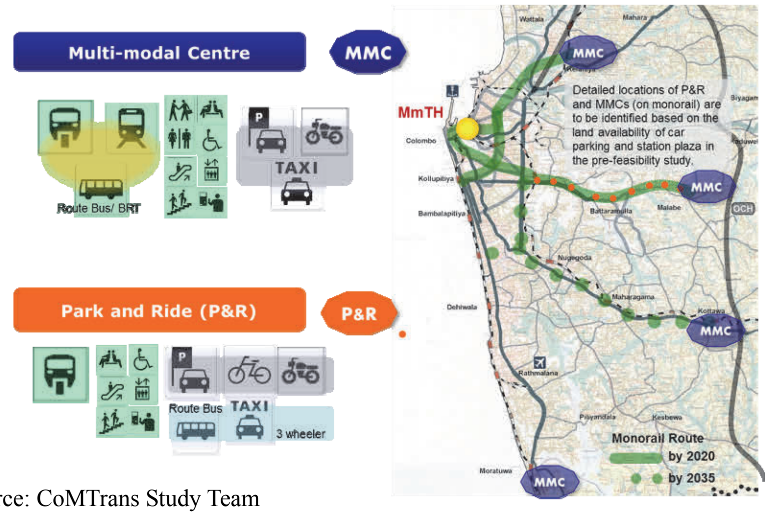
While a multi-modal transport hub will be a key component to connect all major public transport modes, concentration of all bus transport in a limited area might cause congestion in the surrounding area. Therefore, the "Multi-Modal Centre" is proposed to divert a part of the transport hub function to the suburbs of the Colombo Metropolitan Area. Four multi-modal centres on major corridors are proposed to serve passengers by corridor.

In order to promote public transport use, integrated transit facilities for the different modes of transport are planned along the planned monorail corridors.

The Multi-modal centres (MMC) function as the transit facilities for passengers from feeder buses and inter-provincial buses at the edge of the urban area to the city centre by monorail and commuter railway. It should have enough space for kiss & ride and drop-off. CoMTrans proposes the following four MMCs that will be located on four major corridors;

- MMC near Kelaniya in a New railway station, CKE interchange, Monorail and Bus terminals
- MMC at Malabe with Monorail and Bus Terminal
- MMC at Makumbura with Monorail, Bus terminal and OCH/Southern Expressway
- MMC at Moratuwa with Coast railway Line and BRT

Park & Ride (P&R) is the facility which encourages transfer from private mode to public mode. Basically it provides car and motorcycle parking and smooth connection with public transport, e.g. monorail. Feeder buses will be connected at this P&R to transfer to higher capacity public transport modes.



Source: CoMTrans Study Team

Figure 5.13.3 Concept of Multi-modal Centre and Park & Ride

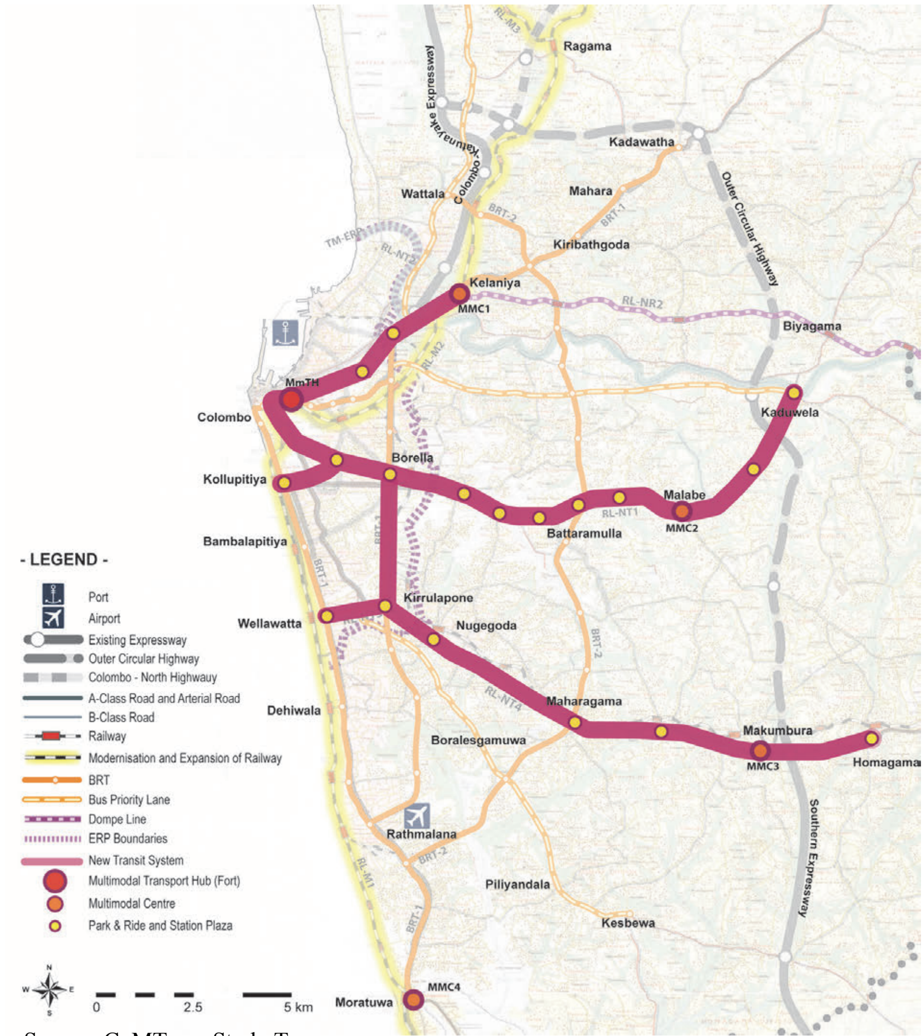
<u>Provision of Direct Access to Multi-modal Transport Hubs for Inter-city Bus Services</u>

Further extension from the Port Access Road to the MmTH is recommended in order to provide direct access for intercity bus services. Currently, 10,800 buses for both intercity and intra-city bus services are concentrated in the Pettah bus terminals and they cause traffic congestion in the surrounding area. If intercity buses can be taken off of the arterial roads in the area, traffic congestion would be reduced. This access road should be developed together with MmTH development. Coordination of the two projects is required.

<u>Park & Ride and Station Plaza Development</u>

To enhance a modal shift from private modes of transport to public transport, park & ride and kiss & ride (drop-off and pick-up) at monorail stations are essential options. Park & ride will allow car, private three-wheeler and motorcycle users to go by a private mode to the station and park to ride the monorail. While transit oriented development is becoming a universal concept to achieve economically and environmentally sustainable cities and transport systems, it takes time to change urban structure. In the early stage of development of a public transport system, park & ride enhances the modal shift to a public transport mode.

A station plaza with a station square, bus bay, taxi bay, sidewalks and commercial developments in front of or above a monorail station is also a key to attract passengers from adjacent areas. The station plaza can function as a symbol of the area and provide space for gathering in case of natural disaster.



Source: CoMTrans Study Team

Figure 5.13.4 Monorail System with MmTH, MMC and P&R

(2) Modernisation of Existing Railway System

Passenger Demand on Railway

It is estimated that total railway passengers would increase to 1,715,000 passengers per day in 2035 if the proposed improvement of the railway were undertaken. Passenger demand on railway together with other major public transport modes is illustrated in Figure 5.10.3.

Electrification of Railway Line

To deal with the increasing passenger demand, electrification is recommended to improve operation and for better environmental performance.

The advantages of electrification are as follows:

- No emission of polluting gas or carbon dioxide.
- Less noise and vibration.
- Operation efficiency is higher.
- Energy cost reduction.

However to maintain the rolling stock in an electrified railway, different facilities are required. This includes construction of substations, a depot and workshop and installation of overhead contact wire systems for the electric trains.

Renewal of Rolling Stock

There are two types of rolling stock for electrified lines. One is an electric locomotive with passenger coaches and the other is Electric Multiple Units (EMU). EMU is recommended to maximise the merits of electrification.

The advantages of EMU compared to electric locomotives are as follows.

- Trains can easily turn back at the terminals without shunting the locomotives.
- Higher acceleration and deceleration are expected.
- Air conditioning is easier because the cars easily get an auxiliary power supply.
- Power consumption can be minimised by a regenerative brake system.

Currently trains are running with the doors open to cool down the inside with the air from outside. This is very dangerous, therefore, air conditioning is required not only for passengers' comfort but also as a safety issue. A power source for the air conditioning system will be required on the train. When the line is not electrified it is necessary to install an engine and generator set on each car and this makes another source of noise, vibration and air pollution. In an electrified railway an inverter is installed as the auxiliary power supply for air conditioning and lighting and also for other electrical power needs.

Improvement of Track

Track rehabilitation is essential for improving the speed and frequency of the trains. Irregularity of alignment is seen in the current tracks and it causes vibration in the train when running. Fastenings along the Coast line are damaged by the salty air. Urgent rehabilitation is required.

Track rehabilitation includes the renewal of rails, fasteners, ballast and sleepers and to improve both vertical and horizontal alignments.

Renewal of Signalling Systems

Various types of signalling systems are installed in the current railway and those are all obsolete. Systems shall be upgraded and standardised to secure safety. Also it is essential for increasing the speed and line capacity.

Automatic Train Protection is required at the same time as renewal of the Signalling System.

Basic function of ATP is as follows.

- Allowable speed is indicated on the panel in the driver's cab depending on signal aspect and track condition.
- When the speed of the train exceeds allowable speed an alarm is activated.
- If the driver does not apply the brakes when the alarm is activated, the emergency brakes will be applied.

In the ATP system, on-board equipment is installed in the driver's cab on the train. Therefore, not only the installation of wayside systems but also the modification of existing rolling stock to equip on-board ATP systems is required.

Renewal of Telecommunication System

The current telecommunication system is already obsolete and sometimes malfunctions. The telecommunication system is essential for smooth train operation and to secure safety, especially in emergencies. To renew the telecommunication system, a world standard system shall be selected so that spare parts can be easily obtained.

Improvement of Train Operation

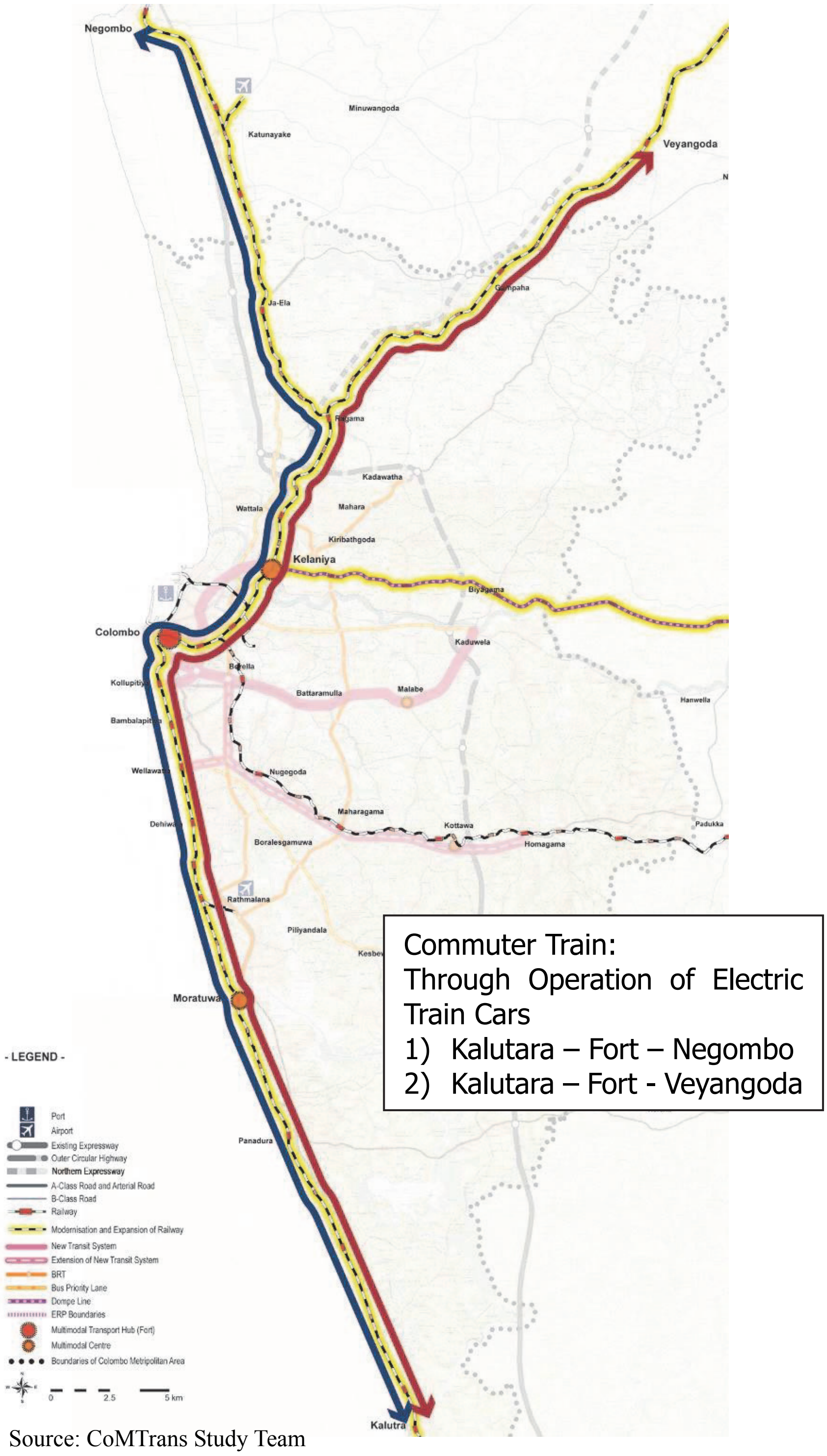
Through operation is recommended in the Fort and Maradana sections. Currently, most of the trains going north start from the Colombo Fort station and trains going south start from Maradana station. This makes the Fort and Maradana sections very congested and trains stay a long time at Fort and Maradana stations because those are terminal stations.

By not terminating the commuter trains at Colombo Fort and Maradana stations, the number of trains can be reduced in these sections and platform occupying time can be reduced. It will relax the congested condition drastically.

(3) Construction of Airport Connection Line

According to the Air Passenger OD Interview survey, the total number of air passengers leaving the airport amounted to 8185 persons by 64 flights on the survey day. The largest share of access modes to the international airport is private vehicles (car, jeep, passenger van and pickup) which consist of 38% followed by taxi at 32%. The share of public modes of transport is small. Buses carry 16% of the air passengers while railway transport only one percent of the passengers. This implies that public modes of transport should be improved for airport access.

Puttalam line runs very close to Bandaranaike Airport. The railway track branches from Katunayake South towards the airport but it does not reach the passenger terminal of the airport. Currently, only a freight train is operated once a day. Only a few kilometres of extension can connect the line to the passenger terminal and it can then provide passenger service from the city centre to the airport without being affected by road congestion. Electrification is also required for rapid and comfortable service.

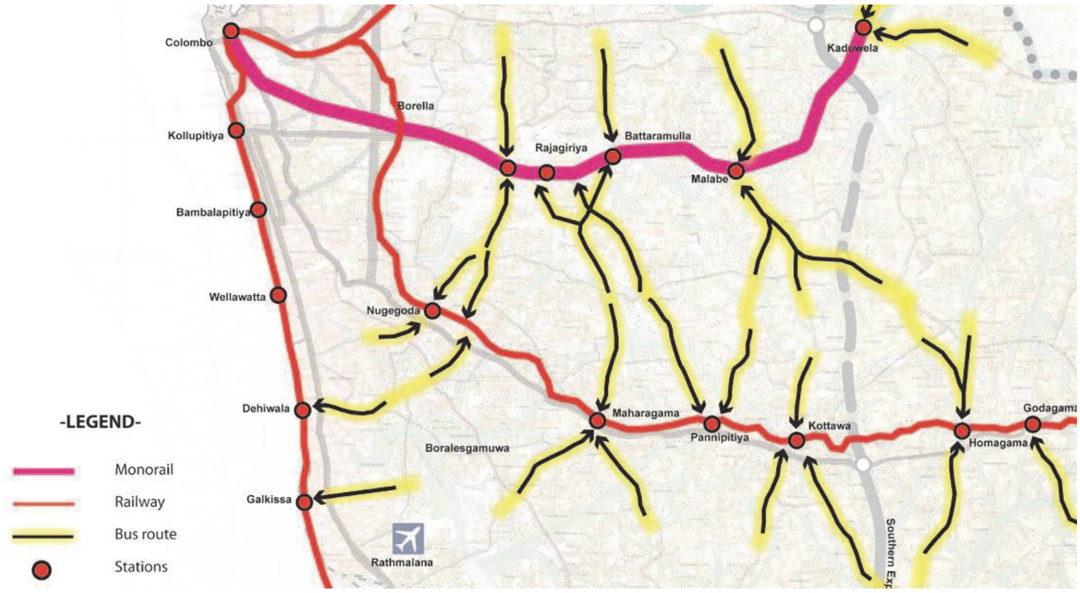


Source: CoMTrans Study Team

Figure 5.13.5 Commuter Train Operation

(4) Development of Access Roads to Stations of the Railways and the New Transit System

At present, railway service areas are limited due to the lack of access roads to the railway stations, in particular in suburban areas. Railway system improvement and development would not attract a great many passengers to use railway service if good access roads to railway stations are not provided. Therefore, it is strongly recommended to improve and to develop access roads to the stations at the same time as the railway and new transit system development. If sufficient width of access roads is not provided, it will be difficult to operate feeder bus services for railway passengers. Coordination between mass transit systems and the road network is of great importance for promotion of public transport.



Source: CoMTrans Study Team

Figure 5.13.6 Development of Access Roads to Stations of the Railways and the New Transit System

(5) Introduction of Bus Rapid Transit (BRT)

Conventional bus operation is often disturbed by traffic congestion with private passenger cars, in particular, in the city centre.

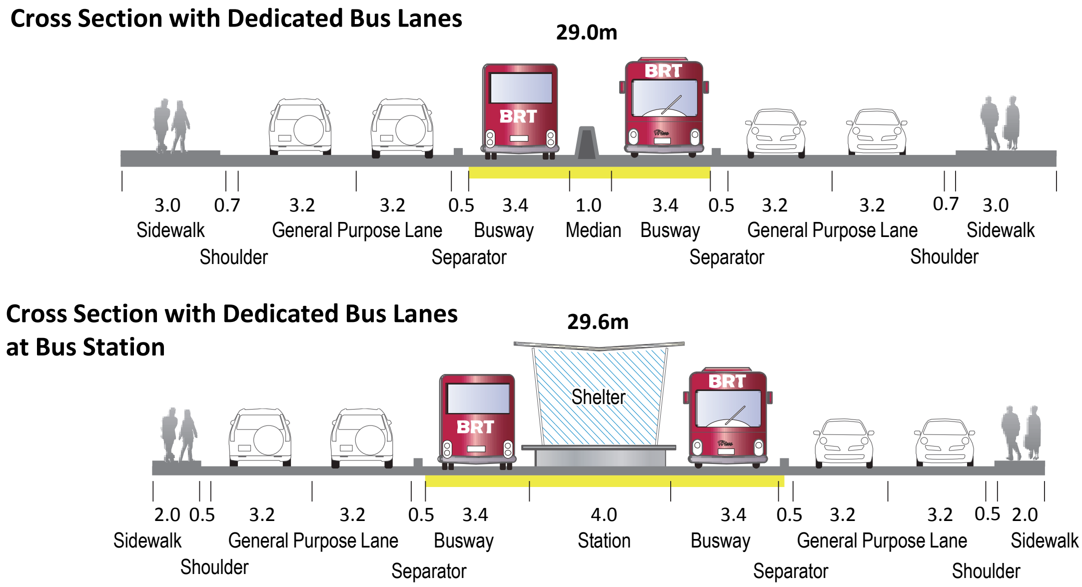
Bus rapid transit (BRT) can provide congestion-free public transport services since it has dedicated bus lanes. BRT is not expensive compared to a rail-based public transport system because usually it utilises the existing road facilities. Therefore, it can be regarded as an economical option although it requires three lanes per direction so as not to disturb ordinary traffic flows significantly.

Advantages of BRT compared to ordinary bus transport are listed below:

- High speed operation with an exclusive bus lane
- Reliable service by punctual operation

- Efficient transit with level boarding platforms and pre-boarding fare collection
- Central control of bus operation to ensure a quick response to any service disruptions
- Branding and market identification to attract various users including private car users, tourists etc.

Typical cross section of BRT systems are shown in Figure 5.13.7 and examples of BRT systems in other cities are shown in Figure 5.13.8.



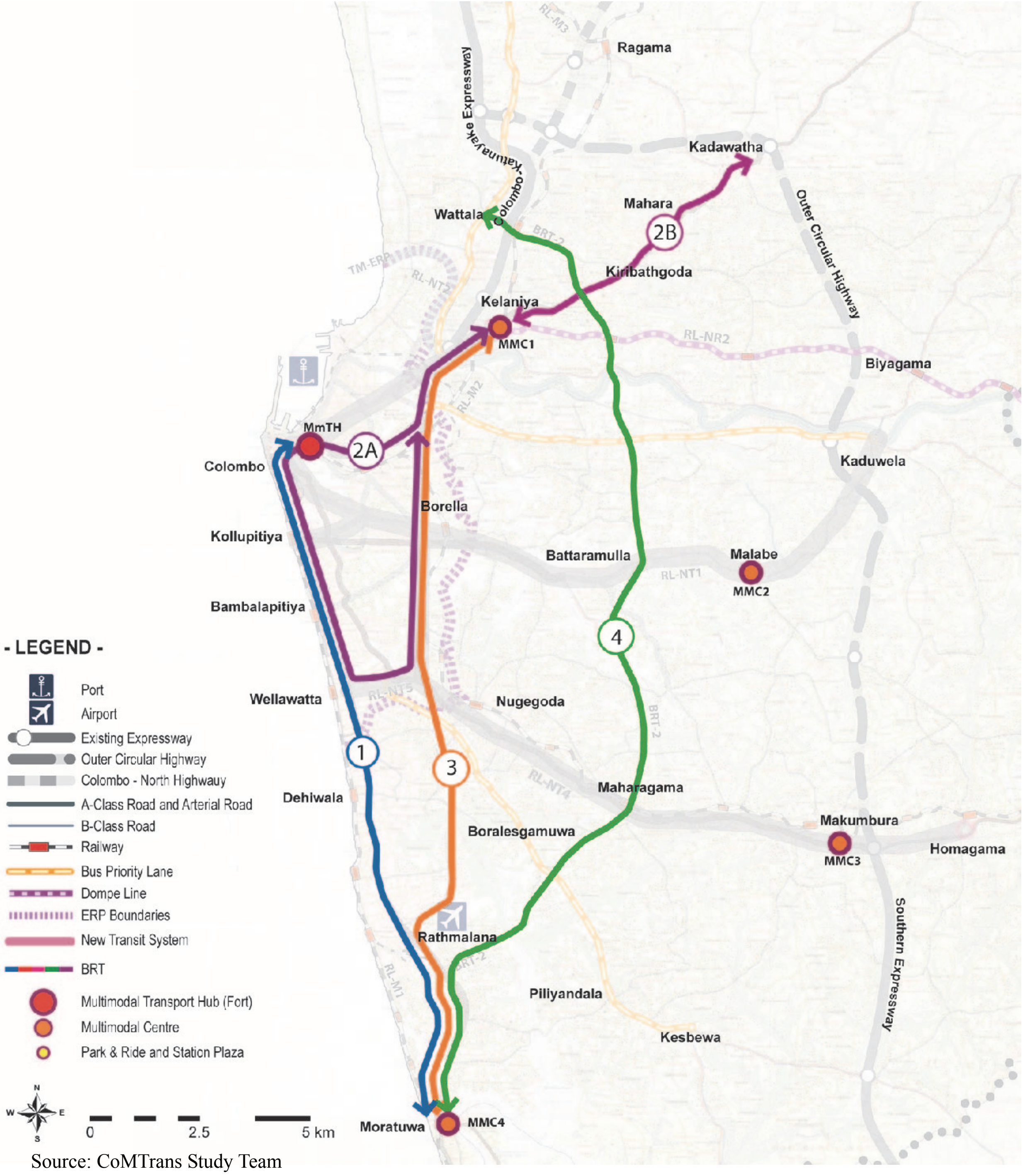
Source: CoMTrans Study Team

Figure 5.13.7 Typical Cross Section of BRT System

Source: CoMTrans Study Team

Figure 5.13.8 Examples of BRT Systems in Jakarta and Curitiba

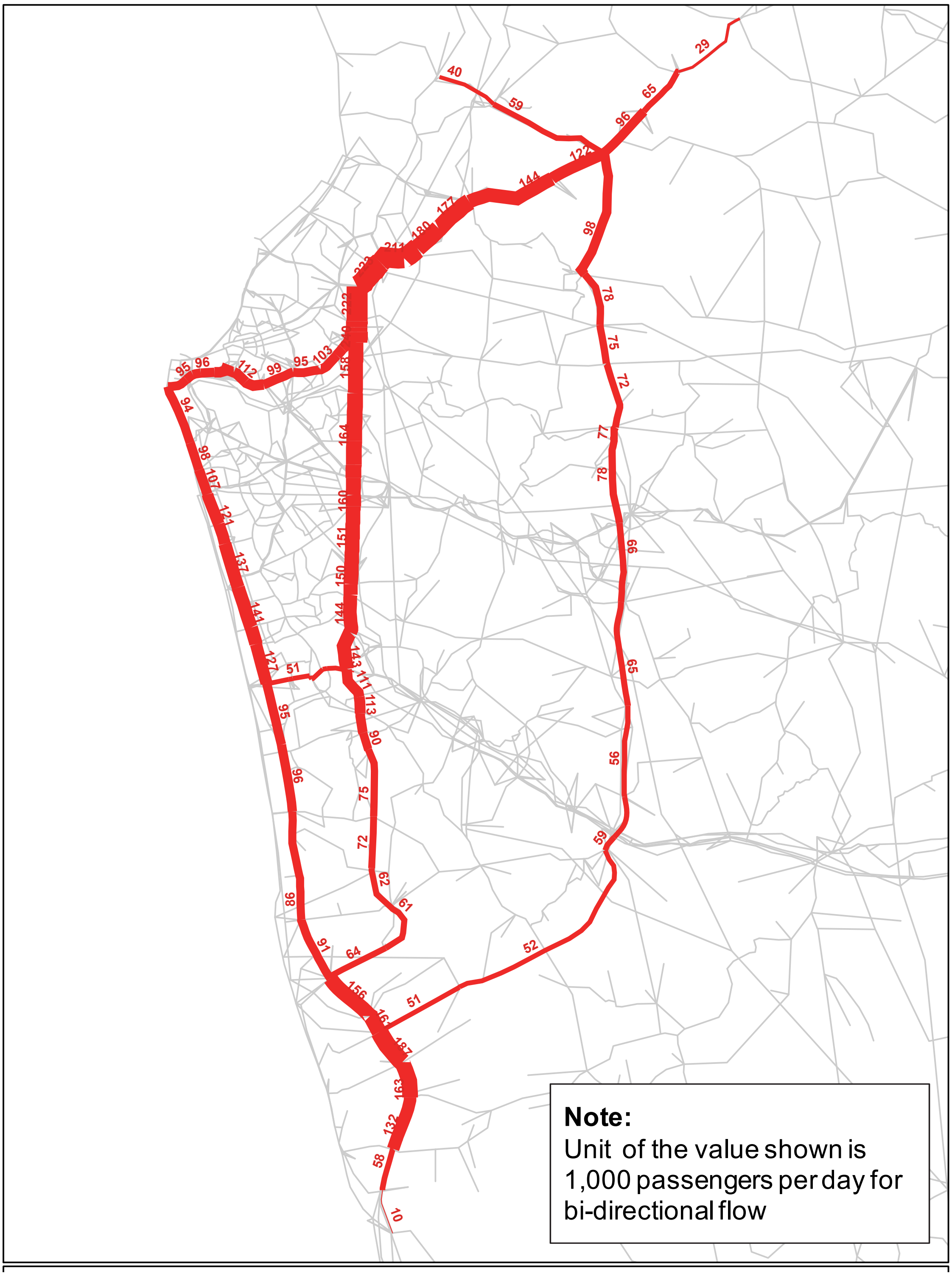
However, the existing roads which have enough space for the introduction of the exclusive bus lanes are limited in the suburbs around CMC, therefore BRT should be introduced along with the development of the road network as shown in Figure 5.13.11. Proposed BRT routes are shown in Figure 5.13.9.



Source: CoMTrans Study Team

Figure 5.13.9 Introduction of BRT

Passenger demand on the BRT was estimated as illustrated in Figure 5.13.10. The maximum passenger demand appears at 223,000 passengers per day for both directions near new Kelani Bridge. PPHPD is 20,000 persons per hour per direction.



Source: CoMTrans Estimate

Figure 5.13.10 Passenger Demand on BRT in 2035

(6) Road Development for Introducing BRT

It is proposed to introduce the Bus Rapid Transit (BRT) to form an efficient public transport network together with the existing railway network and a new transit system.

In the short-term, wide roads with three lanes per direction are to be utilised to accommodate dedicated bus lanes. This category of road includes the Base Line Road, Sri Saddhmma Mawatha, Pradeera Mawatha, Sri Sangaraja Mawatha and Olcott Mawatha.

Base Line Road Extension/ Marine Drive Extension

Extension of the Base Line Road as well as the extension of Marine Drive enables the introduction of dedicated bus lanes in the middle of Galle Road since these road extensions would provide additional road capacity for private modes of transport and give space for BRT.

Kandy Road

Kandy road is another candidate for BRT, however, the road does not have sufficient road space to accommodate dedicated bus lanes. Kandy road has been widened to two lanes per direction recently, therefore, it seems that it would be difficult to get acceptance from the residents along the road who will be affected by further land acquisition for road widening.

Middle Ring Road

BRT system development on the Middle Ring Road, which is a part of the ring road network as mentioned below, is a strategic way for public transport development. At present, large passenger demand does not exist there, consequently, it is not necessary to develop BRT for now. However, if it is possible to secure space in the median for future development of BRT, it would be easier to develop the BRT system in the intermediate or long term. To promote BRT system development, transit oriented development (TOD) at major intersections with major arterial roads is also recommended. By allowing a higher floor ratio, it would guide high-density land use in the areas surrounding BRT stations.

Source: CoMTrans Study Team

Figure 5.13.11 Road Development for BRT Operation

(7) Bus Priority System and Bus Location System for BRT

It is proposed to introduce both a Bus Priority System and a Bus Location System for BRT. It includes

- Mounting an RFID tag to each BRT bus,
- Installation of RFID receiving equipment,
- Development of a system for collection of the traveling status information,
- Development of a system to adjust the phasing time of the signals, and
- Development of a system for providing traffic information on the web.

Bus Priority System

Improvement of convenience for the users of BRT by improvement of the travel environment of the BRT (Stabilisation of travel speed)

Bus Location System

- Controlling BRT bus operation
- Providing passengers with bus operational information such as bus arrival time

Bus Location System and IC Ticket for Public Buses

It is proposed to introduce a Bus Location System for public buses. The system includes Global Positioning System (GPS) for transmitting locational information of each bus. This will provide real time bus location thus it is very useful for a bus company to control bus operation. Bus passengers are able to get the information of the bus operation on the specific bus route thus they can estimate waiting time for the next bus at bus stops.

At the same time it is also recommended to introduce IC Ticket for bus services. Recently the introduction of the IC Card has been started on some buses in which the bus conductor has a communication device to report usage of the card to the centre. With the ticketing system, the bus operators can monitor the ticket sales. This enables them to record the number of passengers with discount tickets and makes it possible to provide a subsidy for private bus operators if the government would like to do so.

With the application of this new technology, the bus operation regime could be reformed to provide better services to passengers.

(8) Improvement of Bus Stops and Bus Terminals

Bus Stops

Most bus stops in the seven corridors don’t have suitable facilities such as bus bays for the safety of passengers and vehicles in the same lane or bus shelters for passenger’s comfort. Installation of these amenities in the seven corridors and other major arterial roads should be carried out while considering the impact to the pedestrians on the sidewalks.

Bus Terminals

Existing bus terminals and railway stations are not properly connected in the Pettah area as mentioned in Sub-section 3.3.5. This has caused many passengers to cross arterial roads and troublesome access between terminals and stations. Therefore, the development of multi modal transport hubs which secure direct access to other terminals and transport modes should be developed as shown in the proposed plans for integrated transport systems with a new transit system. On the other hand, in the suburbs around CMC the expansion of existing terminals should be carried out depending on each future demand to avoid interrupting traffic flows on existing roads.

(9) Regulatory Scheme for Road-Based Public Transport Modes

A regulatory scheme for proper restrictions on road-based public transport modes should be established taking into account road safety, congestion of roads, transparent service for customers and the employment of drivers and owners.

Capacity Development for Bus Operation Improvement

Capacity development for bus operations is not only about conventional approaches, such as institutional, administrative, and knowledge and skills, but also it should encompass disciplinary, moral and behavioural aspects, considering the nature of delivering services to the passengers. In that sense, the capacity building for general bus services is perceived in three tiers, i.e. the regulator, operator and employees. Considering the functional responsibilities of each tier, the focus of capacity building will be varied.

a) Regulator (Inter-Provincial bus services: National Transport Commission, Intra-Provincial bus services: Western Province Road and Passenger Transport Authority)

Institutional capacity development to build a strong regulatory body and law enforcement shall be the main focus for the regulator. Continuing management on passenger needs assessment for existing routes and updating the bus route network is one of the core capacities, among others, to maintain effective and passenger-centred bus services, along with law enforcement for the safety and security of passengers.

b) Operator (Public bus services: Sri Lanka Transport Board, Private bus services: Private bus operators)

As a direct service provider, the operator needs to implement institutional and individual capacity enhancement to be a more passenger-centred service provider. Reinforcing a supervising function for bus operation services, i.e. bus fleet conditions, driving skills and driver's performance, compliance with traffic safety practices and timely operation according to the time table, are areas in institutional capacity building, along with inspectors' knowledge enhancement for bus operation control as individual capacity development.

c) Bus Drivers and Conductors

Reckless driving behaviours of bus drivers shows an indisputable necessity to re-educate drivers to focus more on traffic and passengers' safety. Disciplinary and moral education to value safety and reliability of public transport service is also one of the capacity building measures that should be undertaken by the operator to enhance the employees' capacity.

Table 5.13.2 Projects in Program (1) for Promotion of Public Transport Use

Sector	Projects			Outline of the Project	Length (km)	Phase		
	ID	Name				Short-	Intermediate	Long-
Rail-way	RL-M1	Modernization of Existing Railway	Coastal Line Colombo Fort - Karutara South Modernization of Existing Railway Construction of New Railway Line	Replacing signalling system (new interlocking and train protection systems)	42.5	✔		
				Electrification (double track)	42.5		✔	
				Procurement of new train	42.5		✔	
				Construction third line and track layout improvement	42.5			✔
	RL-M2		Main Line Colombo Fort – Veyangoda Modernization of Existing Railway	Replacing signalling system (New interlocking and train protection systems), Upgrade existing track (double track)	37.6	✔		
				Electrification (double track)	37.6		✔	
				Procurement of new train	37.6		✔	
	RL-M3		Puttalam Line Modernization of Existing Railway Ragama - Negombo	Replacing signalling system (New interlocking and train protection systems) Electrification Track layout improvement Procurement of new train	23.3		✔	
	RL-M5		Main Line Modernization of Existing Railway (Colombo Fort – Maradana)	Improvement of train operation	4.0	✔		
	RL-NR1	New Railway Line	Airport Connection Construction of New Railway Line Katunayaka South - Airport Terminal	Extension of existing track to airport terminal Replacing signalling system Rehabilitation of existing single track Electrification	2.2		✔	
	RL-NT1	New Transit System	Monorail [Phase 1]	Malabe – Kotahena Town Hall - Kollupitiya	23.0	✔		
	RL-NT2		Monorail [Phase 2-1]	Kotahena – Kelaniya Malabe - Kaduwela	11.9		✔	
	RL-NT3		Monorail [Phase 2-2]	Additional New rolling stock				✔
	RL-NT4		Monorail [High Level Road]	Borella - Homagama	19.7		✔	
	RL-NT5		Connecting line of Monorail [HL] and Coastal Line	Siebel - Wellawatta	3.4			✔
	RL-SF1	Station Facility Improvement		Major Station: Fort, Maradana, Main Station: Negombo, Gampaha, Ragama, Kottawa, Moratuwa, Sub-stations: Main Line (Demadagoda, Kelaniya, Genemulla), Coastal Line (Secretariat, Kollupitiya, Bumbalapitiya, Dehiwala, Rathmalana), Puttalam Line (Kandana, Ja-Ela, Seeduwa, Katunayaka South), KV-Line (Baseline, Narahenpita, Nugegoda, Maharagama, Mlapalla)		✔		
	RL-SP1	Spare Parts, Coach Renewals				✔	✔	✔

Table 5.13.2 Projects in Program (1) for Promotion of Public Transport Use – continued

Sector	Projects			Outline of the Project	Length (km)	Phase		
						Short-	Intermediate	Long-
Road	RD-RN1	Provision of Road Space for introducing BRT	Galle Road Widening for BRT Corridor	Widening of Galle Road to secure road space for future development of BRT	14.8		✔	
	RD-RN2	Securing Space for Future Development of BRT	Development of Middle Ring Road for BRT Corridor	Development of Middle Ring Road to secure road space for future development of BRT and connect between the suburb areas around CMC	30.2		✔	
	RD-RN3	Provision of Alternate Road for introducing BRT	Baseline Road Extension	Extension of Baseline Road to provide alternate road for private passenger cars and to utilise Galle road for BRT	6.2		✔	
	RD-RN4		Marine Drive Extension	Extension of Marine Drive to provide alternate road for private passenger cars and utilise Galle road for BRT	5.3	✔		
	RD-RN9	Support on feeder services for railway and monorail	Access Roads to Railway/Monorail Station	Development of the connection between each station and arterial roads	89.1		✔	✔
Bus/ BRT	BRT-1	BRT Instalment	Phase-1	Route-1: Fort - Moratuwa (20.6km) Route-2 : Fort - Siebel Avenue (9.9km) Route-3: Fort - Kadawatha (16.5km) Route-4 Kiribathgoda-Wellawatta (17.0km)	45.7	✔		
	BRT-2		Phase-2	Route-5 Borella-Moratuwa (17.7km) Route-6 Wattala-Maharagama (23.5km) Route-7 Battaramulla Moratuwa (20.1km)	38.8		✔	✔
	BT-1	Improvement of Bus Terminals				✔		
	BT-2					✔		
	B-ST1	Improvement of Bus Stop				✔		
	B-CD1	Capacity Development				✔		
Traffic Management	TM-BL1	Bus Location System for BRT + PTPS	BRT Section/Phase1	Introduction section of BRT(Phase1)		✔		
	TM-BL2		BRT Section/Phase2	Introduction section of BRT(Phase2)			✔	
	TM-BL3	Bus Location System for Buses		whole of the Colombo Metropolitan Area				✔
Transport Interchange Facility	MmTH	Multi-modal Transport Hub	Fort/Pettah MmTH	Monorail, Rail, Bus, BRT terminals with Station Plaza		✔		
	MMC1	Multi-modal Centre	Kelaniya MMC			✔		
	MMC2		Malabe MMC			✔		
	MMC3		Makumbra MMC			✔		
	MMC4		Moratuwa MMC			✔		
	MMC5	Park & Ride Facility				✔		

Source: CoMTrans Study Team

5.13.2 Urban Transport System Development Programme (2) for the Alleviation of Traffic Congestion

The urban transport system development programme consists of the projects for the urban transport policy (2): ***Alleviation of Traffic Congestion***.

(1) Ring Road Network

At present, due to the lack of circumferential roads, cars cannot avoid traffic congestion in the centre of Colombo. If ring roads are developed, they will provide detour routes for traffic of which the destinations are not in the centre of Colombo.

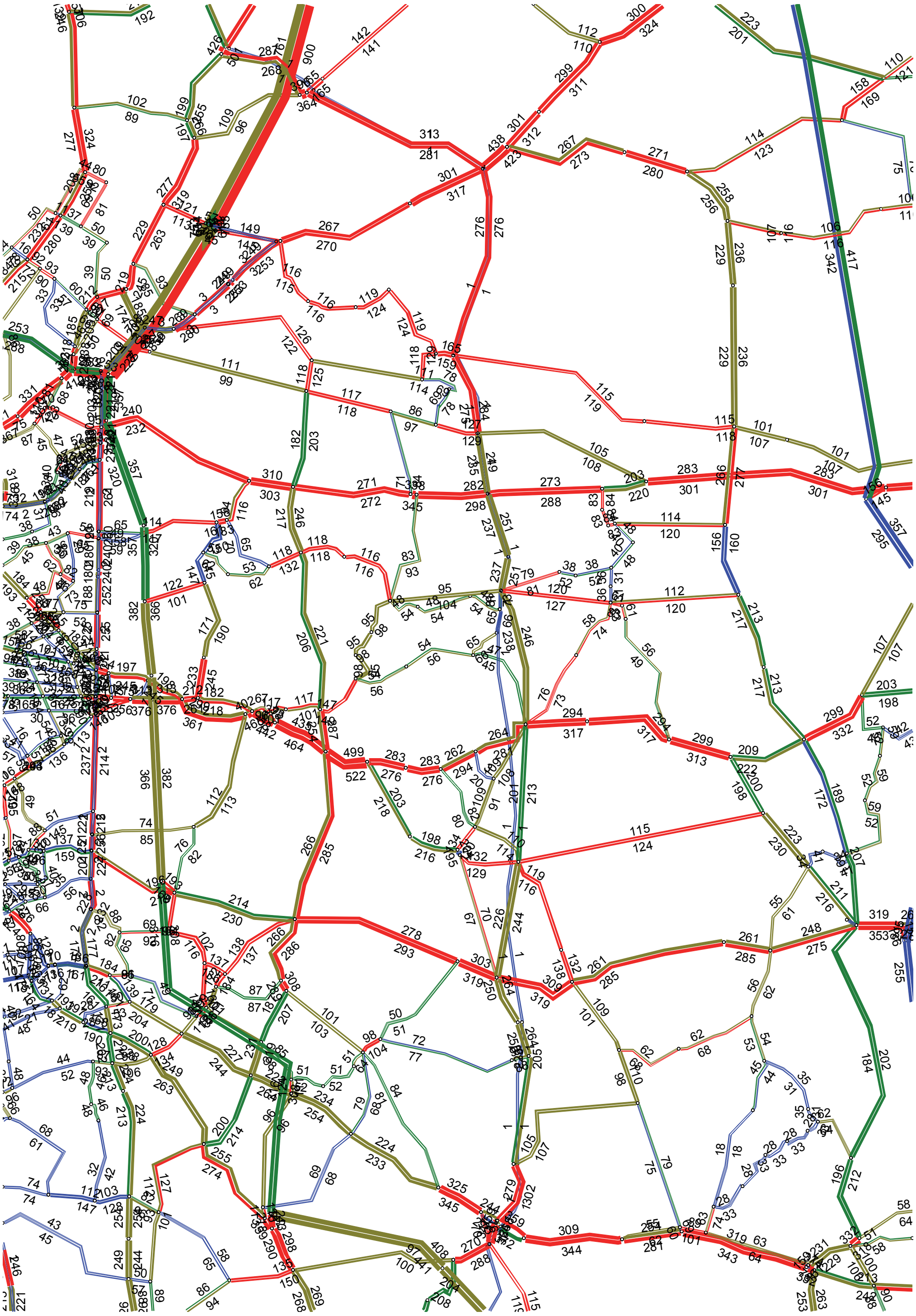
Three ring roads are proposed which will enhance the accessibility between the suburbs and the centre of Colombo and distribute the heavy traffic volume especially on major arterial roads in the CMC. These ring roads are basically developed with the existing roads such as B class and other minor arterial roads managed by RDA and WPRDA.

Future traffic demands of these ring roads are indicated in Figure 5.13.13. The estimated traffic demand on the Middle Ring Road is about 50,000 pcu per day for both directions. In some sections, the traffic volume would reach about 60,000 pcu. Those for the Western Ring Road and the Eastern Ring Road would amount to around 40,000 pcu per day for both directions.

Although the tentative alignments of the ring roads are indicated Figure 5.13.2, the alignment of those roads will be studied further in feasibility study stage.

Source: CoMTrans Study Team

Figure 5.13.12 Ring Road Network Development



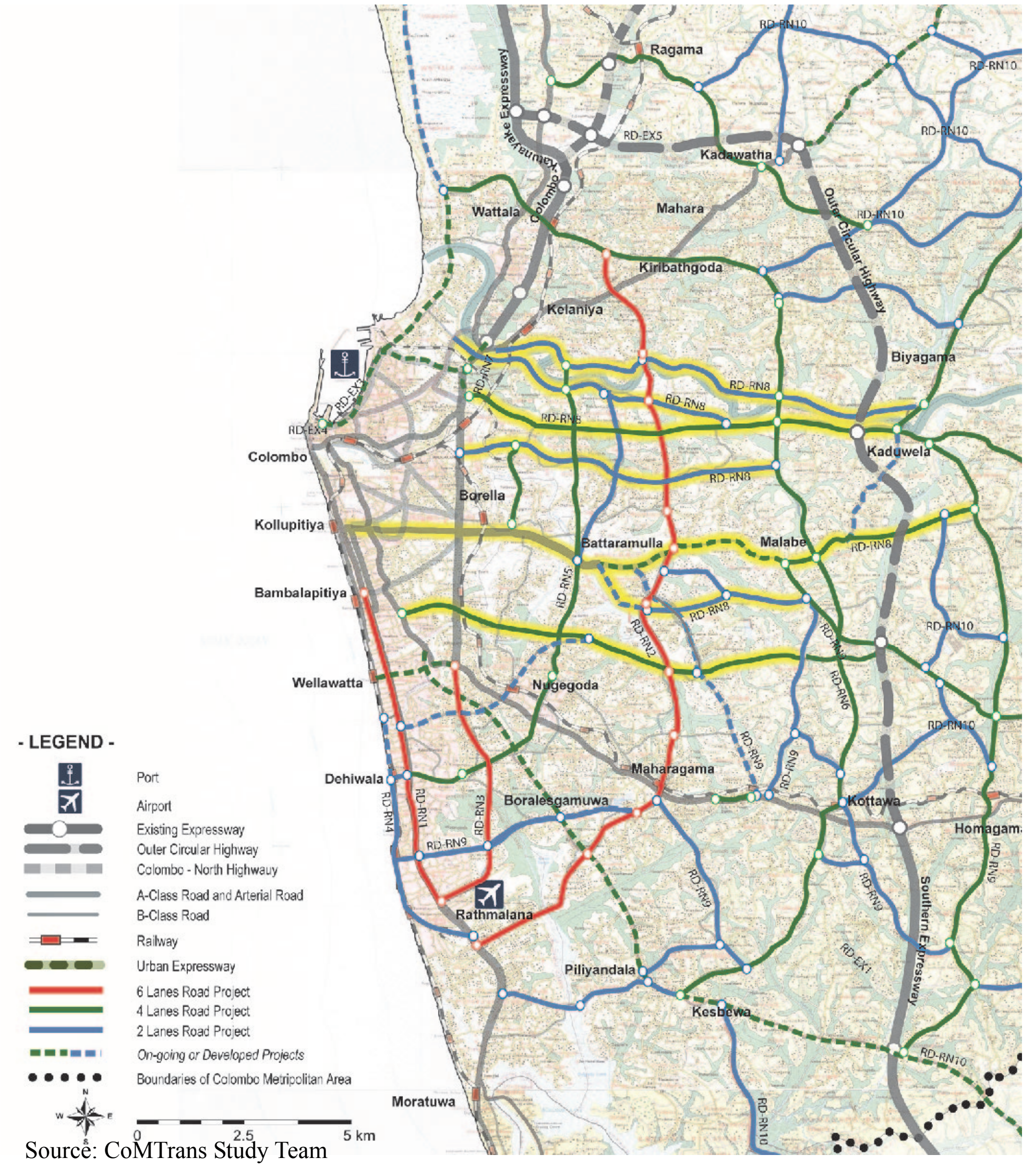
Source: CoMTrans Estimate

Figure 5.13.13 Estimated Traffic Volume on Ring Roads and East-West Arterial Road Network Development in Eastern Suburban Area 2035

(2) East – West Arterial Road Development in Eastern Part of the Suburban Area

The road network in the suburban areas is very limited, thus traffic flows are concentrated on the major arterial roads and chronic traffic congestion has been brought about. To accommodate the traffic demand, it is proposed to develop east-west arterial roads in suburban areas. The east-west roads would be a part of the access roads to monorail stations. The traffic demand on these east-west arterial roads was estimated in the range between 50,000 and 60,000 pcu per day for both direction as illustrated in Figure 5.13.13. Traffic volume of Malabe-Battramulla Road in the Battaramulla area would exceed 100,000 pcu per day for both directions.

Although the tentative alignments of the ring roads are indicated Figure 5.13.2, the alignment of those roads will be studied further in the feasibility study stage.



Source: CoMTrans Study Team

Figure 5.13.14 East-West Arterial Road Network Development in Eastern Suburban Area

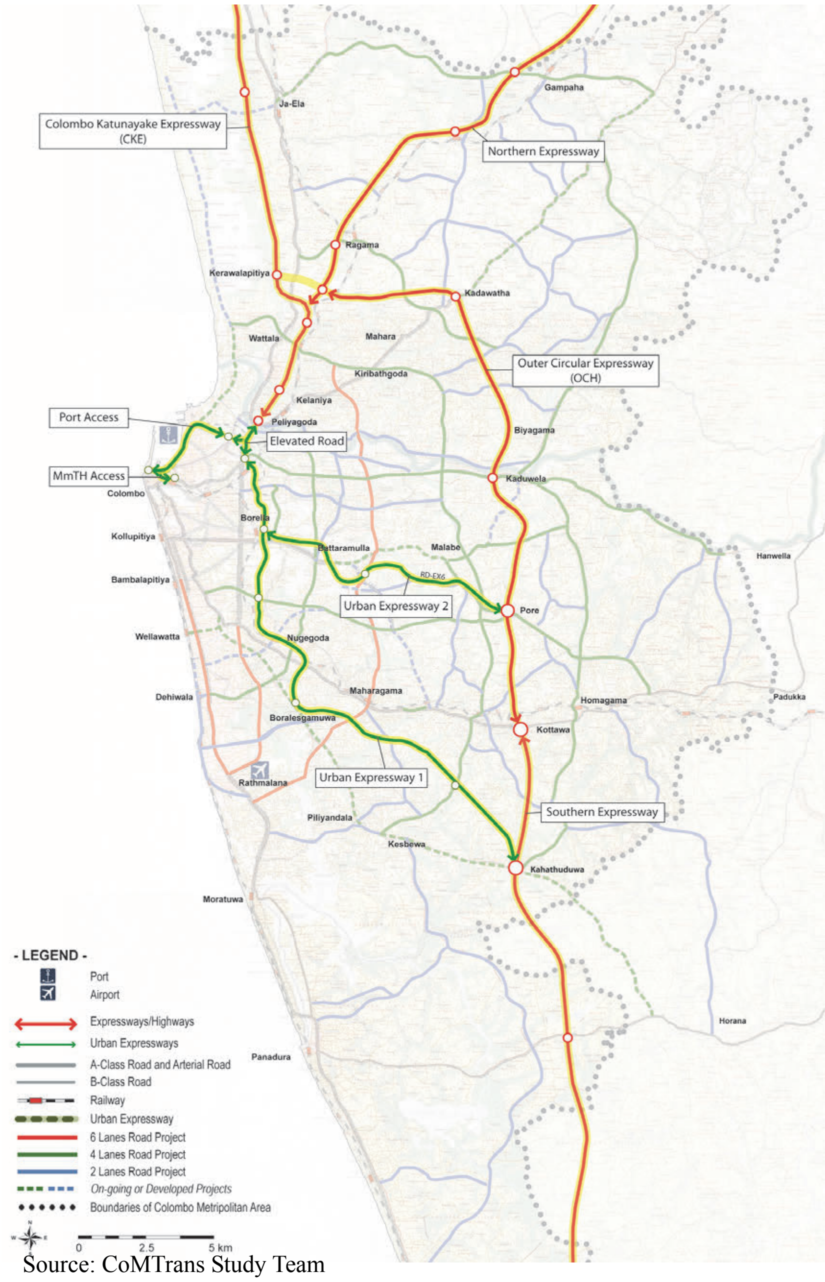
(3) Expressway Network Development

Under the current condition of the expressway network development, it is proposed to connect the CKE with the new urban expressway through the planned elevated road via Kirillapone up to the Southern Expressway as shown in the urban expressway 1 in Figure 5.13.15.

Another urban expressway development option is the connection between Pore and Borella. This expressway as urban expressway 2 is shown in Figure 5.13.15 and should be carefully examined because the route is competitive with the planned Monorail Malabe – Borella - Fort line. It could reduce passenger demand on the Monorail.

When the two urban expressway options are compared, urban expressway 1 is better from the viewpoint of network coverage since it would cover a wider area in the metropolitan area.

Although the tentative alignments of the ring roads are indicated Figure 5.13.2, the alignment of those roads will be studied further in the feasibility study stage.



Source: CoMTrans Study Team

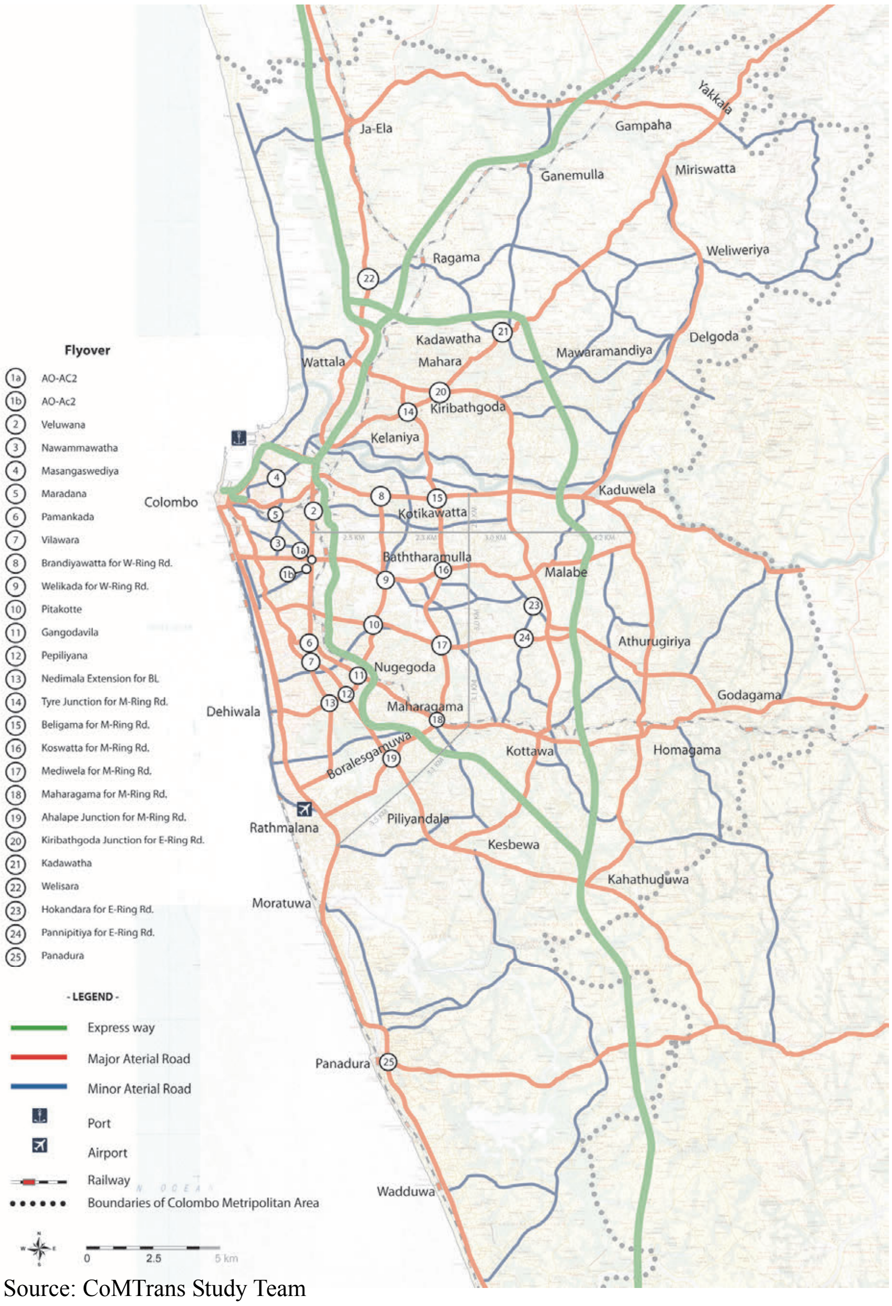
Figure 5.13.15 Expressway Network Development

(4) Flyover Development

In urbanised areas, traffic congestion is often observed at intersections due to insufficient traffic capacity which makes the intersections bottlenecks. Construction of a flyover provides grade separation of traffic flows and increases traffic capacity at intersections. It is proposed to develop flyovers at major intersections on the major arterial radial roads from the suburbs to the city centre as indicated in Figure 5.13.16.

However the development of flyovers in the city centre should be carefully examined from an aesthetics point of view. If area-wide traffic signal control could substitute for grade separation, it might be better for aesthetics in the city centre.

In line with the idea for reducing the traffic load at saturated intersections, if some road links, such as short cuts, could alleviate traffic congestion at the intersections, addition of those links shall be studied, such as the short-cut route for the crossing of Beira Lake which have been proposed originally under the Beira Lake Restoration Project Master Plan (1995).



Source: CoMTrans Study Team

Figure 5.13.16 Flyover Development Plan

(5) Port Access Road

Development of a port access road as a part of the expressway is proposed to deal with truck traffic in the port and surrounding area. If port access is provided, then it would reduce heavy vehicle traffic flows on the arterial road network in the vicinity of Colombo port. If space inside the port can be used for expressway road development, the road will be connected with CKE.

(6) Traffic Control

Traffic Signal Control Improvement

Traffic Signal Control Improvement is proposed, which includes Development of a Central Control Centre for traffic signals and Installation /Improvement of signalisation for intersections (including Controllers)

Purpose of the Project is as follows

- Reduce traffic congestion by optimised signal control
- Increase in traffic capacity of intersections by signalisation at No-signal/Roundabouts
- Improvement of the environment (noise, air) by reduction of traffic congestion

Traffic Information System

A Traffic Information System is proposed, which includes the installation of CCTV, the development of a system to detect sudden events (traffic volume, travel time, accidents etc.), and the development of a system for providing traffic information on the web.

This will maximise the transportation network function using real-time traffic information, closed to traffic information and traffic regulation information and provide for:

- Appropriate route selection
- Optimisation of traffic volume sharing

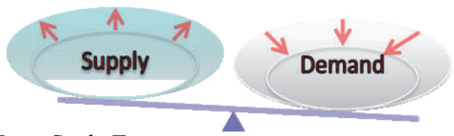
Parking Information System

A Parking Information System is proposed, which includes the development of a system for collection of parking full/empty information and the development of a system for providing information.

This would reduce traffic prowling while looking for parking within the city by providing parking location information and full/empty status of each parking facility.

(7) Transport Demand Management

In order to materialise the modal shift from private modes to public transport, it is necessary to apply a Transport Demand Management scheme.



Source: CoMTrans Study Team

Figure 5.13.17 Image of the Balance of Supply and Demand

Policy measures for TDM are as follows;

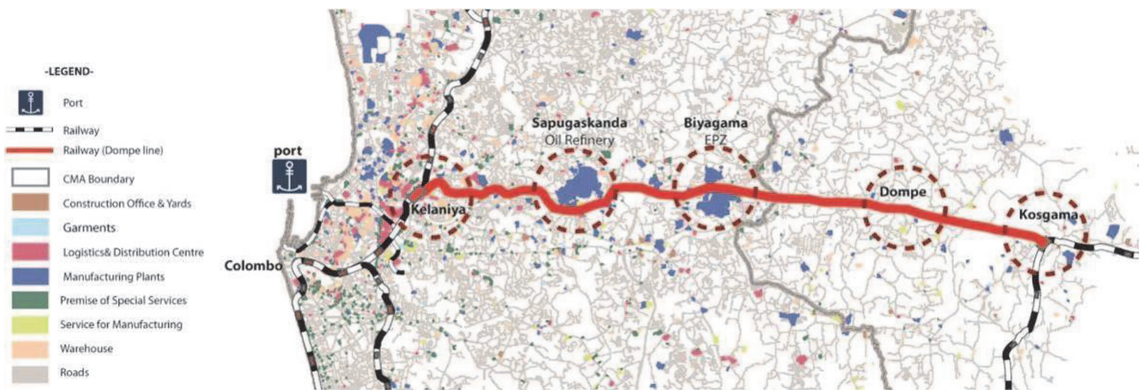
- Fuel tax increase,
- Electronic Road Pricing (ERP),
- Peak hour shift by mobility management and regulation applications,
- Park and Ride (P&R) with incentive scheme and
- Parking pricing policy,
- HOV (High Occupancy Vehicle) lane etc.

In this urban transport master plan, the following impacts to traffic demand by TDM policies are assumed:

- Overall modal shift to public transport (10% of car users),
- Modal shift to public transport entering CMC (10% of car users entering CMC) and
- Peak hour demand reduction (20%).

(8) Construction of Railway Freight Line

The development of a freight railway line has been planned to carry bulk products, like oil, and containers up to Dompe by the private sector. It would alleviate traffic congestion in the northern part of Colombo where many trucks carry cargo on the roads.



Source: CoMTrans Study Team

Figure 5.13.18 Dompe Line Development Plan

Table 5.13.3 Projects in Programme (2) for Alleviation of Traffic Congestion

Sector	Projects: ID	Projects: Name		Outline of the Project	Length (km)	Phase: Short	Phase: Intermediate	Phase: Long
Road	RD-RN5	Enhancement of Traffic Distribution Function of Road Network	Western Ring Road	Development of the Ring Road by making most use of the existing roads for distributing traffic flows between the suburb areas and CBD. On-going projects are on B232.	22.8	✔	✔	
	RD-RN6		Eastern Ring Road	Development of the Ring Road by making most use of the existing roads for distributing traffic flows between the suburb areas and CBD.	50.6		✔	✔
	RD-RN7		Connection between CKE - Kelani Bridge (New) - KelanitissaJCT	JICA Loan, On-going project. This road is planned as alternative route with elevated structure for heavy traffic on existing bridge. End of this connection is set on an existing road with an interchange in an urban area, it is a concern that increasing traffic volume will concentrate on that point in the future.	2.3	✔		
	RD-RN8	Enhancement of east-west connection	East - West Roads	Development of arterial road utilising existing roads in the east-west direction On-going projects and existing plans are on B231, B435, B241 and AB10.	60.1		✔	
	RD-RN10	Development of Suburban Arterial Road		Development of the connection between each rural road and Major Road	135.4			✔
	RD-FO	Construction of Flyover		25 identified locations		✔	✔	
	RD-EX1	Construction of New Urban Expressway	Urban expressway-1: Connection between SEW and CKE	Development of urban expressway to connect CKE and SEW through urban area to avoid traffic concentration at one point in urban area	25.5		✔	✔
	RD-EX3	Construction of New Urban Expressway	Urban expressway-3: Port Access	Between the end of CKE and Colombo Port	5.0	✔		
	RD-EX4	Construction of New Urban Expressway	Urban expressway-4: Access to MmTH at Fort station	Development of an urban expressway to provide direct access from Malabe to Borella to deal with the anticipated increasing car traffic demand.	0.8	✔		
	RD-EX5	Construction of New Urban Expressway	Outer Circular Highway: 3rd Section	Financed by China Exim Bank, On-going project. A part of OCH	9.2	✔		
	RD-EX6	Construction of New Urban Expressway	Northern Expressway	Inter-regional expressway to connect Colombo and Kandy	20.0	✔		
Traffic Management	TM-S1	Traffic Signal Instalment	Phase-1 Development of the central control room. Improvement of traffic signal control along The Priority Route	Central control room Improvement of Signal (29) Installation of signal (25) (Change exist Roundabout and No-Signal)		✔		
	TM-S2		Phase-2 Improvement of traffic signal control along to The 2nd Priority Route	Improvement of Signal (37) Installation of signal (93) (Change exist Roundabout and No-Signal)			✔	
	TM-S3		Installation of spot traffic signal control associated with road improvement at current congestion points	Construction of Arterial Roads and Upgrading of Road: 16		✔		
				Construction of Arterial Roads and Upgrading of Road: 43			✔	
				Construction of Arterial Roads and Upgrading of Road: 101				✔
	TM-TI1	Traffic Information System		whole of the Colombo Metropolitan Area				✔
	TM-P1	Parking Information System		whole of the Colombo Metropolitan Area, and R+R Parking				✔
	TM-ERP	ERP System		whole of the CMC boundary			✔	
Railway	RL-NR2	Dompe Freight Line Development		Construction of Dompe railway line			✔	

5.13.3 Urban Transport System Development Programme (3) for Reduction of Air Pollutants/Traffic Noise and Promotion of Health

Urban transport system development programme (3) consists of the projects for the urban transport policy 3: ***Reduction of Air Pollutants/Traffic Noise and Promotion of Health.***

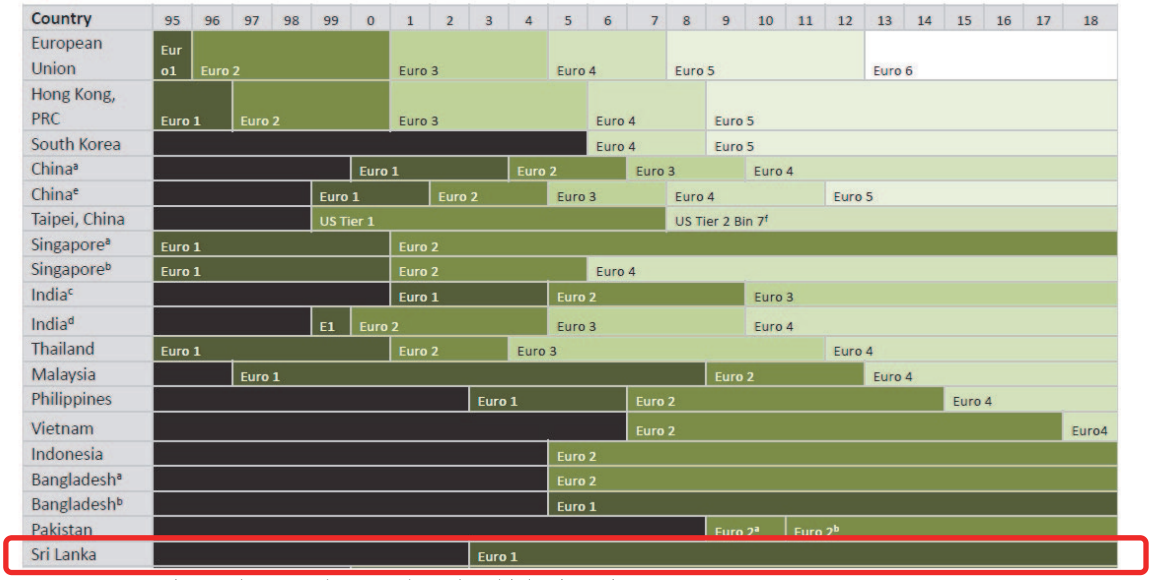
(1) Establishment of Environmental Management Scheme

Environmental pollution could be avoided by continuous environmental management, implementing pollution control programmes that are evaluated and, if necessary, upgraded on a project cycle basis.

This requires an environmental management scheme which consists of environmental monitoring for evaluation and environmental impact simulation based on a regularly updated emission source inventory for planning. To establish and develop the scheme, capacity building for technical staffs and reinforcement of institution/capacity for policy makers in the scheme should be undertaken.

(2) Establishment and Enhancement of Air Pollutant Emission Standards for Newly Manufactured and Imported Vehicles

Establishing and the enhancement of emission standards for newly manufactured vehicles and for vehicles newly imported to the country is the most effective way to reduce vehicle emissions. Sri Lanka has adopted the emission standards established by the European Union and other equivalent standards for these vehicles since 2003. Different standards have been applied for each type of vehicle (Light-Duty Vehicles, Heavy-Duty vehicles, etc.). However, these standards are not effectively enforced and there has been no major enhancement to these standards. For example, emission standards for New – Light-Duty Vehicles have remained as EURO 1 since 2003. Thus, there should be a mechanism to review the existing standards applied for each type of vehicle and to update these standards in a practical manner.



Source: CAI Asia; Update on Clean Fuels and Vehicles in Asia. Oct 2011

Figure 5.13.19 Automotive Emission Standards for New Light-Duty Vehicles in East Asia and Europe

(3) Enhancement of Vehicle Inspection and Maintenance Programmes

Reduction of air pollutants from vehicles is a primary measure to deal with air pollution problems caused by automobiles. Sri Lanka has an air emission reduction strategy mainly implemented and managed by the Department of Motor Traffic and Air Resource Management Centre (Air Mac). In the strategy, a Vehicle Emission Testing (VET) programme was officially commenced in November, 2008 as a Pilot Project in the Western Province. This programme requires that all vehicles check their emission to ascertain whether they are within the vehicle emission standards. The Department of Motor Traffic has mandated that the certificate showing that the vehicle passed the emission testing must be submitted in order to renew the annual license for the vehicle. From 2008 to 2012, approximately seven million vehicles have been tested and approximately 15% of the tested vehicles failed to meet the standard. However, there has been a discussion that this programme has received many complaints, in that vehicles with serious emission issues are also given the green light. Thus, in order to improve this programme, the following aspects must be enhanced;

- Capacity building for VET centre technicians,
- Improvement of inspection and maintenance facilities,
- Audit the performance of inspectors, and
- Increase awareness of the public.

Table 5.13.4 Vehicle Emission Standards for Petrol and Diesel Vehicles

A. Petro Vehicles

Type of Vehicle	Emission Standards (Effective from April 1, 2008)		Remarks
	Carbon Monoxide CO (% v/v)	Hydrocarbon HC (ppm v/v)	
1. Petro motor vehicles other than motor cycles and motor tricycles	4.5	1200	Both idling and 2500 RPM/no load
2. Petro motor cycles and motor tricycles	6	9000	

B. Diesel Vehicles

Type of Vehicle	Emission Standards (Effective from April 1, 2008) Smoke Capacity on Snap Acceleration K factor (m^{-1})
Diesel Vehicles	8.0

Source: Central Environmental Authority (CEA)

(4) Low Sulphur Diesel Programme

In order to reduce PM10 emission, a predominant air pollution factor, and to ensure compatibility with advanced diesel emission control systems such as trap oxidisers and oxidation catalysts, sulphur content in diesel should be kept at a low level. In Sri Lanka, steps were taken in 2007 to reduce the maximum sulphur content in diesel from 3,000 ppm to 500 ppm, however, this standard has not been met due to the inability of the refinery in Sri Lanka. In order to meet the standard for sulphur content of 500 ppm practically and further improve the fuel quality, it is fundamental to establish a mechanism to collaborate with the refinery sector to supply low sulphur diesel fuel.

(5) Promotion of Natural Gas Vehicles

The promotion of natural gas vehicles could reduce air pollutants like PM10 significantly. Although a natural gas vehicle requires its own engine configuration, gasoline vehicles have the same fuel combustion mode and can be converted to a dedicated natural gas type while diesel vehicles can be converted to dual fuel type (uses diesel and natural gas at the same time), by attaching additional equipment such as a storage tank. Natural gas vehicle promotion also requires sufficient refuelling stations, specially trained staff and equipped garages as its infrastructure.

(6) Promotion of Hybrid Cars and Electric Vehicles

Hybrid cars and electric vehicles are less polluting vehicles, thus it is recommended to promote these types of vehicles by giving tax incentives. Regarding the rate of reduction of taxes, a detailed study should be conducted to estimate economic benefits from these types of vehicles.

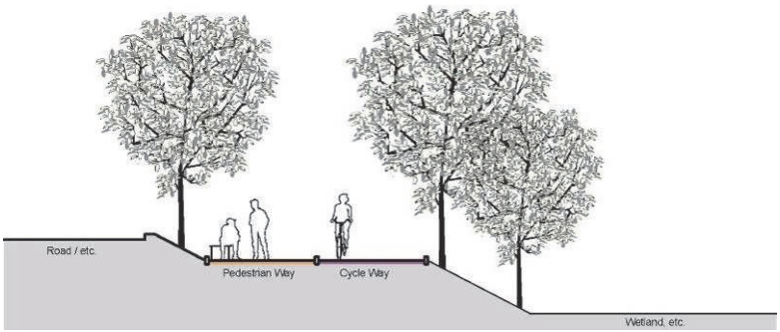
(7) Promotion of Walking and Bicycle Use for Energy Saving and to Promote Health

Walking and bicycling are non-motorised modes of transport without consuming fuel; thus, these modes are considered as environmentally friendly means of transport. Recently, walking and bicycling has become popular since walking and bicycling are good for health.

It is proposed to develop a pedestrian network as well as a pedestrian/bicycle network as shown in Figure 5.13.22. The network connects parks and Beira lake in the city centre and it is located along the wetland, coastal line and Kelani river.

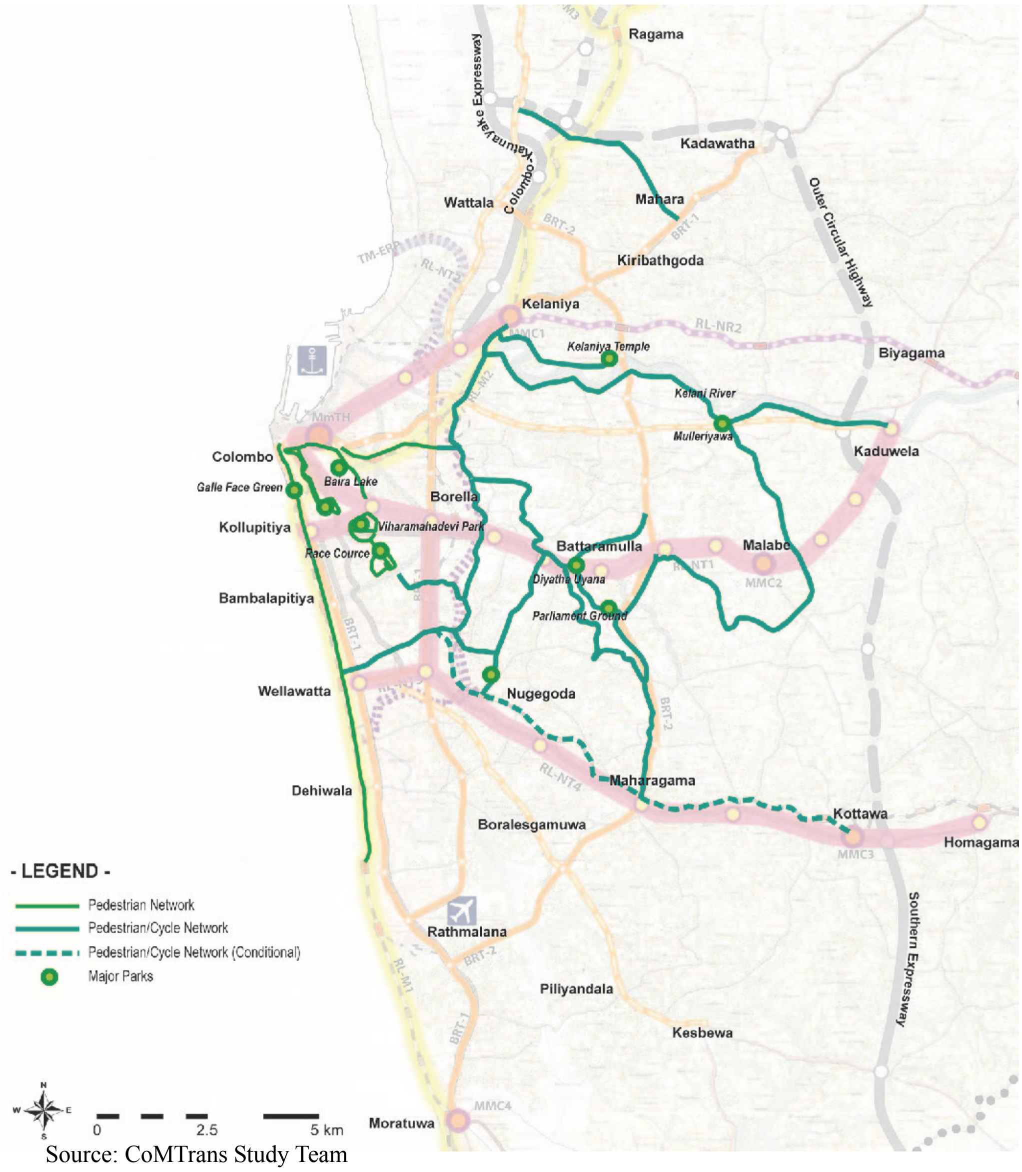
Source: CoMTrans Study Team

Figure 5.13.20 Example of Pedestrian Paths in Colombo



Source: CoMTrans Study Team

Figure 5.13.21 Typical Cross Section of Pedestrian and Cycle Way



Source: CoMTrans Study Team

Figure 5.13.22 Pedestrian Path and Bicycle Road Network

(8) Provision of Sidewalk for Urban Roads

The provision of sidewalks is required to secure sufficient space for walking trips, which is a mode of access to public transport for urban residents and workers as well as tourists for creating more attractive urban areas.

The current cross section of urban roads is still insufficient (see photo below). For example, there is no distinction between the shoulder and sidewalk on High Level Road. This is probably because the sidewalk was not included in the design standard. Therefore, it is proposed to establish a road standard for urban areas to create sufficient sidewalks.

The proposed cross section can be applied to create a sidewalk on the existing road of which ROW is less than 20 metres for four- lane roads.

- East-West arterial road development in the eastern part of the suburban area (widening, additional road links)
- Marin drive extension from Dehiwala to the south

Source: CoMTrans Study Team

Figure 5.13.23 Proposed Cross Section for Creating Sidewalks in Urban Areas

Table 5.13.5 Projects in Programme (3) for Reduction of Air Pollutants/Traffic Noise and Promotion of Health

Sector	Projects			Outline of the Project	Length (km)	Phase		
	ID	Name				Short	Intermediate	Long
Railway	RL-NR2	New Railway Line	Dompe Line Construction of New Railway Line	Kelaniya - Dompe New Construction of railway with double track Mainly cargo train and some passenger train Non-electrification	22.8			✔
Environmental	EN-01	Air Emission Standard for Vehicles				✔		
	EN-02	Vehicle Inspection and Maintenance Programmes				✔		
	EN-03	Low Sulphur Diesel Programme				✔		
	EN-04	Promotion of Natural Gas Vehicles				✔		
	EN-05	Promotion of Hybrid Cars and Electric Vehicles				✔	✔	
	EN-06	Promotion of Walking and Bicycles				✔		

Source: CoMTrans Study Team

5.13.4 Urban Transport System Development Programme (4) for Reduction of Fatalities and Injuries in Traffic Accidents and the Improvement of Security

The urban transport system development programme (4) consists of the projects for the urban transport policy 4: ***Reduction of Fatalities and Injuries in Transport Accidents and Improvement of Security***

Based on the analysis in the chapter 3, countermeasures for traffic accidents in the Western Province are proposed in Table 5.13.6.

Table 5.13.6 Countermeasures for Traffic Accidents in Western Province

Category	Objective	Countermeasure
Engineering	Decrease pedestrian accidents on roadside	Improvement of sidewalks
		Guardrails
	Decrease pedestrian accidents when they are crossing a road	Installation of pedestrian crossings
		Traffic light at intersection and pedestrian crossing
		Installation of road traffic signs warning of a pedestrian crossing
	Decrease head on accidents	Installation of Centre Median
	Decrease accidents during overtaking	Introducing Fast lane
		Introducing No-passing zone
	Decrease accidents of motorcycle/bicycle	Installation of motorcycle/bicycle lanes
	Decrease accidents during night time	Increase and improve roadside lights
		Encourage using reflective material
System	Improve the skill of the drivers	Tight controls on drivers without a license
		Improve education before issuing driver's license
		Tightening driver's license examination
	Decrease accidents caused by over speeding	Setup speed traps
	Smoothing traffic flow and reduce blind spots	Prohibit roadside parking
Education	Improve traffic manner of riders and pedestrians	Education for young riders and old pedestrians
		Road safety education in school
	Improve the skill of the drivers	High level of driving education before issuing license
		Education for public transport drivers (Bus, Three wheeler)

Source: CoMTrans Study Team

(1) Education on Traffic Safety

Most traffic accidents are attributable to human error, in fact, most traffic accidents on ordinary roads are caused by carelessness and violation of traffic rules. Traffic safety education programmes for both drivers and pupils at schools are effective measures to improve traffic safety.

(2) Rehabilitation and Installation of Traffic Signal System

A considerable number of traffic lights are out of order and need repair work in order to function properly. In addition, further installation of traffic signals should be undertaken, in particular, outside of CMC, where the number of traffic signals installed is very limited. More road sections should also be signalised for the safety of crossing pedestrians.

(3) Rehabilitation of Railway Signal System

Railway signals do not function properly at present. Due to improper railway signal systems, trains are often delayed or cancelled. The old signal system is not able to protect trains automatically and thus there are high risks for train collision. Rehabilitation of railway signals is a task urgently needed to improve railway safety.

(4) Analysis on Causes of Traffic Accidents

A traffic accident record reporting system should be developed and an accident database should be established as a part of an urban transport database system for analyses of the causes of traffic accidents.

(5) Provision of Sidewalks and Pedestrian Crossings

Many traffic accidents involve pedestrians and one reason for many pedestrians being involved in those accidents is lack of pedestrian facilities. Sidewalks and pedestrian facilities should be provided to reduce traffic accidents on the roads.

(6) Establishment of Urban Road Design Standard for Sidewalks

As recommended earlier, an urban road design standard should be established and sidewalks should be clearly indicated in the standard cross section for urban roads.

Table 5.13.7 Projects in Program (4) for Reduction of Transport Accidents and Improvement of Security

Sector	Projects		Outline of the Project	Length (km)	Phase		
	ID	Name			Short	Intermediate	Long
Safety	SF-01	Traffic Safety Education	Traffic safety education for drivers and school children		✔		
	SF-02	Rehabilitation and Installation of Traffic Signal System	Repair and new installation of traffic signals		✔	✔	
	SF-03	Rehabilitation of Railway Signal System	Repair of railway signal system		✔		
	SF-04	Provision of Sidewalks and Pedestrian Crossings	Provision of sidewalk along major arterial road and minor arterial roads		✔		
	SF-05	Establishment of Urban Road Design Standard for Sidewalks	Establish design standard of urban roads including sidewalk		✔		

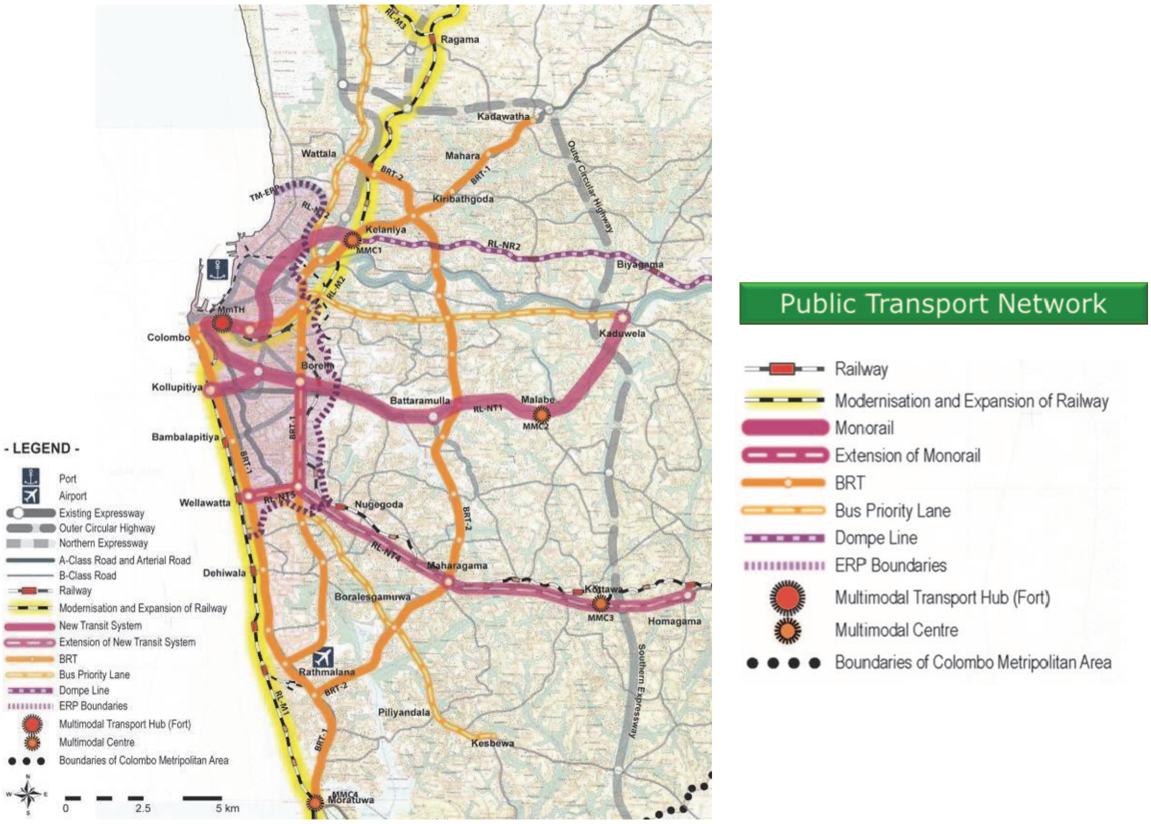
Source: CoMTrans Study Team

5.14 CoMTrans Urban Transport Master Plan

5.14.1 Composition of Urban Transport Master Plan

(1) Public Transport System Development Plan

The entire public transport network with the modernised railway, new transit network (monorail), BRT and bus priority lane, as well as intermodal facilities in the final stage of the planning horizon of the year 2035 is shown in Figure 5.14.1.

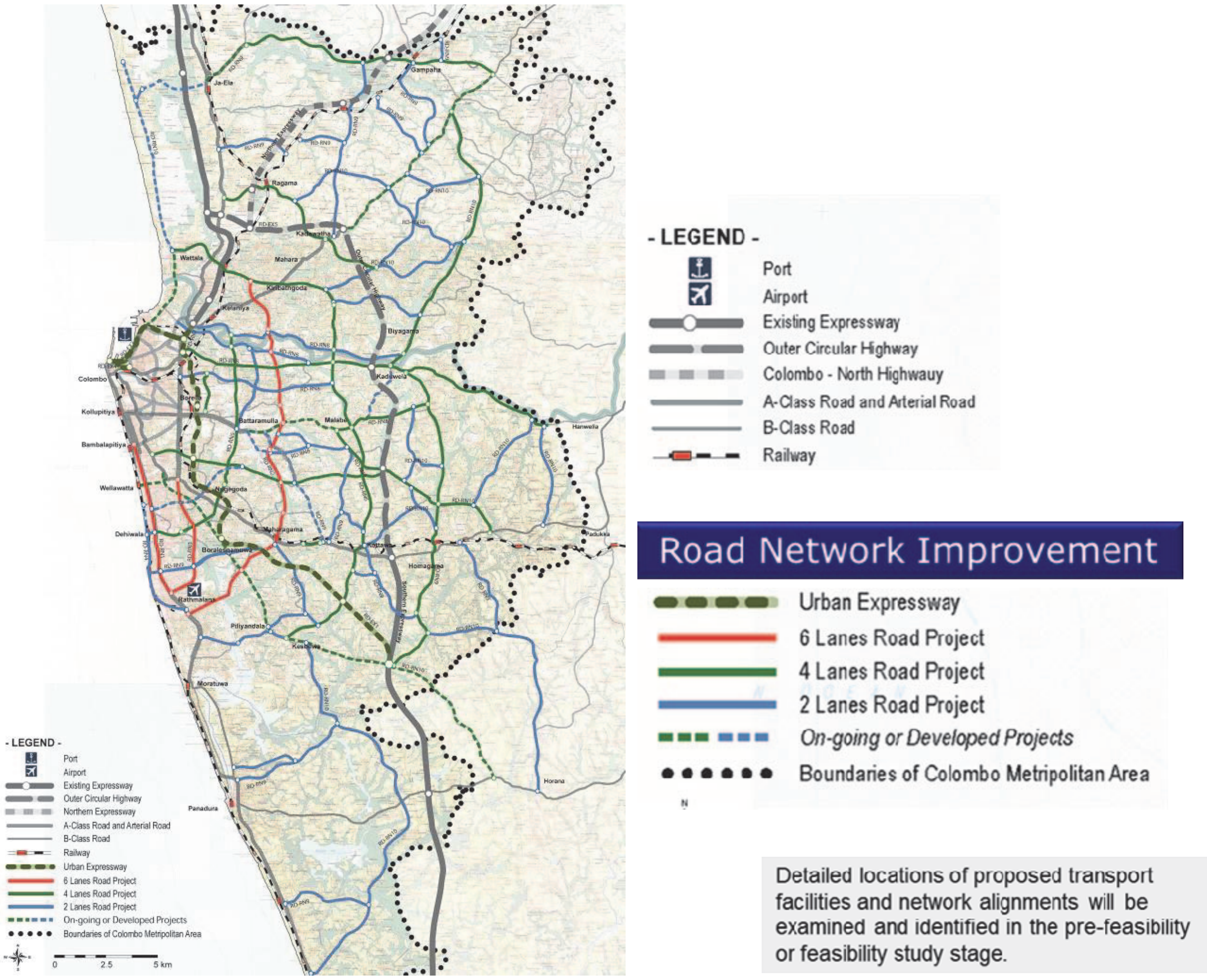


Source: CoMTrans Study Team

Figure 5.14.1 Public Transport System Development Plan

(2) Road Network Development Plan

The entire road network in the final stage of 2035 is illustrated in Figure 5.14.2.



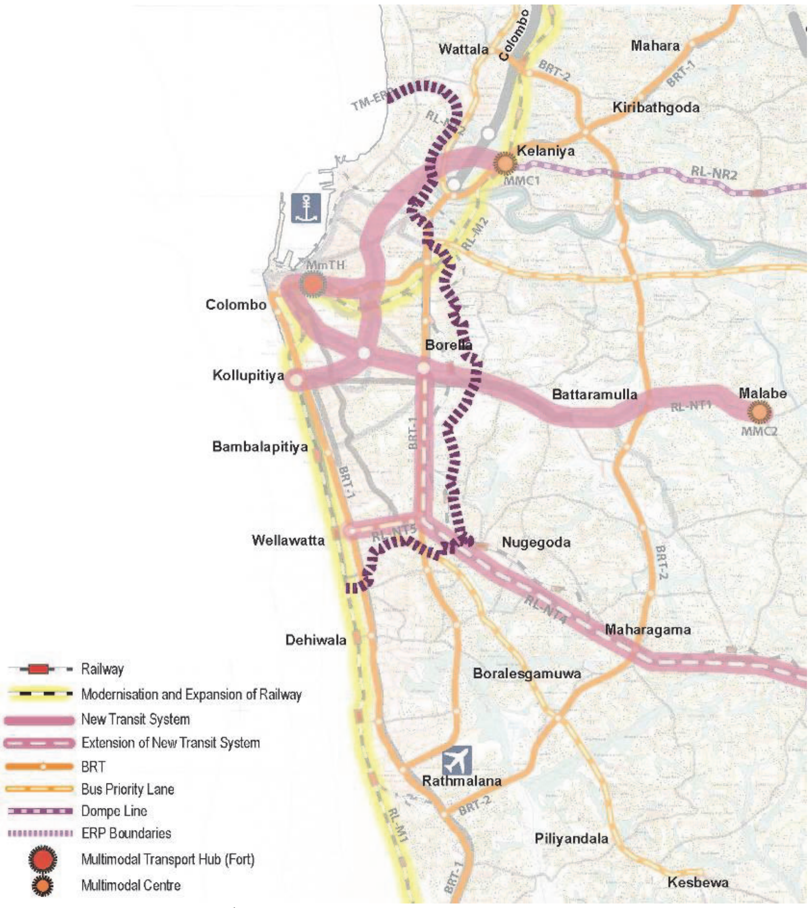
Source: CoMTrans Study Team

Figure 5.14.2 Road Network Development Plan

(3) Transport Demand Management

ERP System

An ERP System is proposed, which includes the development of a system for the installation of toll gates, and installation of fee payment machines. The boundaries of the ERP system are proposed to be on the boundaries of CMC, as shown in Figure 5.14.3.



Source: CoMTrans Study Team

Figure 5.14.3 ERP Area

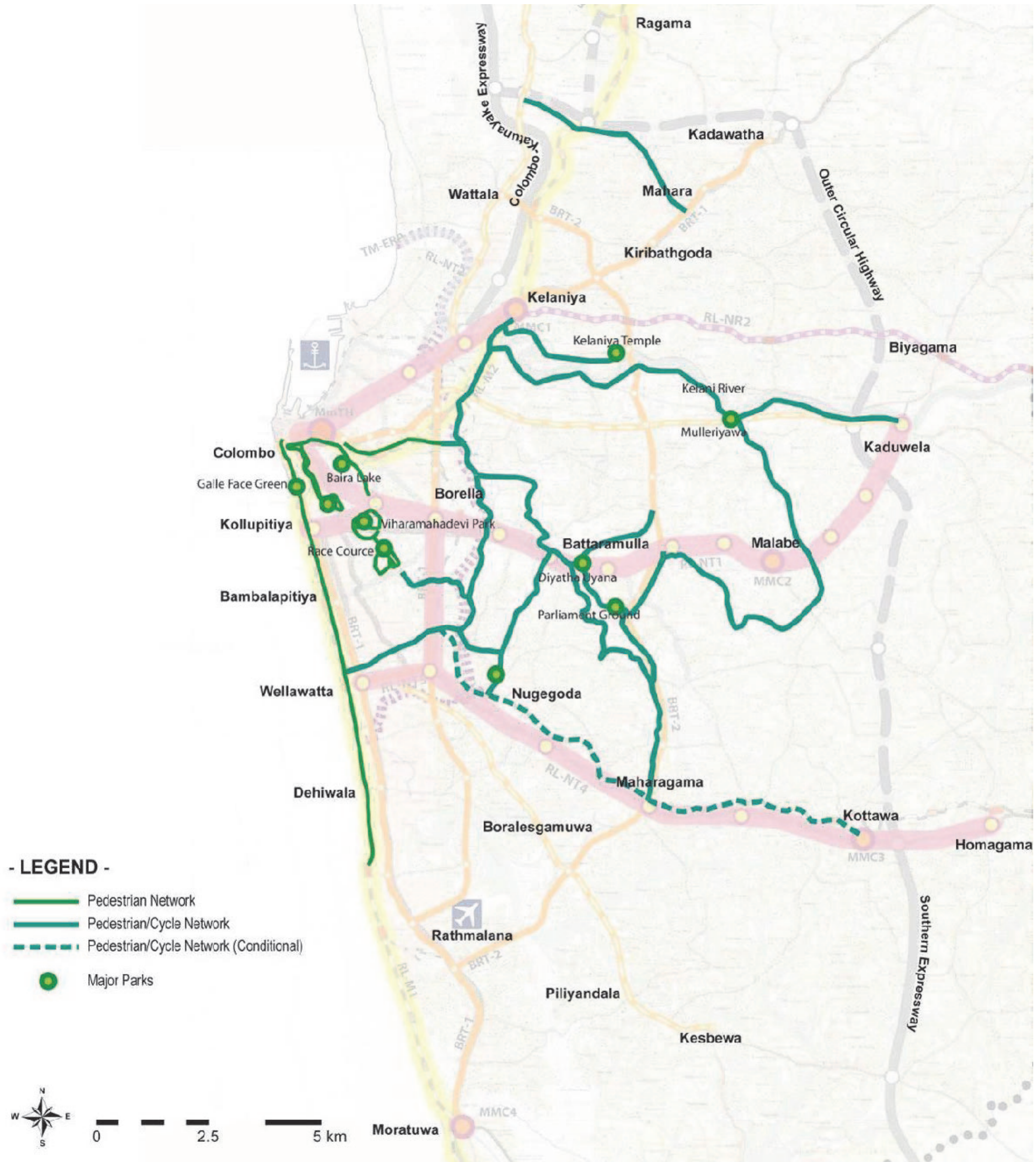
Purpose of the Project is as follows;

- Reduce the flow of traffic within the city of Colombo and the promotion of change to public transport by the installation of a system to charge the vehicles which travel across the CMC boundary

(4) Pedestrian Path and Cycle Road Network Development Plan

As mentioned in Chapter 5.8 (7), it is proposed to facilitate the promotion of walking and bicycle riding. This contributes to energy saving in transportation as well as in health. The network proposed includes a pedestrian way and pedestrian and cycle way. It is proposed along the coast, Kelani River, and wetlands, mainly. Inside the city, together with the proposed sidewalk instalment, a safe pedestrian network will connect between parks and important monuments. The network is shown in Figure 5.8.2.

A typical cross section is shown below in Figure 5.13.21. Depending on ground conditions, it should be carefully installed without harming the transport network or the social/environmental conditions.



Source: CoMTrans Study Team

Figure 5.14.4 Pedestrian Path and Cycle Road Network

5.14.2 Phase Development Plan

CoMTrans proposes the phased development programme for urban transport system for short term (~2020), intermediate term (~2025) and long term (~2035), based on the consideration of budget constraints and a logical sequence of project implementation. An outline of the expected future urban transport system at each stage and necessary actions to be taken are listed as follows:

(1) Short Term Development Plan (~2020)

Expected future urban transport system image: the Short-term development programme aims to establish an urgent public transport network by the year 2020. As discussed in the previous Chapters, a quality public transport system is urgently needed to avoid a shift from public transport to private modes of transport. The public transport system which attracts potential car users is a congestion free transport system, including railway, monorail and BRT. It is ideal to develop rail-based transport to cover the CMA in a short period because the rail-based transport system is not disturbed by ordinary road traffic; however, it needs a considerable amount of funds for initial development. Thus considering a budget constraint it is proposed to introduce a monorail system as a first step to attract the existing and potential car users. The monorail system should be supported by BRT to formulate quality public transport network. It is also proposed to increase traffic capacity of the roads where it is urgently needed in order to alleviate current traffic congestion in CMA.

Major developments to be implemented by 2020 include:

- The monorail system shall be developed in the Malabe corridor (Malabe - Fort) where currently severe road traffic congestion occurs without rail-based public transport services. The monorail network will connect between the northern area of CMC and Fort area to provide smooth north-south passenger movement within the central area of CMC.
- As the first step to improve public transport services, a BRT system will be installed in Galle Corridor, Kandy Corridor and Baseline Road where the BRT system can be installed physically with sufficient road width and potential public transport passenger demands. Once these BRT systems are linked as a circular BRT network, people can move along a variety of routes within the urban area. In addition, in Horana corridor and Negombo corridor, where it is difficult to install BRT, a bus priority system will be introduced and connected with the BRT network, monorail network and the existing railway. This can realise an integrated urban public transport network even in the early stages.
- In order to make the public transport system more attractive and effective for use, a Multi-modal Transport Hub (MmTH) at Fort/Pettah will be built to ensure the smooth transfer to various transport modes and to provide good access to the urban centre. A Multi-modal Centre (MMC) will also be built in each of the four locations at the end points of major corridors connected by public transport. These MMC will encourage more people to use public transport services for entering CMC.
- With regard to the road network, the new elevated road connected from CKE via new Kelani Bridge to Colombo port will be constructed to prevent container trailers and port-related vehicles from running on ground level roads. In addition, once the said port-access elevated road is connected with MmTH by a direct access ramp, inter-provincial buses can enter directly to the elevated road and further expressways.

- On-going road widening/extension projects are essential on major corridors to ensure the road traffic capacity. Especially, the Marine Drive to Dehiwala extension project and inner ring-roads connected with Dehiwala, Nugegoda, and Battaramulla by two-lane road creates the diversity of route selection to major future destinations of Battalamura.
- In addition to the road developments mentioned above, the urban transport master plan aims to alleviate traffic congestion, especially at peak hours, by the improvement of traffic management including traffic signal improvements at major intersections with area control systems, as well as the traffic demand management (TDM) and mobility management (MM) for the purpose of the improvement of people's consciousness and changes in the time required for commuting.
- For traffic safety issues on walking environments, inter-ministerial/institutional coordination and collaboration are essential to provide enough space for sidewalks and to reduce traffic accidents.

The short-term transport system development programme for the public transport network is illustrated in Figure 5.14.5 and the short-term road network development programme is shown in Figure 5.14.6.

(2) Intermediate Term Development Plan (~2025)

Expected future urban transport system image: By the year of 2025, the intermediate-term urban transport system development programme shall further enhance the public transport system that was developed by 2020 to prevent people from shifting from public transport to private modes of transport. It is expected that increasing household income would bring about a shifting to car and motorcycle use. In order to prevent such a shift, further enhancement of the public transport system is needed. It aims to develop efficient and convenient urban transport systems. In addition, the urban transport system development would support economic activities not only within CMA but also inter-provincial activities.

Major transport system developments by 2025 include:

- Modernisation and extension of the existing railways shall be completed. This implies that the development of the mass transit system will be materialised. With this development, the MMCs which are planned to be developed in the short-term will be more efficient and effective.
- A BRT system shall be installed on the Middle Ring road which connects Rathmalana, Battaramulla and Wattala, and it would provide public transport service between sub centres directly, not via the centre of CMC.
- New major roads towards CMC will be constructed which run in the east-west direction, parallel to the Malabe Corridor, High Level Road and Low level road, so that the current concentrated traffic flow on those three corridors could be distributed.
- Road traffic capacity on the Galle corridor will be supplemented by Marin Drive extension for south bound traffic from Dehiwala to Rathmalana.
- The Base Line road will also be extended to Rathmalana, to provide an additional route in the eastern side of CMC from Galle road.

- Development of the three Ring Roads as arterial roads would provide alternative routes for various trip demand movements within the metropolitan area. It would provide a detour for the Base Line road when it is congested.
- The urban expressway will connect the south side of Kelani Bridge via the CMC boundary and the Southern Expressway, so that ample traffic capacity would be provided for long-distance interprovincial travel as well as trips from the suburbs to the city centre.
- An Electronic Road Pricing (ERP) system as a measure of TDM shall be introduced for the heavily congested area to control private vehicle traffic entering the restricted area and to encourage them to shift to the public transport services.
- The intermediate-term development programme for public transport system is illustrated in Figure 5.14.7 and that of the road network is shown in Figure 5.14.8.

(3) Long Term Development Plan (~2035)

Expected future urban transport system image: By the year 2035 as the target year of the master plan, the long-term development programme shall complete development of the urban transport system with public transport systems integrated with the road network.

Major developments to be completed by 2035 are:

- The Monorail system will be installed on the High Level Road and it would be connected with other public transport systems to meet future transport demand.
- Continuous efforts to improve the accessibility by road to railway stations will be made to create a more user-friendly rail-based public transport system.
- As the function of the basic road network in suburban areas in terms of distributors, disaster prevention and basic infrastructure to form a good urban environment, two lane roads shall be installed at intervals of 1 or 2km in the area between corridors.

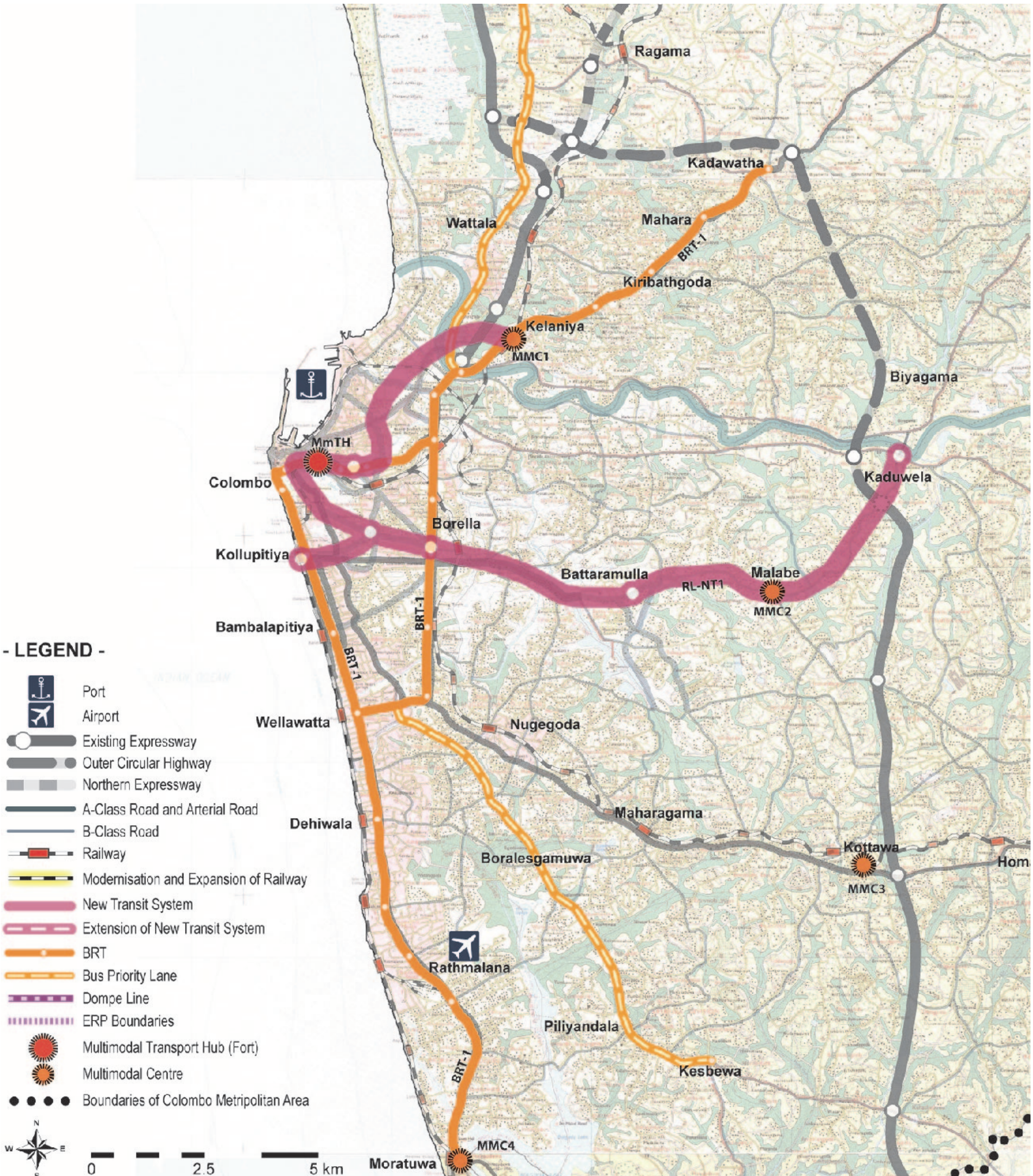
The long-term development programme for the public transport system by the year 2035 is illustrated in Figure 5.14.9 and that for the road network is shown in Figure 5.14.10.

Detailed locations of the proposed transport facilities and the network alignments will be examined and identified in the feasibility study stage.

The further steps of the Study should include establishment of responsible bodies and agencies for implementation of the urban transport master plan, a fund raising mechanism for the project implementation and regulatory framework relevant to implementation of the master plan.

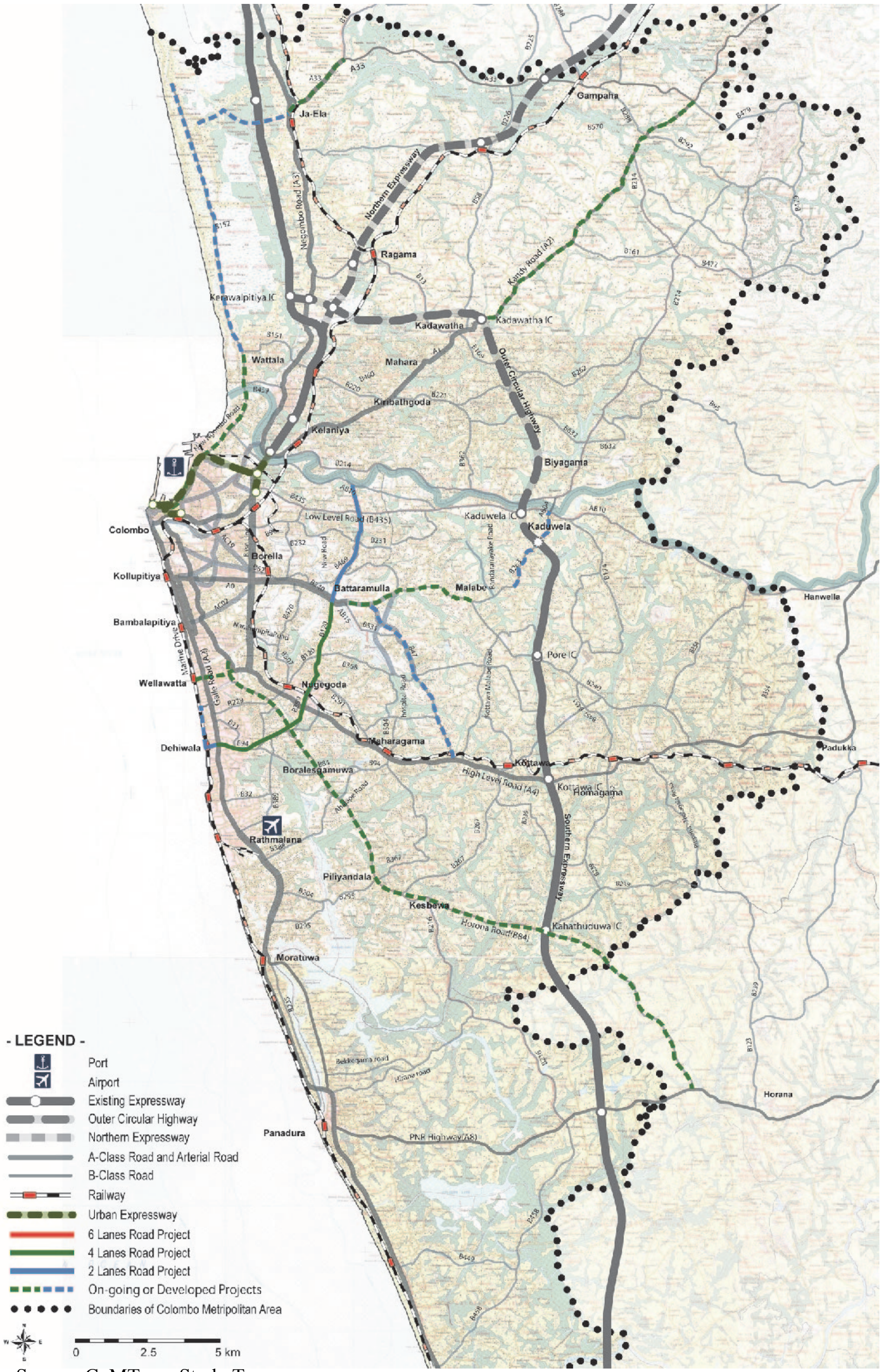
Figure 5.14.11 illustrates the CoMTrans projects on the map in CMA. Figure 5.14.12 depicts the relationship between urban structure and urban transport system.

Short term development Programme (~2020)



Source: CoMTrans Study Team

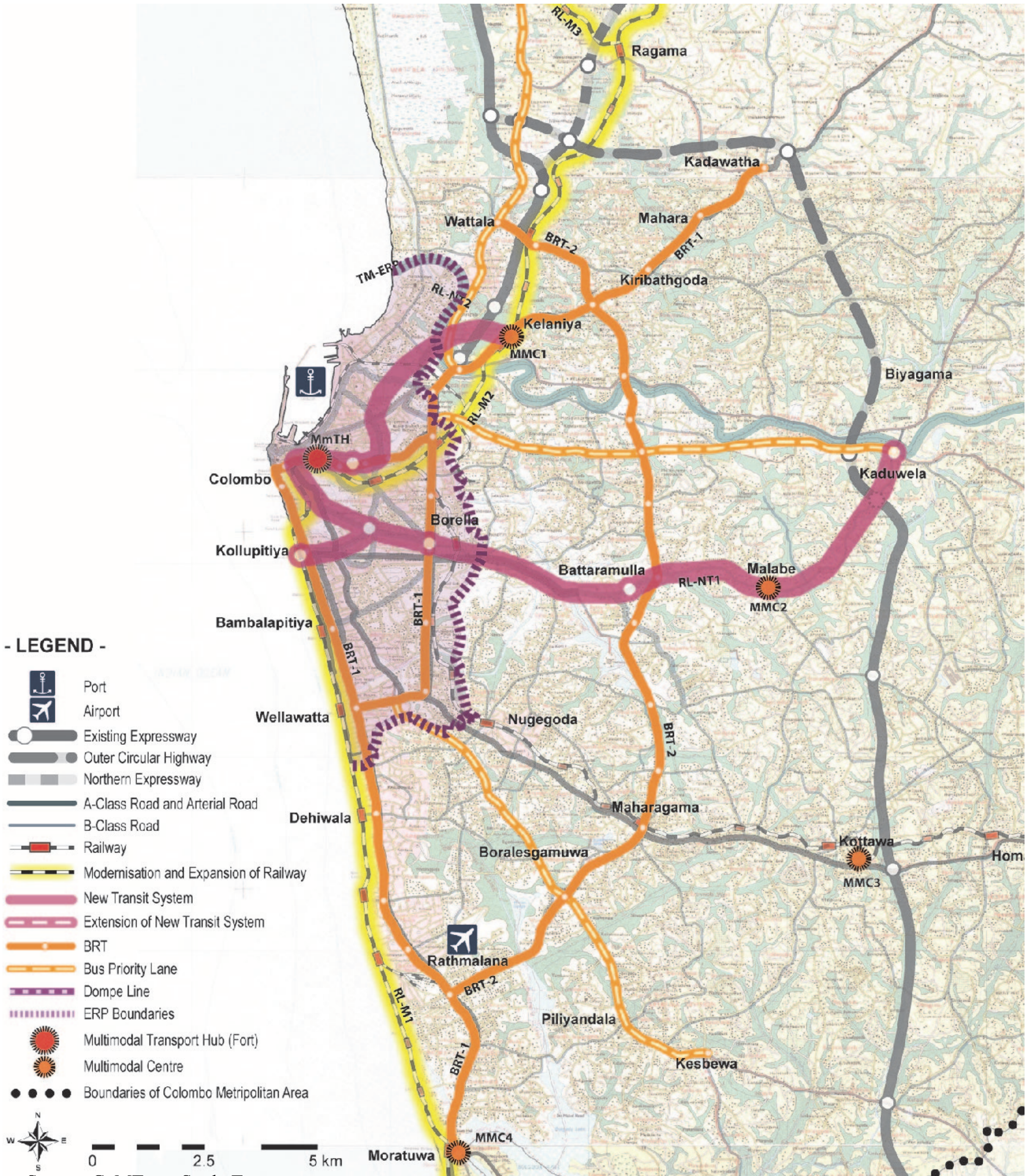
Figure 5.14.5 Short-Term Public Transport Development Plan (~2020)



Source: CoMTrans Study Team

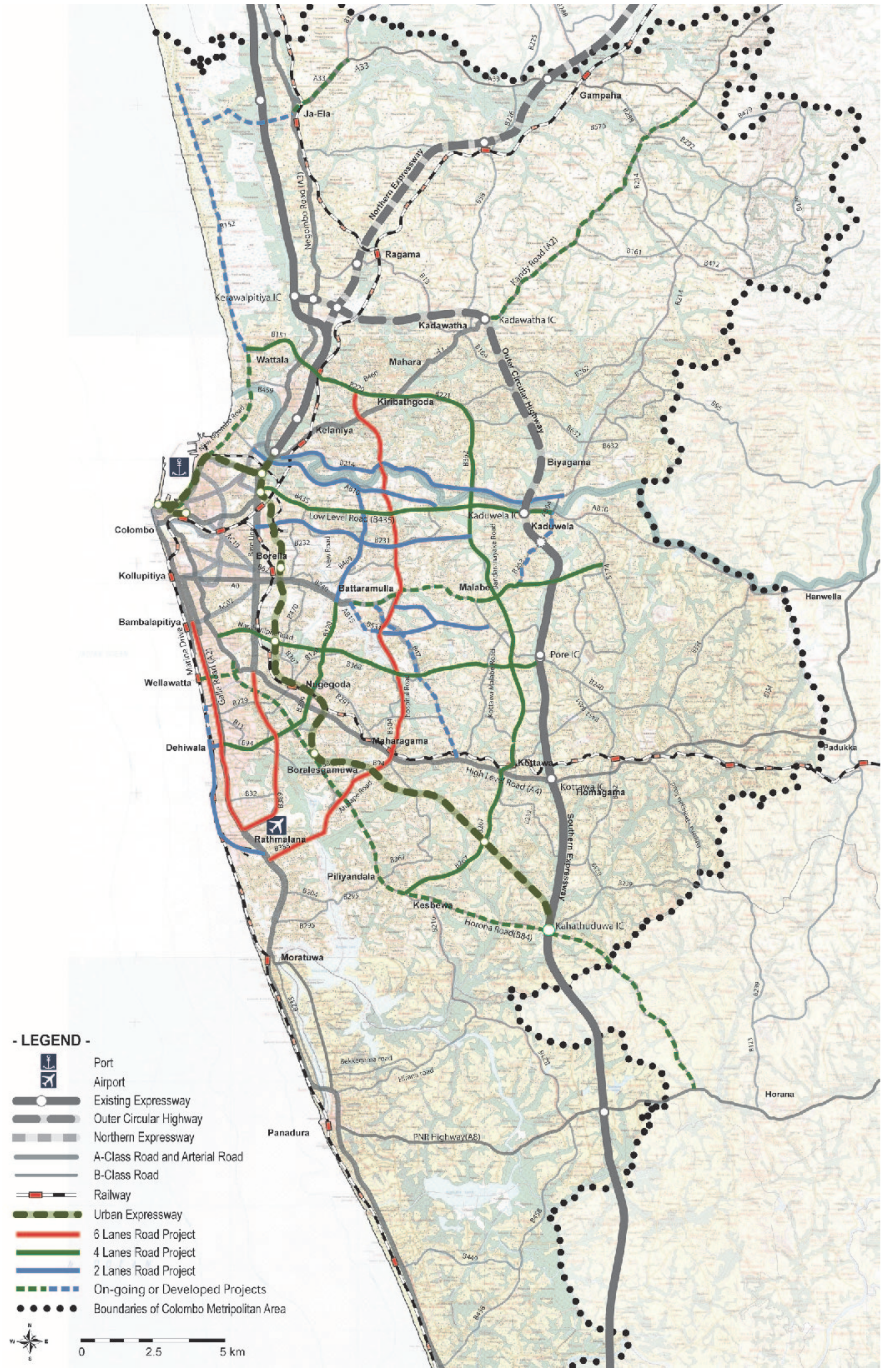
Figure 5.14.6 Short-Term Road Network Development Programme (~2020)

Intermediate term development Programme (~2025)



Source: CoMTrans Study Team

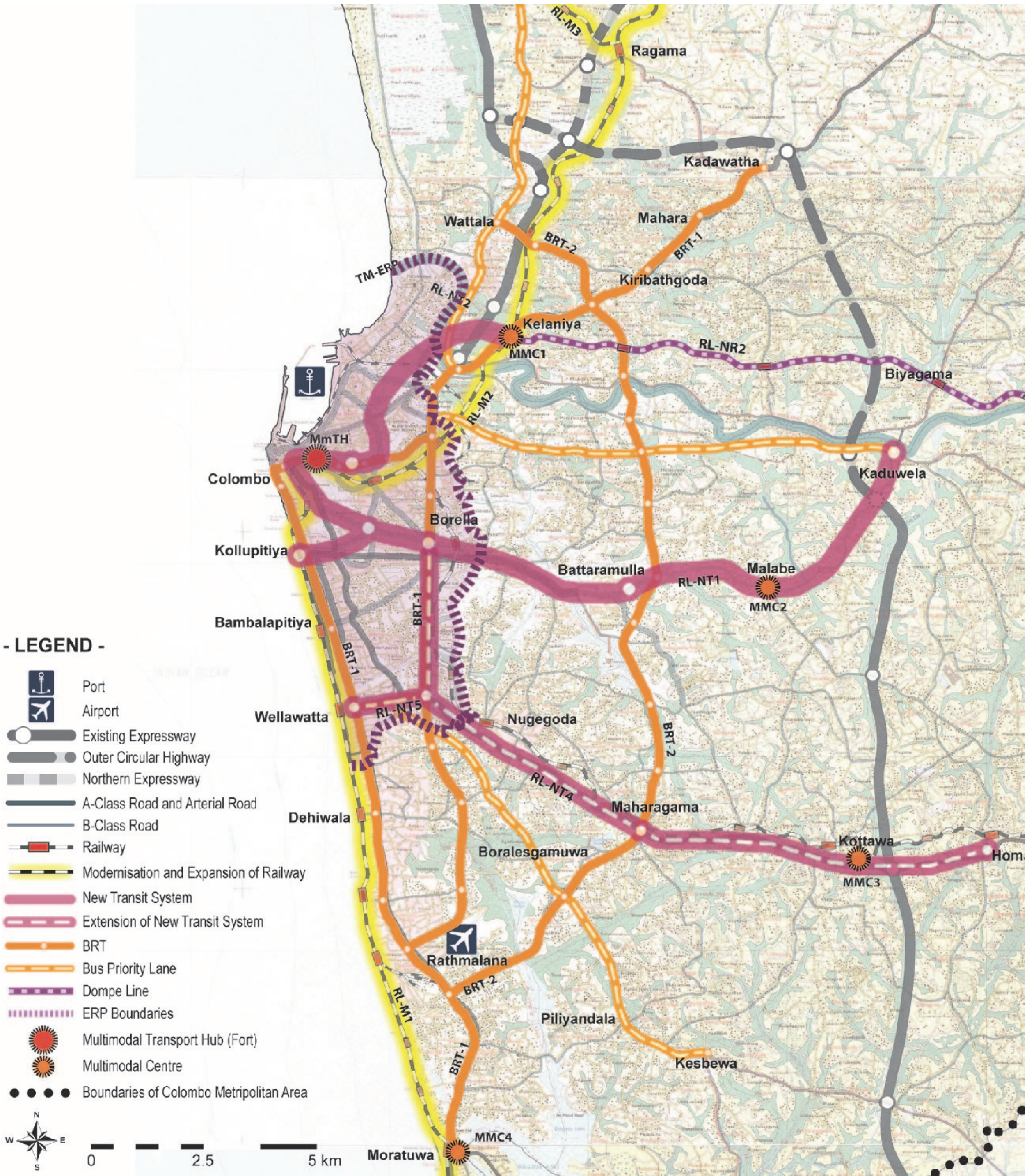
Figure 5.14.7 Intermediate-Term Public Transport System Development Plan (~2025)



Source: CoMTrans Study Team

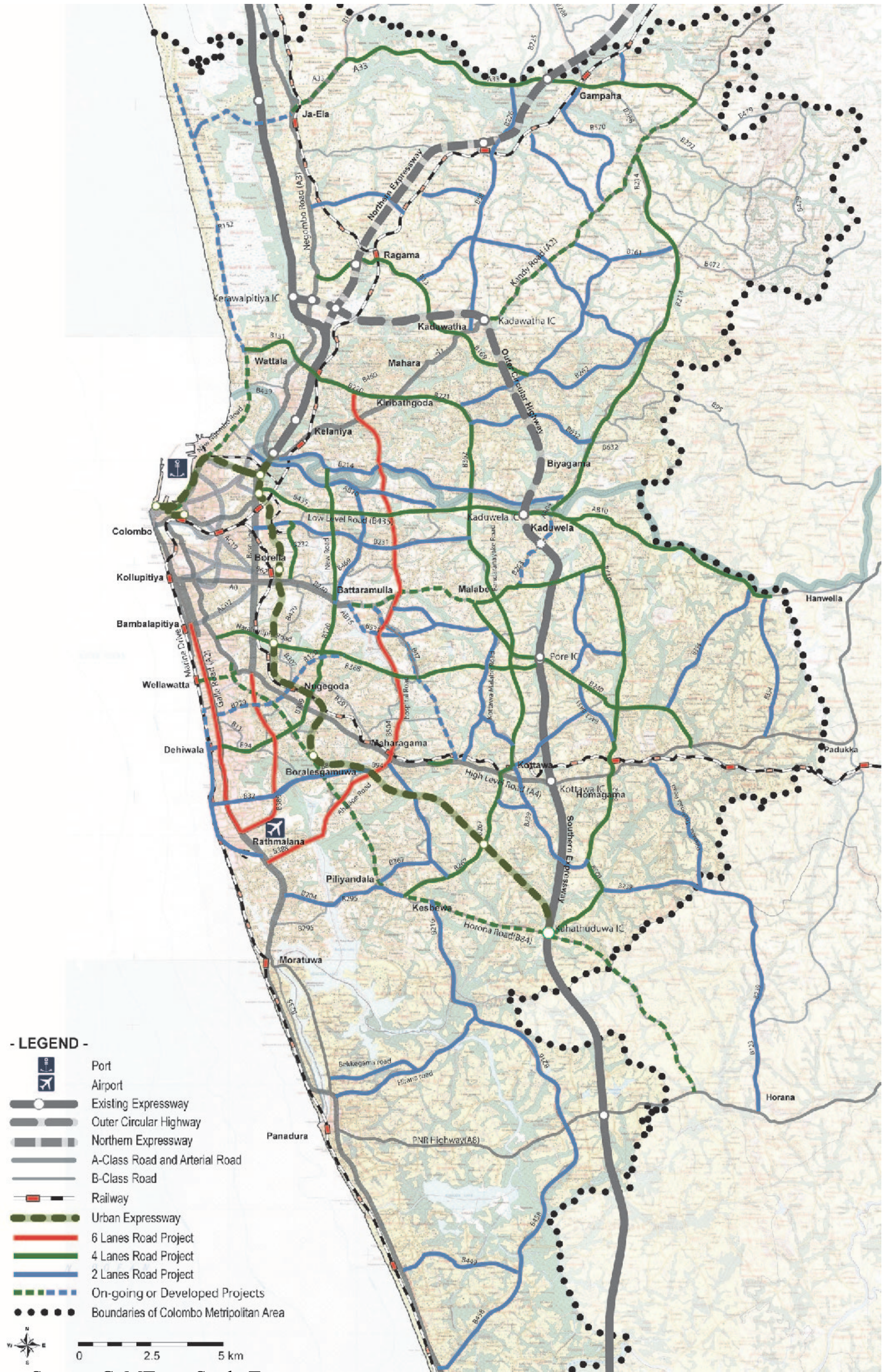
Figure 5.14.8 Intermediate-Term Road Network Development Plan (~2025)

Long term development Programme (~2035)



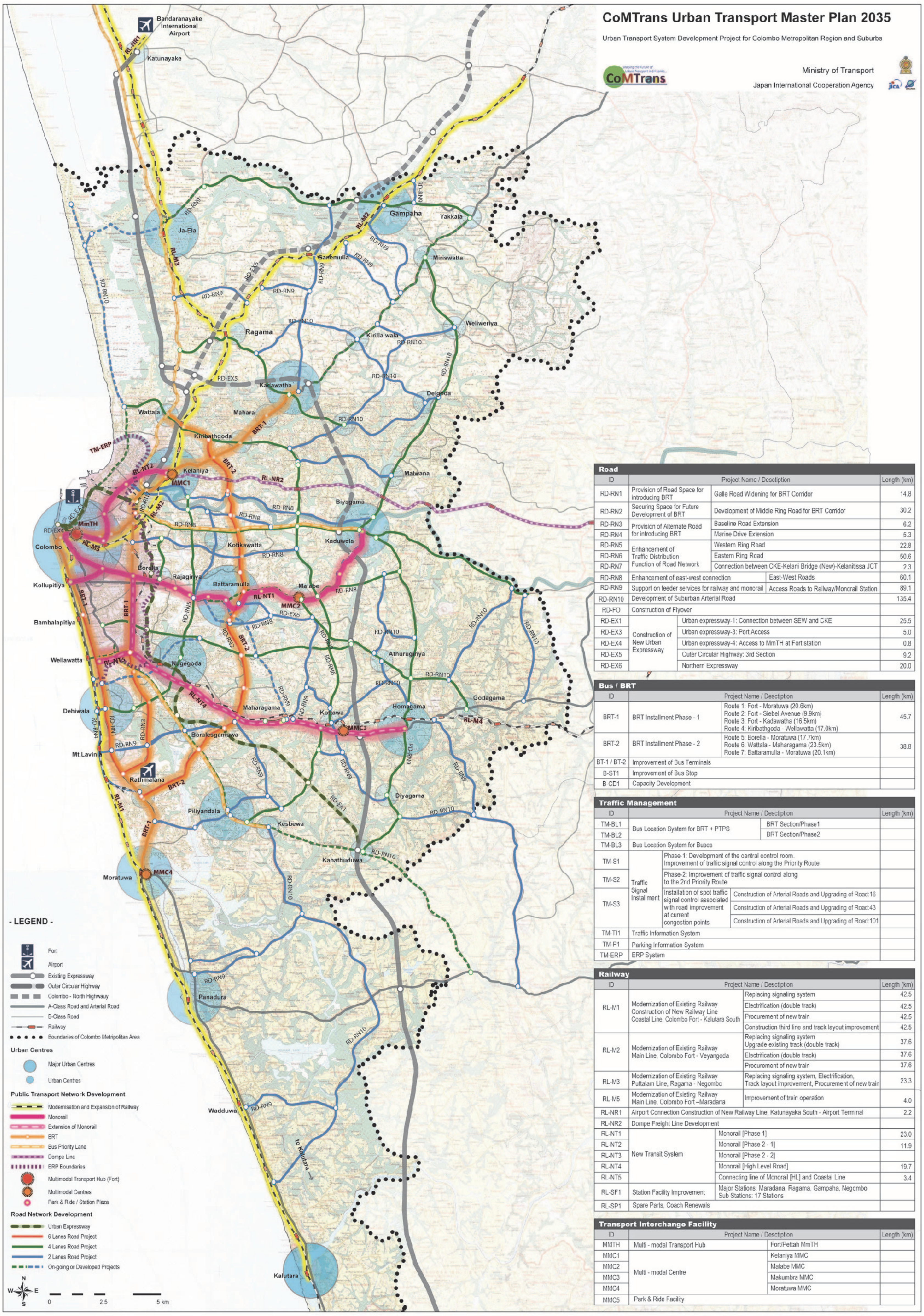
Source: CoMTrans Study Team

Figure 5.14.9 Long-Term Development Public Transport System Plan (~2035)



Source: CoMTrans Study Team

Figure 5.14.10 Long-Term Road Network Development Plan (~2035)



Road			
ID	Project Name / Desctiption		Length (km)
RD-RN1	Provision of Road Space for introducing BRT	Galle Road Widening for BRT Corridor	14.8
RD-RN2	Securing Space for Future Development of BRT	Development of Middle Ring Road for BRT Corridor	30.2
RD-RN3	Provision of Alternate Road for introducing BRT	Baseline Road Extension	6.2
RD-RN4		Marine Drive Extension	5.3
RD-RN5	Enhancement of Traffic Distribution Function of Road Network	Western Ring Road	22.8
RD-RN6		Eastern Ring Road	50.6
RD-RN7		Connection between CKE-Kelani Bridge (New)-Kelanitissa JCT	2.3
RD-RN8	Enhancement of east-west connection	East-West Roads	60.1
RD-RN9	Support on feeder services for railway and monorail	Access Roads to Railway/Monorail Station	89.1
RD-RN10	Development of Suburban Arterial Road		135.4
RD-FO	Construction of Flyover		
RD-EX1	Construction of New Urban Expressway	Urban expressway-1: Connection between SEW and CKE	25.5
RD-EX3		Urban expressway-3: Port Access	5.0
RD-EX4		Urban expressway-4: Access to MmTH at Fort station	0.8
RD-EX5		Outer Circular Highway: 3rd Section	9.2
RD-EX6		Northern Expressway	20.0

Bus / BRT			
ID	Project Name / Desctiption		Length (km)
BRT-1	BRT Installment Phase - 1	Route 1: Fort - Moratuwa (20.6km) Route 2: Fort - Siebel Avenue (9.9km) Route 3: Fort - Kadawatha (16.5km) Route 4: Kiribathgoda - Wellawatta (17.0km)	45.7
BRT-2	BRT Installment Phase - 2	Route 5: Borella - Moratuwa (17.7km) Route 6: Wattala - Maharagama (23.5km) Route 7: Battaramulla - Moratuwa (20.1km)	38.8
BT-1 / BT-2	Improvement of Bus Terminals		
B-ST1	Improvement of Bus Stop		
B CD1	Capacity Development		

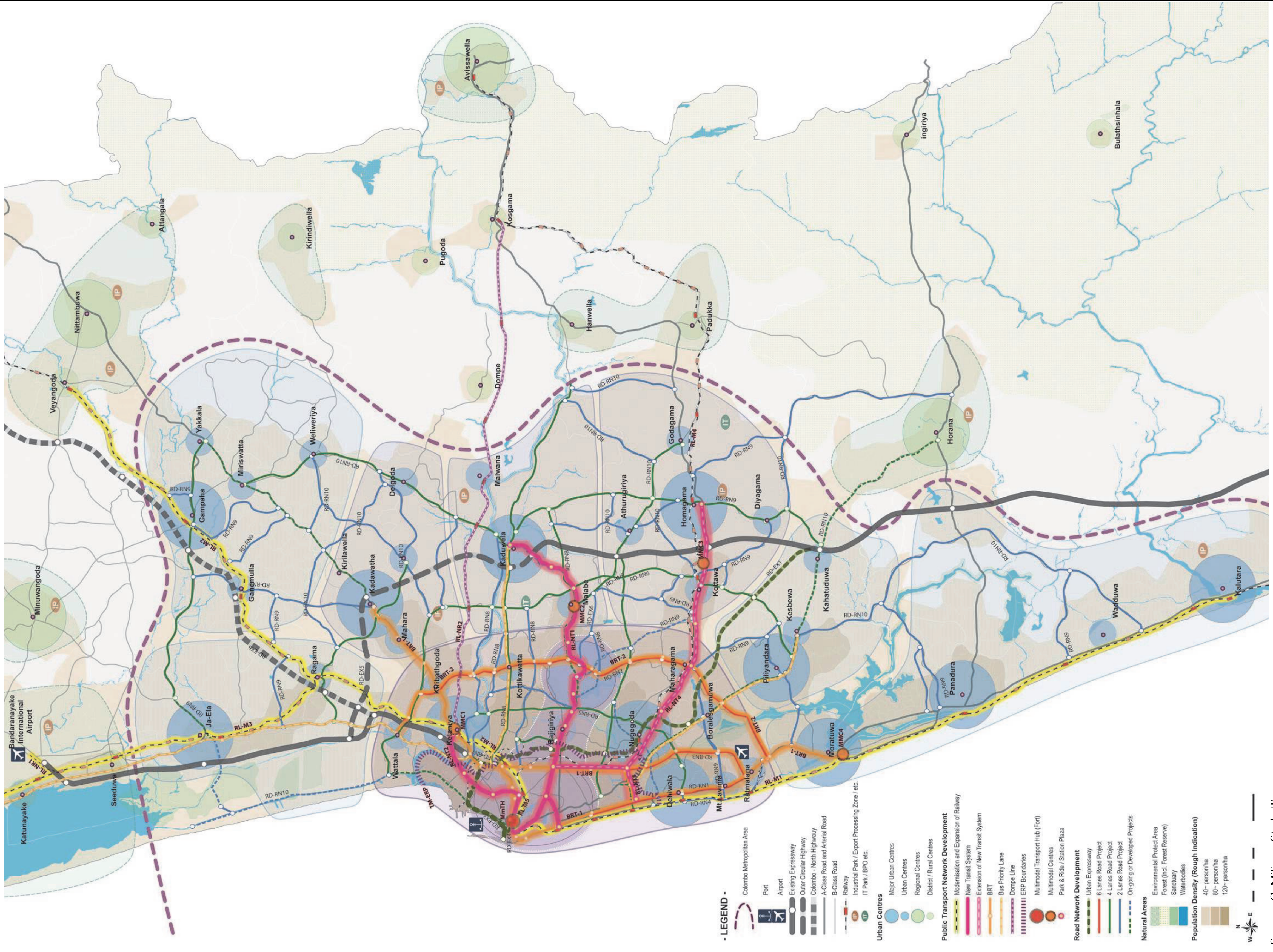
Traffic Management				
ID	Project Name / Desctiption			Length (km)
TM-BL1	Bus Location System for BRT + PTPS		BRT Section/Phase1	
TM-BL2			BRT Section/Phase2	
TM-BL3	Bus Location System for Buses			
TM-S1	Traffic Signal Installment	Phase-1: Development of the central control room. Improvement of traffic signal control along the Priority Route		
TM-S2		Phase-2: Improvement of traffic signal control along to the 2nd Priority Route		
TM-S3		Installation of spot traffic signal control associated with road improvement at current congestion points	Construction of Arterial Roads and Upgrading of Road:16	
			Construction of Arterial Roads and Upgrading of Road:43	
			Construction of Arterial Roads and Upgrading of Road:101	
TM-TI1	Traffic Information System			
TM-P1	Parking Information System			
TM-ERP	ERP System			

Railway			
ID	Project Name / Desctiption		Length (km)
RL-M1	Modernization of Existing Railway Construction of New Railway Line Coastal Line. Colombo Fort - Kalutara South	Replacing signaling system	42.5
		Electrification (double track)	42.5
		Procurement of new train	42.5
		Construction third line and track layout improvement	42.5
RL-M2	Modernization of Existing Railway Main Line. Colombo Fort - Veyangoda	Replacing signaling system Upgrade existing track (double track)	37.6
		Electrification (double track)	37.6
		Procurement of new train	37.6
RL-M3	Modernization of Existing Railway Puttalam Line, Ragama - Negombo	Replacing signaling system, Electrification, Track layout improvement, Procurement of new train	23.3
RL-M5	Modernization of Existing Railway Main Line. Colombo Fort –Maradana	Improvement of train operation	4.0
RL-NR1	Airport Connection Construction of New Railway Line. Katunayaka South - Airport Terminal		2.2
RL-NR2	Dompe Freight Line Development		
RL-NT1	New Transit System	Monorail [Phase 1]	23.0
RL-NT2		Monorail [Phase 2 - 1]	11.9
RL-NT3		Monorail [Phase 2 - 2]	
RL-NT4		Monorail [High Level Road]	19.7
RL-NT5		Connecting line of Monorail [HL] and Coastal Line	3.4
RL-SF1	Station Facility Improvement	Major Stations: Maradana. Ragama, Gampaha, Negombo Sub Stations: 17 Stations	
RL-SP1	Spare Parts, Coach Renewals		

Transport Interchange Facility			
ID	Project Name / Desctiption		Length (km)
MMTH	Multi - modal Transport Hub	Fort/Pettah MmTH	
MMC1	Multi - modal Centre	Kelaniya MMC	
MMC2		Malabe MMC	
MMC3		Makumbra MMC	
MMC4		Moratuwa MMC	
MMC5	Park & Ride Facility		

Source: CoMTrans Study Team

Figure 5.14.11 CoMTrans Urban Transport Master Plan 2035



Source: CoMTrans Study Team

Figure 5.14.12 CoMTrans Urban Transport Master Plan and Urban Structure in CMA

CHAPTER 6 Implementation Plan and Institutional Arrangement

6.1 Implementation Plan for CoMTrans Master Plan

It is, in principal, necessary to undertake various analytical steps with regard to the "project life cycle" as defined by the GLK in order to estimate the impact of the "CoMTrans Master Plan" implementation on the public investment budget.

However, since the CoMTrans Master Plan is a transport network development plan, in which all projects are inherently inter-linked, it suffices to analyse accumulated required investment totals over the three planning horizons (short, medium and long-term), the total planning period (2015-2035) and investigate how these totals compare to the Government's policy targets established for public investments in the transport sector.

6.1.1 Total Investment Cost Required for CoMTrans Master Plan Implementation

Table 6.1.1 shows the needed investment volume for CoMTrans realisation without assuming any particular financing model.

- The total investment volume over the planning period from 2015 to 2035 is estimated at Rs 2,780,900 million, of this 59% of the total is for net investments and about 41% for implied O&M cost.
- The distribution of the investment and O&M combined cost components is estimated at 35% over the short-term, 31% over the intermediate term and the balance of 34% over the long-term.
- This total volume may exceed the capacity to finance at a 100% self-financing rate from public budget and envisaged public investment resources.

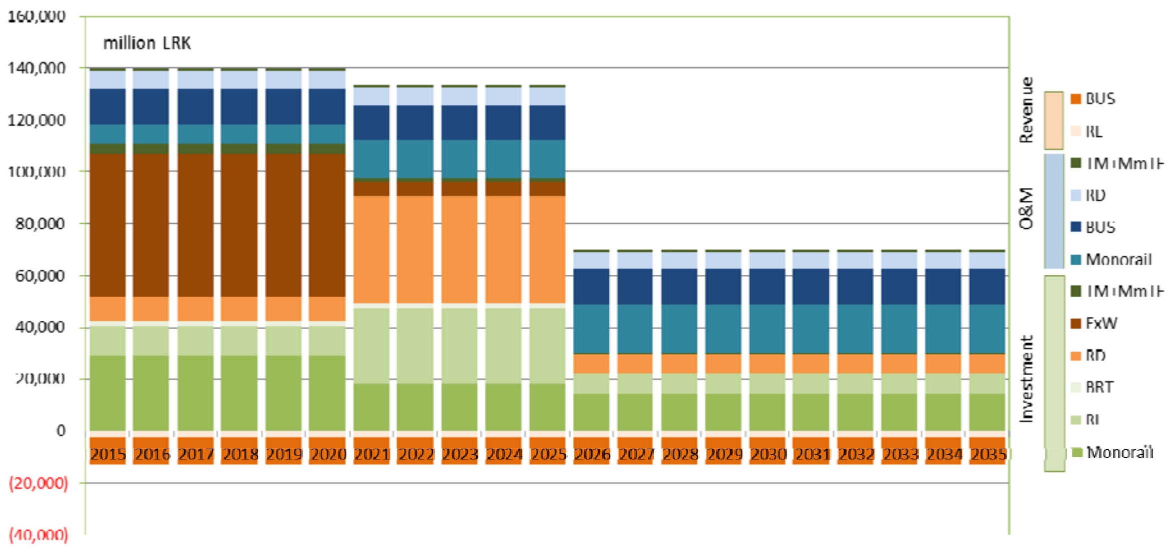
Figure 6.1.1 depicts the estimated annual requirement flow for investment and O&M cost by each transport mode. If there are larger portion of costs of investment in the short-term, then the share of O&M costs becomes larger in the intermediate and long-term.

Table 6.1.1 Total Investment Requirements for the Entire CoMTrans Master Plan Realisation

million LKR

Base Case			Short 2015-2020 *6 years*	Intermediate 2021-2025 *5 years*	Long 2026-2035 *10 years*	Total 2015-2035 *21 years*	Note
Cost	Grand Total		**978,300**	**862,500**	**940,000**	**2,780,900**	
Cost	Investment	**Total**	**741,100**	**598,100**	**300,900**	**1,640,100**	
		Monorail	173,800	89,800	144,600	408,200	
		Railway	67,800	146,400	74,500	288,700	
		BRT	12,300	9,300	0	21,700	
		Bus	0	0	0	0	
		Road	462,700	345,100	74,300	882,100	
		Expressway	*407,100*	*138,300*	*0*	*545,400*	
		Other Road	*55,700*	*206,700*	*74,300*	*336,700*	
		Traffic Management	2,800	7,500	7,500	17,700	
		Multi-modal Transit Facility	21,700	0	0	21,700	
	O&M	**Total**	**237,200**	**264,400**	**639,200**	**1,140,800**	
		Monorail	52,100	65,900	204,100	322,100	*5% of Investemnt Cost*
		Railway	46,100	75,000	187,300	308,500	
		Additional Investment	*20,300*	*53,500*	*144,300*	*218,200*	*5% of Investemnt Cost*
		Existing Infrastructure	*25,800*	*21,500*	*43,000*	*90,300*	*50% of current National OM cost*
		BRT	10,300	14,100	28,300	52,700	*13% of Investment Cost*
		Bus	81,000	67,500	135,000	283,500	*50% of current National OM cost*
		Road	43,500	38,100	76,200	157,800	
		Additional Investment	*0*	*200*	*400*	*600*	*4.3 mil. LKR/km/year*
		Existing Infrastructure	*40,700*	*33,900*	*67,900*	*142,500*	*Currnt OM cost for AB roads*
		Expressway	*2,800*	*4,000*	*7,900*	*14,700*	*12.6 mil.LKR/km/year*
		Traffic Management	200	500	1,800	2,500	*1% of Investment Cost*
		Multi-modal Transit Facility	3,900	3,300	6,500	13,700	*3% of Inevestment Cost*
Revenue		**Total**	**76,800**	**64,000**	**128,000**	**268,800**	
		Monorail	0	0	0	0	*TBD*
		Railway	13,800	11,500	23,000	48,300	*50% of current Natinal Revenue*
		BRT	0	0	0	0	*TBD*
		Bus	63,000	52,500	105,000	220,500	*50% of current Natinal Revenue*

Source: CoMTrans Estimate



Source: CoMTrans Estimate

Figure 6.1.1 Investment Cost, O&M Cost and Revenue of CoMTrans Master Plan Projects

6.1.2 Government Budget Requirement to Implement CoMTrans Master Plan

Table 6.1.2 summarises the potential public budget impact if a PPP financing scheme is assumed for the expressways, parts of O&M of the monorail and parts of the BRT system.

Table 6.1.2 Total Investment Requirements for the Entire CoMTrans Master Plan Realisation (PPP Financing Scheme)

							million LKR
Financing Model A [Application of PPP Scheme] Investment: Expressway (Gov. 20%) exl. OCH & New Kelani Bridge O&M: Monorail, BRT, Expressway (Private)			**Short** *2015-2020* *6 years*	**Intermediate** *2021-2025* *5 years*	**Long** *2026-2035* *10 years*	**Total** *2015-2035* *21 years*	*Note*
Cost	**Grand Total**		**868,900**	**687,900**	**699,700**	**2,256,500**	
	Investment	**Total**	**665,700**	**487,500**	**300,900**	**1,454,100**	
		Monorail	173,800	89,800	144,600	408,200	
		Railway	67,800	146,400	74,500	288,700	
		BRT	12,300	9,300	0	21,700	
		Bus	0	0	0	0	
		Road	387,400	234,400	74,300	696,100	
		Expressway	*331,700*	*27,700*	*0*	*109,100*	*Gov. share = 20%*
		Other Road	*55,700*	*206,700*	*74,300*	*336,700*	
		Traffic Management	2,800	7,500	7,500	17,700	
		Multi-modal Transit Facility	21,700	0	0	21,700	
	O&M	**Total**	**203,100**	**200,400**	**398,900**	**802,400**	
		Monorail	26,100	16,500	0	42,500	*5% of Investemnt Cost* *Short-term: Gov. 50%* *Intermediate-term: Gov. 25%*
		Railway	46,100	75,000	187,300	308,500	
		Additional Investment	*20,300*	*53,500*	*144,300*	*218,200*	*5% of Investemnt Cost*
		Existing Infrastructure	*25,800*	*21,500*	*43,000*	*90,300*	*50% of current National OM cost*
		BRT	5,200	3,500	0	8,700	*13% of Investment Cost >> Private* *Short-term: Gov. 50%* *Intermediate-term: Gov. 25%*
		Bus	81,000	67,500	135,000	283,500	*50% of current National OM cost*
		Road	40,700	34,100	68,200	143,100	
		Additional Investment	*0*	*200*	*400*	*600*	*4.3 mil. LKR/km/year*
		Existing Infrastructure	*40,700*	*33,900*	*67,900*	*142,500*	*Currnt OM cost for AB roads*
		Expressway	*0*	*0*	*0*	*0*	*12.6 mil.LKR/km/year >> Private*
		Traffic Management	200	500	1,800	2,500	*1% of Investment Cost*
		Multi-modal Transit Facility	3,900	3,300	6,500	13,700	*3% of Inevestment Cost*
Revenue		**Total**	**76,800**	**64,000**	**128,000**	**268,800**	
		Monorail	0	0	0	0	*TBD*
		Railway	13,800	11,500	23,000	48,300	*50% of current Natinal Revenue*
		BRT	0	0	0	0	*TBD*
		Bus	63,000	52,500	105,000	220,500	*50% of current Natinal Revenue*

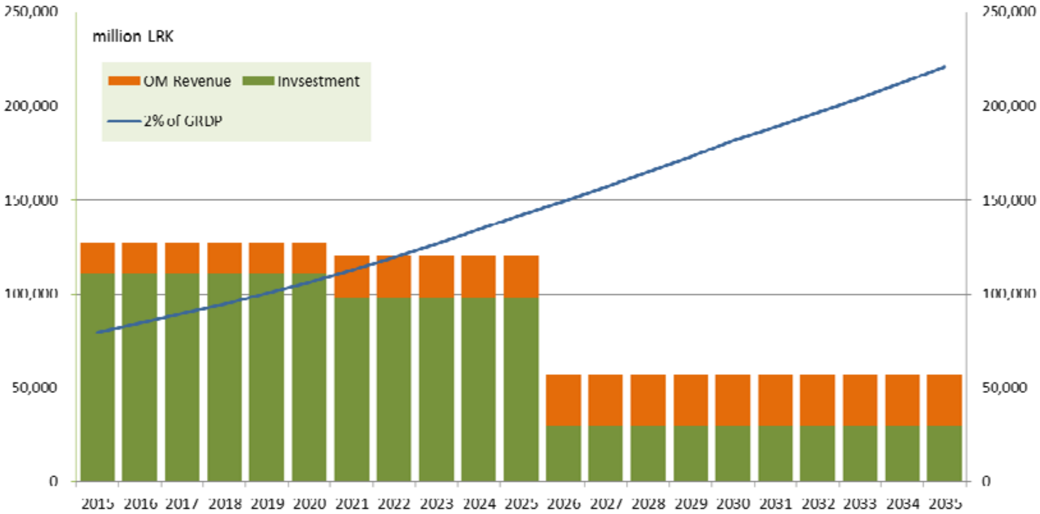
Source: CoMTrans Estimate

Table 6.1.2 demonstrates the “reduction in burden” on the public budget that could be achieved if the expressways are predominantly financed under a PPP scheme and the O&M burden for the monorail and also the BRT system could be shifted to private sector interests. The main message of the numbers is:

- Total net additions to investment over the whole planning period would be reduced from Rs 2,780,960 million to Rs 2,256,500 million or roughly by 19%
- The major gain would originate from reductions to the public investment budget, and
- Minor gain would also be achieved through reducing the impact on the Government’s O&M expenditure.

Figure 6.1.2 depicts the situation in a more graphical format.

If it is assumed that the maximum allocation to the urban transport sector is 2% of GRDP in the Western Province, in the short term a shortage of development funds is expected. Consequently to fill the gap between the government budget and amount required for investment, it should consider utilising external financial sources such as ODA.



Source: CoMTrans Estimate

Figure 6.1.2 Estimated Investment Cost and OM Cost of CoMTrans Master Plan

6.2 Institutional Setup and Regulatory Framework for Urban Transport

6.2.1 Transport Administration in Sri Lanka

The National Transport Policy sets the following administrative structure to ensure the adequate provision of transport infrastructure and services.

The transport administrative structure is divided into five steps, i.e. policy, planning, implementation and monitoring, regulation, infrastructure provision, and service provision. The table shows the institutions which deliver the abovementioned five functions by transport mode.

Table 6.2.1 Transport Administrative Structure by Transport Mode

<table>
<tr><th></th><th>Policy Making</th><th>Planning</th><th>Regulation</th><th>Infrastructure Provision</th><th>Service Provision</th></tr>
<tr><td>Motor vehicles (all)</td><td rowspan="9">Ministry of Transport assisted by NTC and other stakeholders</td><td rowspan="9">NTC
(in concurrence with province for national plans and to get concurrence from centre to provincial plans).</td><td>DMT</td><td>RDA/PRDA/ LA & Private</td><td>Private</td></tr>
<tr><td>Railways</td><td colspan="3">SLR</td></tr>
<tr><td>Inland Waterways</td><td></td><td>Provincial Councils</td><td>Private</td></tr>
<tr><td>Road Passenger Transport Services</td><td>NTC (Inter)
RPTA (Intra)</td><td>SLTB/NTC/ RPTA/LA/ Private</td><td>SLTB/Private</td></tr>
<tr><td>Para-transit (carriage of passengers)</td><td>DMT/NTC
RPTA (Intra)
LA</td><td>LA</td><td>Private</td></tr>
<tr><td>Rental vehicles</td><td>DMT</td><td>Private</td><td>Private</td></tr>
<tr><td>Freight vehicles (carriage of goods)</td><td>NTC (Inter)
RPTA (Intra)</td><td>Private</td><td>Private</td></tr>
<tr><td>Non-motorised</td><td>LA</td><td>RDA/PRDA/
LA</td><td>Private</td></tr>
<tr><td>Traffic Management</td><td>LA</td><td>RDA/PRDA/ LA</td><td>RDA/PRDA/ LA</td></tr>
</table>

Source: National Transport Policy on Transport in Sri Lanka, Ministry of Transport, 2009.

Corresponding to the table above, detailed functional responsibilities are illustrated in the table in the following page. Although Table 6.2.1 indicates transport policy is made by the MOT assisted by the NTC and other stakeholders and the planning is done by the NTC, the reality is that there are central and provincial governments involved in vertical sphere, and some numbers of institutions involved in horizontal sphere, even if only at the central government level. If including subsidiary institutions, such as the DMT, MOFP and so on, the number of stakeholders increases.

Table 6.2.2 Functional Responsibilities of Transport related Institutions

Sector	Sub-sector	Policy	Planning					Regulation		Fare/Revenue			Infrastructure Development				Asset Management			Operation and Management							Law
		Plolicy Making	Master Plan (Mid-, Long-term Planning)	Strategic planning (Action Plan)	Service Delivery Planning	Planning for Public Transport Infrastructure Developmer (include Budgeting)	Authorization/License and Permit Approval	Regulatory Authority/Regulator	Formulating and updating Administrative & Technical Standards, Norms, Minimum Service Standards and Guidelines	Fare Setting	Managing Fare Collection System	Sales revenue and assets management	Financial planning and Budgetary Expenditure (Budget	Land Acquisition	Procurement of Infrastructure Development (Constructio	Construction Supervision & Technical Inspection	Land	Base Infrastructure	Upper Infrastructure (Equipment & Facility)	Financial Source for Operation and Maintenance (O&M)	Operation and Maintenance of Constructed Infrastructu (Base)	Operation and Management of Equipment & Facility (Up	Financial Arrangement for Business Operation	Business Operation	Property Management (shops, vendors and so on)	Business Operation Performance Evaluation	Law Enforcement
Road Network	Class A & B (National Road)	MoHPS	RDA MoHPS	RDA MoHPS		RDA	RDA	RDA	RDA MoHPS				RDA MoHPS	RDA	RDA	RDA	RDA	RDA	RDA	RDA	RDA & LA	RDA & LA					RDA & NPL
	Class C (Provincial Road)	PRDA	PRDA	PRDA				PRDA	RDA MoHPS				PRDA	PRDA	PRDA	PRDA	PRDA	PRDA	PRDA	PRDA	PRDA	PRDA					PRDA & NPL
	Class D & E (Local Authority Road)	PRDA & LA	LA PC	LA PC				LA	RDA MoHPS				LA PC	LA	LA	LA	LA	LA	LA	LA PC	LA	LA					LA & NPL
	Urban expressway (toll road)	MoHPS	RDA MoHPS	RDA MoHPS	RDA	RDA	RDA	RDA	RDA MoHPS	RDA MoHPS	RDA	RDA	RDA	RDA	RDA	RDA	RDA	RDA	RDA	RDA	RDA	RDA	RDA	RDA	RDA		RDA & NPL
Rail-based Transport	Railway	MOT	SLR MOT	SLR MOT	SLR MOT	SLR MOT	MOT	SLR	SLR	SLR MOT	SLR	SLR	SLR MOT	MOT	SLR	SLR	SLR	SLR	SLR	SLR	SLR	SLR	SLR	SLR	SLR	SLR MOT	SLR MOT
Bus Transport	General bus service (Public) (Inter-province bus service)	NTC	NTC	NTC	NTC	SLTB *5	NTC	NTC	NTC	NTC & SLTB	SLTB	SLTB							SLTB	SLTB		SLTB *5	SLTB	SLTB		SLTB	NTC & NPL
	General bus service (Private) (Inter-province bus service)	NTC	NTC	MoPTS	MoPTS		NTC	NTC	NTC & MoPTS	NTC	NTC	OPR							OPR	OPR		OPR *5	OPR	OPR		OPR	NTC & NPL
	General bus service (Public) (Intra-province bus service)	NTC	NTC	NTC	SLTB	SLTB	SLTB	NTC	NTC	SLTB	SLTB	SLTB							SLTB	SLTB		SLTB *5	SLTB	SLTB		SLTB	NTC & NPL
	General bus service (Private) (Intra-province bus service)	RPTA	RPTA	RPTA	RPTA	RPTA	RPTA	RPTA	NTC & RPTA	NTC	OPR	OPR							OPR	OPR		OPR	OPR	OPR		OPR	RPTA & NPL
	Bus terminal (Inter-provincial bus terminal) (Public)	NTC	SLTB	SLTB	SLTB	SLTB	SLTB	NTC	NTC	NTC	SLTB	SLTB	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC		NTC		NTC & NPL
	Bus terminal (Inter-provincial bus terminal) (Private)	MoPTS	MoPTS	MoPTS	MoPTS	MoPTS	MoPTS	NTC	NTC	NTC	OPR	OPR	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC		NTC		NTC & NPL
	Bus terminal (Intra-provincial bus terminal)	RPTA & UDA	RPTA & UDA	RPTA	RPTA	RPTA	RPTA & PC	NTC	NTC	RPTA	RPTA	RPTA	Prov Council	Prov Council	Prov Council	Prov Council	Prov Council	Prov Council	Prov Council	RPTA	RPTA	RPTA	RPTA		RPTA & LA		RDA & NPL
	Bus stop/shelter (Class A & B roads)	NTC, RDA UDA	NTC, RDA UDA	NTC, RDA UDA		NTC, RDA UDA	RPTA	RDA	RDA				RDA	RDA	RDA	RDA	RDA	RPTA	RPTA	RPTA	RPTA	RPTA					RDA & NPL
	Bus stop/shelter (Class C, D & E roads)	RPTA LA	RPTA LA	RPTA LA		RPTA LA	RPTA LA	PRDA & LA	PRDA & LA				RPTA LA	RPTA LA	RPTA LA	RPTA LA	RPTA LA	RPTA	RPTA	RPTA	RPTA	RPTA					PRDA, LA & NPL
Paratransit	Three Wheeler & Taxi	MoPTS	RPTA	RPTA	RPTA	RPTA & LA	RPTA	RPTA	RPTA	RPTA	OPR	OPR								OPR		OPR	OPR	OPR		OPR	RPTA & NPL
	Private coach services (school van, corporate van)	MoPTS	RPTA	RPTA	RPTA	RPTA & LA	RPTA	RPTA	RPTA	RPTA	OPR	OPR								OPR		OPR	OPR	OPR		OPR	RPTA & NPL

Note: LA: local authorities, OPR: operator

Source: CoMTrans Study Team

The complexity of the existing urban transport administration, as illustrated in Table 6.2.2, makes the urban transport administration in CMA inefficient and this makes it difficult to carry out new transport measures and integrated transport policies, such as inter-modal transfer/connection, a common transport pass system and so on. As stated in the National Transport Policy, the efficiency of transport administration lies in how such complexity can be dealt with in a planned manner. In order to ensure the planning function is strengthened and becomes a responsibility of the assigned agencies, the Government indicated in the National Transport Policy that it would establish a coordination mechanism for urban transport through the Presidential Committee for Urban Transport (PCUT), which is in line with the CoMTrans Study Team's recommendation as well. An ideal structure for the urban transport administration in CMA would be to establish an agency that is powerful in policy making, planning, monitoring budget allocation, and implementation of public transport service delivery, but lean in institutional structure, i.e. not creating another mega institution to hire many staff members and to fight over vested interests with existing institutions.

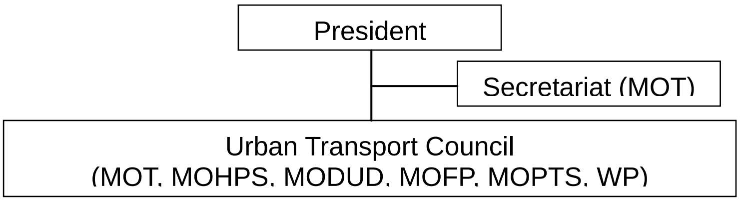
6.2.2 Towards the Realisation of CoMTrans Master Plan

In line with the National Transport Policy, the CoMTrans suggests the establishment of an Urban Transport Council under the President. The council is expected to be a central high-level body that represents all main political decision makers in urban transport, including the Western Provincial Council. The members consist of appropriate ministers and/or deputy ministers from the central government and the chief minister or transport minister of the Western Province Council. The council is to be led by the senior minister in charge for transport in the Administration. The council is set-up for making decisions on urban transport policy and planning in CMA, so it would not replace the existing transport sub-committee under the Cabinet nor the Parliament. The sub-committee for transport under the Cabinet shall be the final resort for the urban transport council, as well, to politically solve transport issues which encompass widespread areas.

(1) Institutional Arrangement

The council must be established as a standing council until its functions are transferred to the envisaged urban transport authority in the future. However, it is not intended to create another institution such as a ministry, department or authority. Therefore, it is suggested to establish a sub-division under the Planning Division of the MOT to support the council as secretariat. The functions of the secretariat are to support all administrative and technical tasks appointed by the council; yet, considering the scarcity of professionals in urban development and transport planning in the government sector, it is suggested that the academia, e.g. University of Moratuwa, provides technical support to the secretariat. Since the council consists of higher-level members, establishment of a technical committee or technical task force shall be taken into account once the council is formally established. The functions of the technical committee, among others, are to update the transport data collected for the CoMTrans master plan, and to formulate roll-over transport annual action plans, to monitor the progress of the master plan, and to provide technical inputs to the council.

It should be underlined that the council, the secretariat in the MOT and the technical committee must be legally supported as formal bodies, i.e. being established under a presidential decree and announced in a Gazette. It should be also noted that the proposed council is not, apparently, a monolithic bureaucracy which consolidates all present departments and agencies, but it is an efficient strategic policy setting body that coordinates and governs all the components of urban transport. It is also not a funding agency, but one of its duties is to make funding decisions under the framework of given functions of the council to support and recommend budget allocations to MOFP, which allocate budget directly to agencies based on its decisive criteria. The council is envisaged to be responsible for every facet of urban mobility including private modes and public transport and will also have some influential role in city development planning in close cooperation with NPPD (National Physical Planning Department), UDA, the Western Provincial Council and local authorities.



Source: CoMTrans Study Team

Figure 6.2.1 Urban Transport Council

(2) Legalising the CoMTrans Master Plan

Unless the CoMTrans master plan becomes a legally binding master plan, there would be no base for the newly established urban transport council to implement the plan, taking into account that respective ministries and local government must already have their own plans to develop roads, public transport service delivery and so on.

Considering that the anticipated members of the council will be almost the same as the members of the steering committee of the CoMTrans master plan project, it is expected that first the CoMTrans master plan would be agreed among the steering committee members and the MOT submit it as a legally binding master plan to the Administration to be endorsed. It is crucial that the short-term projects shall be jointly scrutinised with the National Planning Department of the MOFP, in terms of feasibility of budget allocations for forthcoming project proposals.

(3) Risks for the realisation of CoMTrans Master Plan

In the past, similar recommendations were made in several studies; yet, no coordination body was established. As stated in previous sections, several issues have hindered the realisation of the recommended measures, i.e. lack of continual political willingness and adverse political interventions, unclear delineation of functional responsibilities among transport related institutions, lack of coordination mechanisms, absence of legal basis for the master plan and absence of legal basis for the implementing institutions.

The biggest issue encountered for the realisation of the master plan is the unpredictable political influence and wandering political directions, which are hard to control or prevent. However, once the master plan becomes a legally binding document, it will be at least a roadmap for urban transport development in CMA. The previous JICA study team failed to make its master plan a legally binding plan, so it had weakness in the implementation stage; so it is strongly suggested that the steering committee agree upon the CoMTrans master plan and make it a legally binding plan within the project period. Once the master plan is endorsed by all stakeholders, the council can be established and functional responsibilities between the council and related line ministries, agencies and local authorities become crystal clear since the proposed projects and implementing agencies are indicated in the master plan.

CHAPTER 7 Conclusions and Recommendations for Materialisation of CoMTrans Urban Transport Master Plan

7.1 Conclusions

Economic development has accelerated after the end of the civic conflict and travel demand has also increased rapidly. Colombo is the centre of economic activity in Sri Lanka thus the increase in traffic demand has been remarkable. In the Colombo Metropolitan Area, 6.9 million trips are made each day at present and it is estimated to grow to 12.2 million trips in 2035. It goes without saying that a mass transit system is needed to meet the increasing travel demand. In the CoMTrans master plan it is recommended to develop a monorail system together with a Multi-modal Transport Hub, Multi Modal Centre and Park & Ride systems. It is desirable to develop a rail-based transport system, which is not disturbed by ordinary road traffic. The rail-based transport system, however, requires a considerable amount of investment for development. Consequently, it usually takes a long time to develop the extensive network for a rail-based transport system.

On the other hand, at present buses run at low speeds because buses are caught in the general traffic congestion on the roads, thus punctuality of operation is not ensured. A large number of residents now try to avoid using buses because of the low level of bus services such as over-crowding, lack of punctuality and lack of comfort. Therefore, a higher level of public transport service should be urgently provided to prevent the shift from public to private modes of transport. Furthermore, having merely one route of rail-based transport system is not sufficient to attract people to public transport use but an extensive network should be formulated like a web to cover the major travel destinations in the metropolitan area. Improvement of transport nodes such as station plazas could make it easy and convenient to use public transport systems.

It should also be noted that the ability to pay for transport of the majority of the residents is low and therefore it is difficult to set public transport fares high enough to enable the private sector to provide a high level of public transport services.

In the short term and intermediate term, the public transport network should be formulated by combining the existing Sri Lanka railway which needs upgrading and a monorail system and BRT system. In the long run, a rail-based transport system is needed to provide a higher level of services as well as a higher passenger capacity. The development of a BRT system ensures the space for future rail-based transport system development with a higher level of services.

Improvement of public transport services alone cannot suppress the deeply rooted preference to use private modes of transport; consequently, traffic restraint schemes should be employed in the central area of CMA where traffic congestion is often observed.

Another important measure is to develop sub-centres in suburban areas and to distribute the urban functions, which are currently concentrated in CMC. By creating an alternative urban structure, traffic congestion problems would be alleviated to some extent.

Although promotion of public transport is the most important policy to alleviate the transport problems in the master plan, the road network has not been well developed and the capacity is significantly low in suburban areas. In particular, the progress of road network development has not caught up with the expansion of urbanised areas, therefore, road network development is also important in suburban areas.

Transport infrastructure development requires a long period in order to be realised, thus in order to deal with the current transport problems, immediate actions are necessary. The short-term countermeasures include the installation of area-wide traffic signal systems and the improvement of present signal control. Traffic control such as one way systems is also taken into account for the alleviation of traffic congestion in specific areas.

7.2 Recommended Immediate Actions

(1) Legal Framework for Transport Network Development

The target year of the urban transport master plan is 2035, which is 21 years from now. Developing transport infrastructure needs a long time. Once the urban transport master plan is agreed among the relevant stakeholders, it should be authorised and have legal binding for future development. This implies that the Right of Way (ROW) should be reserved for future development of transport facilities - railway and road networks. If urban development such as commercial building and residential complex developments are allowed in the areas set aside for the planned transport network, it would become difficult to develop the transport network in a desirable form. Therefore it is proposed to establish a legal framework for setting aside a space for future transport system development.

(2) Enhancement of Urban Land Use Regulations

CoMTrans emphasises the importance of integration between land use and the transport systems, thus Transit Oriented Development (TOD) is recommended in this regard. It needs high density urban development in the areas surrounding railway stations and important public transport hubs. Urban land use regulations which designate a type of land use and floor area ratio is needed for guiding land use to a desired pattern. In Sri Lanka, however, the floor area ratio has not been determined for every plot and no limitation on floor area is given to a block exceeding a certain size of plot area. Without limitation of the floor area ratio it is difficult to guide land use in the area surrounding the railway stations into high density, for instance high rise office buildings and apartments. Urban land use plans with guidance for the floor are ratio should be prepared for materialising TOD, otherwise it will be difficult to promote. If such regulations cannot be established, it would lead to failure in TOD and also it would worsen the traffic congestion.

(3) Post Evaluation of Projects in the Urban Transport Master Plan

It is definitely important to conduct a post evaluation to understand the performance of the relevant agencies. If some projects are delayed in implementation, it requires exploring the reasons why the projects have not been executed as scheduled. If the projects have been implemented, the impacts of the projects on transport as well as economic activities should be examined carefully. It should be then fed back to the next stage and the plan should be modified and improved into a more efficient and convenient system. The circumstances surrounding the urban transport will change over time and the initial plan would not be suitable for a new situation. The urban transport master plan, which is prepared for the long period of 20 years, should be regarded as a rolling plan. It should be reviewed regularly and updated to fit in the new circumstances. A Plan-Do-Check-Action (PDCA) cycle should be applied for master plan implementation and monitoring.

(4) Development of Urban Transport Database System

The CoMTrans Study conducted the first large-scale Person Trip Survey in Sri Lanka and other relevant transport surveys. The data collected gives base data not only for transport planning but also for urban planning. In line with the master plan review and updating mentioned above, this database is useful for post evaluation of the master plan. The database should be updated and modified periodically for review and updating the master plan. Since the database covers a broad range of fields; demography, land use, economic activities, industry, and transport, the establishment of an urban transport database centre is desirable for maintenance of the database. The database centre could be established in the Ministry of Transport or a University. In addition, it is necessary to build the capacity of the transport planning experts who can undertake a transport analysis and plan using this database.

(5) Further Investigation on Traffic Safety

Thanks to the accident data provided by the police, an extensive traffic accident database is available and it was analysed in the Study. Further detailed analysis on Black Spots is proposed to identify the places where traffic accidents frequently occur. The analysis will lead to the identification of causes of accidents and required countermeasures.

(6) Promotion of Health in the Transport Sector

Developing of a pedestrian path network and bicycle road network, which connects major parks in the urbanised areas is proposed in the master plan. Construction of these facilities encourages walking, jogging and cycling by the citizens in the metropolitan area. These kinds of facilities contribute to green transport which aims at healthy and environmentally friendly transport.

(7) Bus Operation Reform

Bus operation can be made more efficient and systematic without a huge investment. Currently real-time monitoring of bus operation can be achieved with a GPS device. Fare collection with an IC card through a communication device is available now. The technical solutions are available for the difficulties in monitoring and management of bus operation. Now is a good opportunity to reform bus operation to provide better service for passengers. Installation of a GPS device on the buses enables bus fleet tracking on a real time basis, and then the management of bus companies can control their buses on the roads. Moreover, the introduction of the IC ticket system makes it possible to provide a subsidy for private bus companies, if the government would like to provide subsidy for private companies, since the exact number of discount tickets can be counted.

(8) Feasibility Study for Project Implementation

A number of transport infrastructure development projects as well as soft measures have been proposed in the CoMTrans master plan. Although Monorail and MmTH projects are now under a feasibility study, the feasibility studies on the other projects are also important for alleviation of traffic congestion and the promotion of public transport. This includes BRT system development for developing an extensive quality public transport network integrated with the monorail and employment of ERP for demand management. It is recommended to conduct these feasibility studies at the earliest possible time.

CoMTrans Proposed Project Profiles

CoMTrans PROPOSED PROJECT PROFILE

Proposed projects are described in project profiles below;

	Project ID	Project Name	Type
1	RL-M1	Modernisation of Coast Line (Colombo Fort - Kalutara South)	Rail-based Transport
2	RL-M2	Modernisation of Main Line (Colombo Fort - Veyangoda)	Rail-based Transport
3	RL-M3	Modernisation of Puttaram Line (Ragama - Negombo)	Rail-based Transport
4	RL-M5	Modernisation of Main Line (Colombo Fort - Maradana)	Rail-based Transport
5	RL-NR1	Airport Connection (Katunayake South - Airport Terminal)	Rail-based Transport
6	RL-NR2	Dompe Line (Kelaniya - Dompe)	Rail-based Transport
7	RL-NT1	Monorail [Phase 1]	Rail-based Transport
8	RL-NT2,3	Monorail [Phase 2]	Rail-based Transport
9	RL-NT4	Monorail [High Level Road Line]	Rail-based Transport
10	RL-NT5	Monorail [Connecting Line with Monorail (High Level Road Line)	Rail-based Transport
11	BT-01	Bus Rapid Transit (BRT)	Bus
12	MM-1~5	Multi-modal Transport Hub (MmTH), Multi-modal Centre (MMC), and Park & Ride (P&R)	Rail-based Transport/ Urban Planning
13	RD-RN2	Securing Space for Future Development of BRT / Development of Middle Ring Road for BRT Corridor	Road
14	RD-RN3	Provision of Alternate Road for Introducing BRT / Baseline Road Extension	Road
15	RD-RN4	Provision of Alternate Road for Introducing BRT / Extension of Marine Drive	Road
16	RD-RN5	Enhancement of Traffic Distribution Function of Road Network / Development of Western Ring Road	Road
17	RD-RN6	Enhancement of Traffic Distribution Function of Road Network / Development of Eastern Ring Road	Road
18	RD-EX1	Construction of New Urban Expressway / Connection Between the SEW and the CKE	Road
19	RD-EX3	Construction of New Urban Expressway / Connection Between New Urban Expressway (RD-EX1) and Port Area	Road
20	RD-EX4	Construction of New Urban Expressway / Connection Between New Urban Expressway (RD-EX3) and New Fort Station	Road
21	RD-FO	Fly-over Installation	Road
22	TM-S1,S2,S3	Traffic Signal Control Improvement	Traffic Management
23	TM-TI1	Traffic Information System	Traffic Management
24	TM-BL1,BL2	Bus Priority System + Bus Location System for BRT	Traffic Management
25	TM-BL3	Bus Location System for Public/Private Buses	Traffic Management
26	TM-P1	Parking Information System	Traffic Management
27	TM-ERP	ERP System	Traffic Management
28	RS-1	Education for Road Safety / Tight Control of Driver's Licence	Traffic Safety
29	RS-2	Installation or Improvement of Pedestrian Crossing and Sidewalk	Traffic Safety
30	RS-3	Enforcement of Safety Measures on 7 Corridors to Reduce Traffic Accidents	Traffic Safety
31	EN-01	Air Emission Standard for Vehicles	Environment
32	EN-02	Vehicles Inspection and Maintenance Programmes	Environment
33	EN-03	Low Sulphur Diesel Programmes	Environment
34	EN-04	Promotion of Natural Gas Vehicles	Environment
35	EN-05	Promotion of Hybrid Cars and Electric Vehicles	Environment
36	EN-06	Promotion of Walking and Bicycles	Environment

CoMTrans PROPOSED PROJECT PROFILE

Project ID Code

RL-M1

Project Name

Modernisation of Coast Line

Transport Sub Sector

☑ Railway and New Transit
☐ Bus Transport
☐ Road
☐ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding

Urban Transport Policy:

☑ Promotion of Public Transport
☐ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location

Colombo Fort - Kalutara South (42.5km)

Project Priority

☑ Short-term
☑ Medium-term
☑ Long-term

Implementation Period

Total 10 years

1. Objectives of Project

- To increase the capacity for railway passenger transport with short interval frequency of train service
- To improve safety and level of service for railway passenger such as speed and riding feeling

2. Expected Benefits

- Increase of railway transport capacity to meet future passenger demand
- Improvement of level of service for railway passenger
- Savings in travel time

3. Project Description

- Replacing signalling system (new interlocking and train protection systems) [Short Term]
- Electrification (double track) [Medium-Term]
- Procurement of new train sets [Medium-Term]
- Construction of third line [Long-Term]
- Improvement of track layout [Medium-Term]

4. Linkages with Other Projects/Sectors

- Monorail system with the connection at Kollupitiya, Fort/Pettah Multi-modal Transport Hub (MmTH)
- BRT and bus at Multi-modal Centre (MMC) at Moratuwa

5. Important Assumptions (Conditions for the Project)

6. Implementing Agency

Sri Lanka Railways

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

Sri Lanka Railways

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 596.6 Million
Recurrent O & M: US$ 11.9 M/year

10. Special Considerations

Since the CTC with Relay Interlocking and Bi-directional Automatic Block Signalling on double lines was installed in 1962, replacing of the signalling system is an emergency issue.

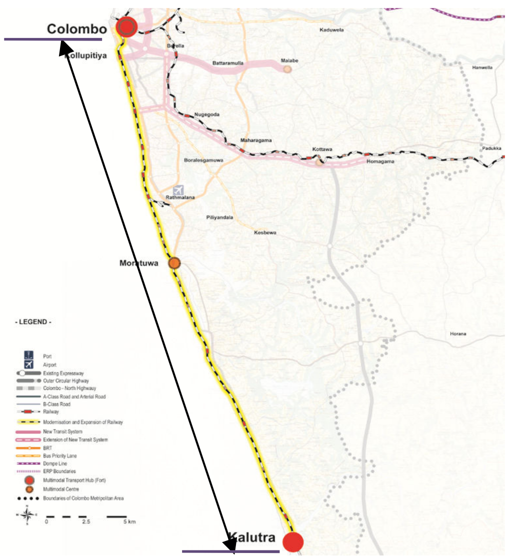
11. Environmental Impact

1) Social Environment
- Land Acquisition: Not major required
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code

RL-M2

Project Name

Modernisation of Main Line

Transport Sub Sector

☑ Railway and New Transit
☐ Bus Transport
☐ Road
☐ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding

Urban Transport Policy:

☑ Promotion of Public Transport
☐ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location

Colombo Fort – Veyangoda (37.6km)

Project Priority

☑ Short-term
☑ Medium-term
☐ Long-term

Implementation Period

Total 10 years

1. Objectives of Project

- To increase the capacity for railway passenger transport with short interval frequency of train service
- To improve safety and level of service for railway passenger such as speed and riding feeling

2. Expected Benefits

- Increase of railway transport capacity to meet future passenger demand
- Improvement of level of service for railway passenger
- Savings in travel time

3. Project Description

- Replacing signalling system (new interlocking and train protection systems) [Short-term]
- Upgrade existing track (double track) [Short-term]
- Electrification (double track) [Medium-term]
- Procurement of new train sets [Medium-term]

4. Linkages with Other Projects/Sectors

- Monorail system around Kelaniya station and at the Fort/Pettah Multi-modal Transport Hub (MmTH)
- BRT and bus at Multi-modal Centre (MMC) at Kelaniya

5. Important Assumptions (Conditions for the Project)

- Collaborating with the track layout improvement between Colombo Fort and Ragama [RL-M5]

6. Implementing Agency

Sri Lanka Railways, financed by Chinese Government

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

Sri Lanka Railways

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost:	US$ 730.6 Million
Recurrent O & M:	US$ 14.6 M/year

10. Special Considerations

Since the CTC with Relay Interlocking and Bi-directional Automatic Block Signalling on double lines was installed in 1962, replacing of the signalling system is an emergency issue.

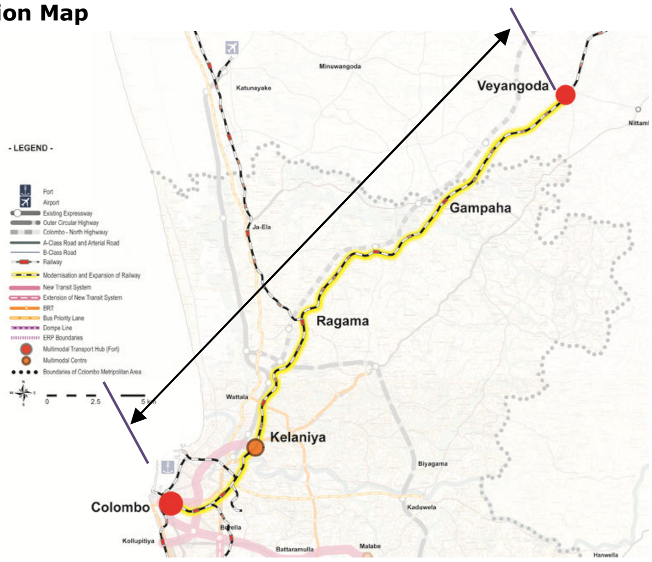
11. Environmental Impact

1) Social Environment
- Land Acquisition: Not major required
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	Project Name	Transport Sub Sector
RL-M3	Modernisation of Puttalam Line	☑ Railway and New Transit ☐ Bus Transport ☐ Road ☐ Traffic Management ☐ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:

☑ Promotion of Public Transport
☐ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location	Project Priority	Implementation Period
Ragama – Negombo (23.3km)	☐ Short-term ☑ Medium-term ☐ Long-term	Total 5 years

1. Objectives of Project
- To increase the capacity for railway passenger transport with short interval frequency of train service
- To improve safety and level of service for railway passenger such as speed and riding feeling

2. Expected Benefits
- Increase of railway transport capacity to meet future passenger demand
- Improvement of level of service for railway passenger
- Savings in travel time

3. Project Description
- Replacing signalling system (new interlocking and train protection systems)
- Electrification (double track)
- Track Layout improvement
- Procurement of new trains

4. Linkages with Other Projects/Sectors
- Bus terminal development at Multi-modal station/centre

5. Important Assumptions (Conditions for the Project)
- Completion of electrification between Fort and Ragama

6. Implementing Agency
Sri Lanka Railways

7. Financing Scheme
☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)
Sri Lanka Railways

9. Project Cost (in 2013 Constant Price)
Initial Investment Cost: US$ 375.1 Million
Recurrent O & M: US$ 7.5 M/year

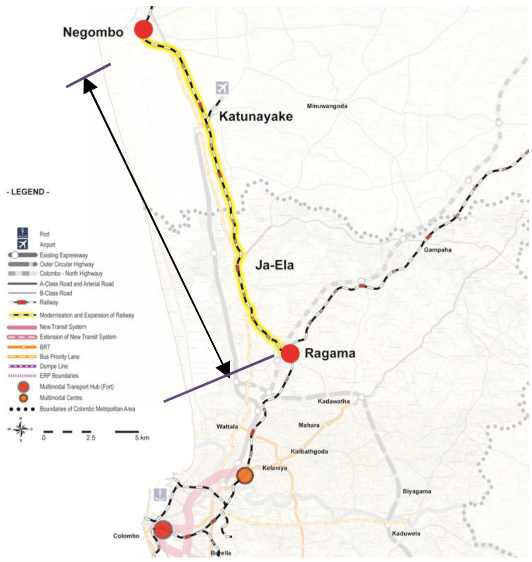
10. Special Considerations
Since the CTC with Relay Interlocking and Bi-directional Automatic Block Signalling on double lines was installed in 1962, replacing of the signalling system is an emergency issue.

11. Environmental Impact
1) Social Environment
- Land Acquisition: Not major required
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code
RL-M5

Project Name
Modernisation of Main Line (Track Layout Improvement)

Transport Sub Sector
☑ Railway and New Transit
☐ Bus Transport
☐ Road
☐ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding

Urban Transport Policy:
☑ Promotion of Public Transport
☐ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location
Colombo Fort – Maradana (4.0km)

Project Priority
☑ Short-term
☐ Medium-term
☐ Long-term

Implementation Period
Total 5 years

1. Objectives of Project
- To increase frequency for railway operation on the most congested section by improving track layout to ensure proper management together with many railway lines on this section

2. Expected Benefits
- Increase railway transport capacity to meet future passenger demand
- Savings in travel time for railway passenger
- Savings in train accidents in this section

3. Project Description
- Track Layout improvement (Colombo Fort - Maradana)
- Construction of a viaduct (double track) for the Main line route as an priority line with electrification and improved signalling system
- Remodelling of station (Fort and Maradana)

4. Linkages with Other Projects/Sectors
- Fort/Pettah Multi-modal Transport Hub (MmTH), which connects with Monorail, BRT and Bus

5. Important Assumptions (Conditions for the Project)
- Collaboration with Electrification and improved signalling system for Main Line [RL-M2]

6. Implementing Agency
Sri Lanka Railways

7. Financing Scheme
☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)
Sri Lanka Railways

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost:	US$ 90.3 Million
Recurrent O & M:	US$ 0.5 M/year

10. Special Considerations
- Since this is the most congested section in Sri Lanka Railways, track layout improvement and installation of viaduct for the priority routes of the Main line are an emergency issue.

11. Environmental Impact
1) Social Environment
- Land Acquisition: Not major required
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map

CoMTrans PROPOSED PROJECT PROFILE

Project ID Code

RL-NR1

Project Name

Airport Connection

Transport Sub Sector

- ☑ Railway and New Transit
- ☐ Bus Transport
- ☐ Road
- ☐ Traffic Management
- ☐ Traffic Safety
- ☐ Environment
- ☐ Urban Planning
- ☐ Institution/Funding

Urban Transport Policy:

- ☑ Promotion of Public Transport
- ☐ Alleviation of Traffic Congestion
- ☐ Reduction of Pollution
- ☐ Reduction of Traffic Accident
- ☐ Promotion of Health

Project Location

Katunayaka South - Airport Terminal (2.2km)

Project Priority

- ☐ Short-term
- ☑ Medium-term
- ☐ Long-term

Implementation Period

Total 3 years

1. Objectives of Project

- To provide direct train operation as an airport access railway service to/from the Fort station to the Airport terminal

2. Expected Benefits

- Promotion of railway service for airport users
- Savings in travel time from the Fort area to the airport

3. Project Description

- Construction of track works (single track)
- Construction of new station at the airport terminal
- Electrification
- Installation of signalling system and communication system

4. Linkages with Other Projects/Sectors

- Bus service for direct airport access

5. Important Assumptions (Conditions for the Project)

Completion of electrification for Main and Puttalam Lines

6. Implementing Agency

Sri Lanka Railways

7. Financing Scheme

- ☑ Public Sector
- ☐ Public Private Partnership
- ☐ Private Sector Initiative

8. Expected Operator (if any)

Sri Lanka Railways

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost:	US$ 25.0 Million
Recurrent O & M:	US$ 0.5 M/year

10. Special Considerations

Currently, public transport service to access the airport from the central part of Colombo is limited to bus. Direct railway access will be realised if only a 2km section will be constructed with proper management of direct operation.

11. Environmental Impact

1) Social Environment
- Land Acquisition: Not major Required
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map

CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	Project Name	Transport Sub Sector
RL-NR2	Dompe Line	☑ Railway and New Transit ☐ Bus Transport ☐ Road ☐ Traffic Management ☐ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:

- ☑ Promotion of Public Transport
- ☐ Alleviation of Traffic Congestion
- ☑ Reduction of Pollution
- ☐ Reduction of Traffic Accident
- ☐ Promotion of Health

Project Location	Project Priority	Implementation Period
Kelaniya - Dompe (22.8km) Alawathupitiya (Stabling Yard)	☐ Short-term ☐ Medium-term ☑ Long-term	Total 5 years

1. Objectives of Project

- To provide railway services mainly for cargo from the oil refinery and dry-port (EPZ) to Colombo port and to connect to Main Line, it will be utilize for passenger transport in future.

2. Expected Benefits

- Reduction of GHGs by modal shift of cargo transport from truck and container trailer
- Savings in travel time costs and hauling costs for cargo

3. Project Description

- Construction of track works (double track)
- Installation of signalling system and communication system and stabling yard at Alawathupitiya

4. Linkages with Other Projects/Sectors

- Monorail system and Multi-modal centre (MMC) at Kelaniya with BRT and Bus services

5. Important Assumptions (Conditions for the Project)

Non electrification

6. Implementing Agency

Sri Lanka Railways

7. Financing Scheme

- ☐ Public Sector
- ☑ Public Private Partnership
- ☐ Private Sector Initiative

8. Expected Operator (if any)

Sri Lanka Railways or Private

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost:	US$ 377.8 Million
Recurrent O & M:	US$ 12.0 M/year

10. Special Considerations

There is the Sapugaskanda oil refinery and several planed dry-port (EPZs). Therefore, railway connection to the Colombo Port area realises cost effective and environmentally friendly solution.

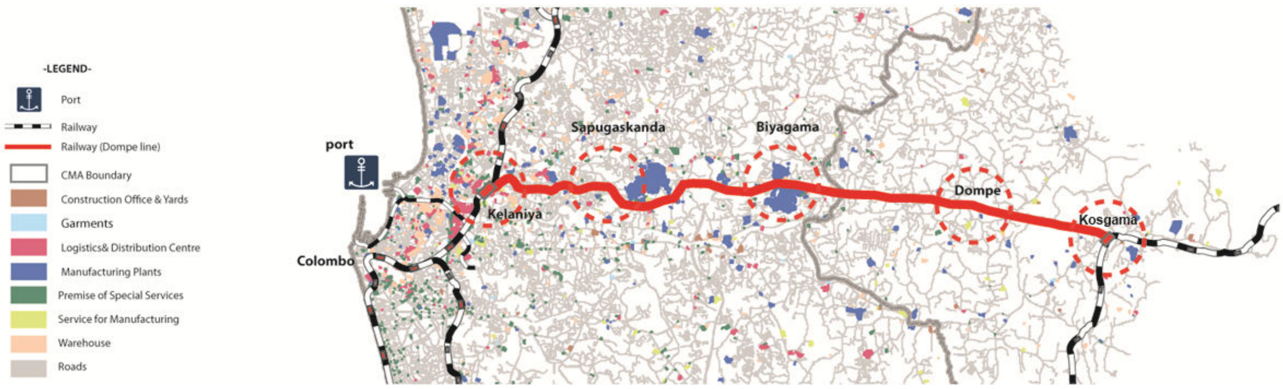
11. Environmental Impact

1) Social Environment
- Land Acquisition: Further investigation is required.
- Resettlement :B or C
- Other Social Impact: B or C

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	Project Name	Transport Sub Sector
RL-NT1	Monorail [Phase 1]	☑ Railway and New Transit ☐ Bus Transport ☐ Road ☐ Traffic Management ☐ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:

☑ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☑ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location	Project Priority	Implementation Period
Malabe-Fort – Kotahena (Route 1), Kolluptiya – Town Hall (Route 2) (Total Length: 23 km)	☑ Short-term ☐ Medium-term ☐ Long-term	More than 6 years

1. Objectives of Project

- To provide a new transit system in the high population density area to alleviate vehicle based transport congestion, as well as in low public transport service area.

2. Expected Benefits

- Reduction of GHGs by modal shift from vehicle based passenger transport and alleviation of vehicle traffic congestion
- Savings in travel time costs

3. Project Description

- Construction of monorail track (simple elevated beam), elevated stations with civil works
- Installation of electrical and mechanical system
- Construction of train depot
- Preparation of rolling stock (train sets)

4. Linkages with Other Projects/Sectors

- Sri Lanka Railways (Main Line, Coast Line)
- Fort/Pettah Malti-modal Transport Hub (MmTH)
- Multi-modal Centre (MMC) with BRT and Bus at Malabe
- Park and Ride (P&R) facilities
- ERP (Electric Road Pricing) system

5. Important Assumptions (Conditions for the Project)

6. Implementing Agency
Ministry of Transport

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)
To be discussed

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 1,321.5 Million
Recurrent O & M: US$ 50.7 M/year

10. Special Considerations

- Several urban developments and road projects shall be coordinated/ accommodated.

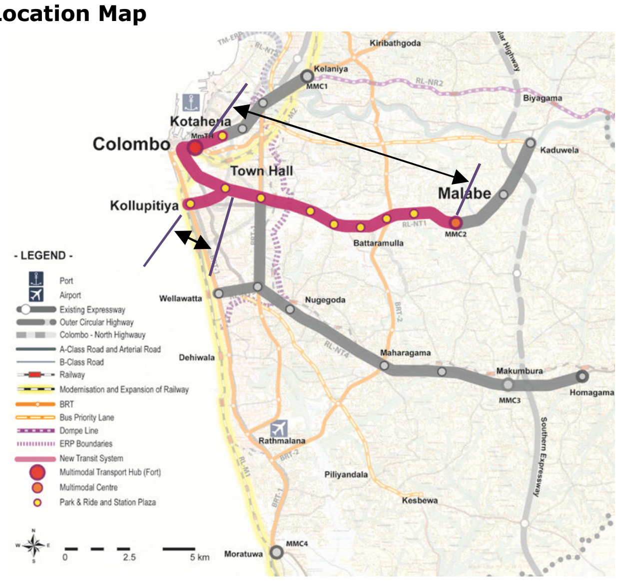
11. Environmental Impact

1) Social Environment
- Land Acquisition: Minimum land acquisition required at some stations (Further study will be conducted under CoMTrans)
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	Project Name
RL-NT2,3	Monorail [Phase 2]

Transport Sub Sector

☑ Railway and New Transit
☐ Bus Transport
☐ Road
☐ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding

Urban Transport Policy:

☑ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☑ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location

Mattakkuliya - Kelaniya

Malabe-Kaduwela

(Total Length: 11.9 km)

Project Priority

☐ Short-term
☑ Medium-term
☑ Long-term

Implementation Period

Total 6 years

1. Objectives of Project

- To provide new transit system extended from phase 1 network to connect with Kelaniya Multi-modal Centre (MMC) in order to alleviate vehicle based transport congestion, as well as in a low public transport service area.

2. Expected Benefits

- Reduction of GHGs by modal shift from vehicle based passenger transport and alleviation of vehicle traffic congestion
- Savings in travel time costs

3. Project Description

- Construction of monorail track (simple elevated beam), elevated stations with civil works
- Installation of electrical and mechanical system
- Preparation of rolling stock (train sets)

4. Linkages with Other Projects/Sectors

- Sri Lanka Railways (Main Line)
- Multi-modal Centre (MMC) with BRT and Bus at Kelaniya
- Park and Ride (P&R) facilities
- ERP (Electric Road Pricing) system

5. Important Assumptions (Conditions for the Project)

6. Implementing Agency

Ministry of Transport

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

To be discussed

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost:	US$ 882.6 Million
Recurrent O & M:	US$ 34.1 M/year

10. Special Considerations

- Additional land acquisition is required if road widening project is not executed by RDA and CMC.

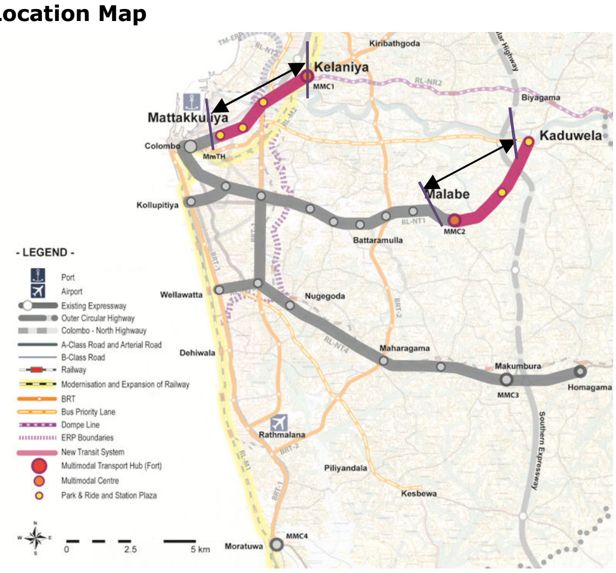
11. Environmental Impact

1) Social Environment
- Land Acquisition: Further investigation is required.
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	Project Name	Transport Sub Sector
RL-NT4	Monorail [High Level Road Line]	☑ Railway and New Transit ☐ Bus Transport ☐ Road ☐ Traffic Management ☐ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:

☑ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☑ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location	Project Priority	Implementation Period
Borella - Homagama (Total Length: 19.7 km)	☐ Short-term ☐ Medium-term ☑ Long-term	Total 6 years

1. Objectives of Project

- To provide a new transit system extended from phase 1 network toward High Level Road, where the large numbers of trips are generated to CMC.

2. Expected Benefits

- Reduction of GHGs by modal shift from vehicle based passenger transport and alleviation of vehicle traffic congestion
- Savings in travel time costs

3. Project Description

- Construction of monorail track (simple elevated beam), elevated stations with civil works
- Installation of electrical and mechanical system
- Preparation of rolling stock (train sets)

4. Linkages with Other Projects/Sectors

- Sri Lanka Railways (KV Line)
- Multi-modal Centre (MMC) with BRT and Bus
- Park and Ride (P&R) facilities
- ERP (Electric Road Pricing) system

5. Important Assumptions (Conditions for the Project)

Completion of monorail project of Phase 1

6. Implementing Agency

Ministry of Transport

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

To be discussed

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost:	US$ 731.1 Million
Recurrent O & M:	US$ 14.4 M/year

10. Special Considerations

- Detailed alignment of monorail network shall be accommodated with future road widening/ construction projects.

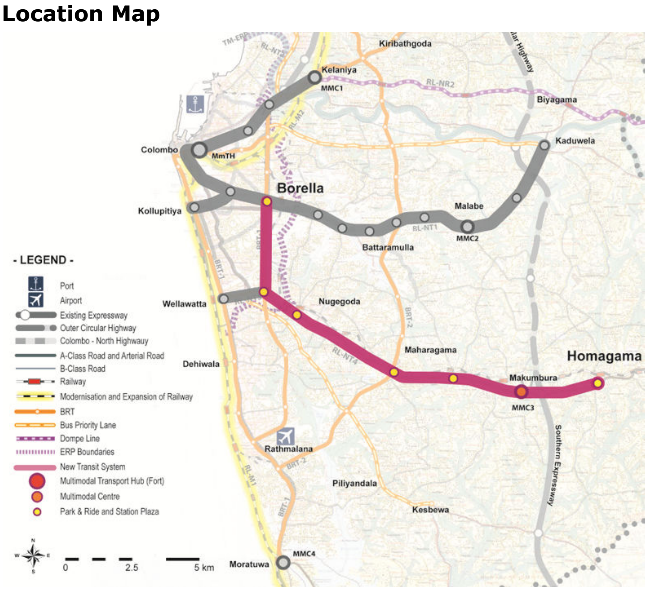
11. Environmental Impact

1) Social Environment
- Land Acquisition: Further investigation is required. Basically minimum land acquisition is required if monorail is constructed on existing road, only required around several station area
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code

RL-NT5

Project Name

Monorail
[Connection with Monorail (High Level Road Line) and Railway (Coast Line)]

Transport Sub Sector

☑ Railway and New Transit
☐ Bus Transport
☐ Road
☐ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding

Urban Transport Policy:

☑ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☑ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location

Siebel - Wellawatta

(Total Length: 3.4 km)

Project Priority

☐ Short-term
☐ Medium-term
☑ Long-term

Implementation Period

Total 6 years

1. Objectives of Project

- To provide a new transit system extended from phase 2 network toward Wellawatta station on Coast Line, which forms enriched and flexible public transport network for promoting public transport users.

2. Expected Benefits

- Reduction of GHGs by a modal shift from vehicle based passenger transport and alleviation of vehicle traffic congestion
- Savings in travel time costs

3. Project Description

- Construction of monorail track (simple elevated beam), elevated stations with civil works
- Installation of electrical and mechanical system
- Preparation of rolling stock (train sets)

4. Linkages with Other Projects/Sectors

- Sri Lanka Railways (Coast Line)
- ERP (Electric Road Pricing) system

5. Important Assumptions (Conditions for the Project)

Completion of monorail project of High Level Road Line

6. Implementing Agency

Ministry of Transport

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

To be discussed

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost:	US$ 169.2 Million
Recurrent O & M:	US$ 3.6 M/year

10. Special Considerations

- Detailed alignment of monorail network and location of stations shall be accommodated with future road widening/ construction projects and railway project on coast line.

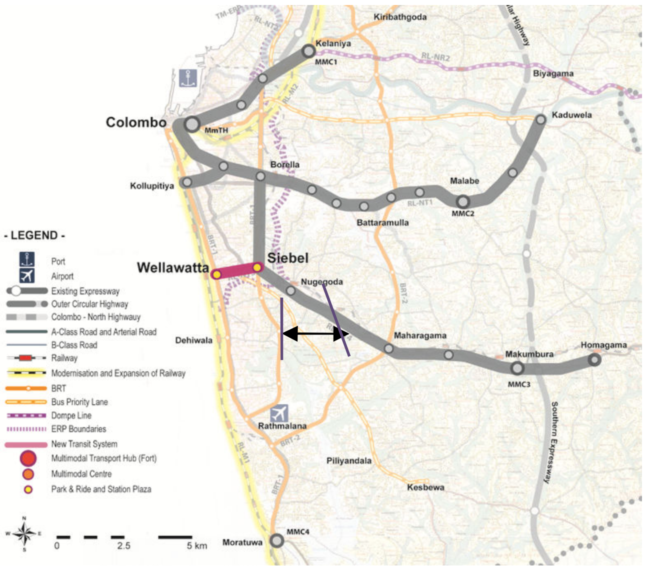
11. Environmental Impact

1) Social Environment
- Land Acquisition: Further investigation is required.
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	Project Name	Transport Sub Sector
BT-01	Bus Rapid Transit (BRT)	☐ Railway and New Transit ☑ Bus Transport ☐ Road ☐ Traffic Management ☐ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:
- ☑ Promotion of Public Transport
- ☐ Alleviation of Traffic Congestion
- ☐ Reduction of Pollution
- ☐ Reduction of Traffic Accident
- ☐ Promotion of Health

Project Location	Project Priority	Implementation Period
Route-1: MmTH-MoratuwaMMC4 Route-2A: KelaniyaMMC1-MmTH-KelaniyaMMC1 Route-2B: KelaniyaMMC1-Kadawatha Route-3: KelaniyaMMC1-MoratuwaMMC4 Route-4: Wattala-Battaramulla-MoratuwaMMC4 (Total length: 135.8 km)	☑ Short-term ☑ Medium-term ☐ Long-term	Total 2 to 3 years for each route

1. Objectives of Project
- To promote the utilisation of public transport by improving the operation speed and quality of bus service

2. Expected Benefits
- Increase of passenger transport capacity for bus services
- Reduction of GHG emission compared ordinary bus
- Savings in Travel Time Costs

3. Project Description
- Installation of exclusive bus-way with bus priority signals
- Installation of bus fleet which has capacity to meet the demand (articulated vehicles)
- Construction of BRT shelters with level boarding platform and with safe access from footpath to ensure the safety and convenience of passengers
- Electronic ticket system will be implemented for smooth boarding and alighting
- Bus location information will be collected by on-board GPS devices, sent to the control centre and used for the operation system and for passenger information boards

4. Linkages with Other Projects/Sectors
- Multi Modal Centre (MMC) at Moratuwa, Kelaniya
- Fort/Pettah Multi-modal Transport Hub (MmTH)
- Sri Lanka Railways
- Monorail
- Ordinary Bus

5. Important Assumptions (Conditions for the Project)
Wide width multiple road lanes is required to install additional dedicated BRT lane. Traffic management at junction and BRT station should be carefully designed for ensuring safety and sufficient of traffic capacity.

6. Implementing Agency
- Ministry of Transport
- Road Development Authority
- Colombo Municipal Council

7. Financing Scheme
- ☑ Public Sector
- ☑ Public Private Partnership
- ☐ Private Sector Initiative

8. Expected Operator (if any)
Both public and private could be operated. Detailed should be discussed and determined.

9. Project Cost (in 2013 Constant Price)
Initial Investment Cost: US$ 165.0 Million
(phase1: US$ 93.9 Million, phase2: US$ 71.0 Million)
Recurrent O & M: US$ 21.5 M/year
(phase1: US$ 13.1 Million, phase2: US$ 8.4 Million)

10. Special Considerations
- Since the traffic congestion is getting severe in the CMC area, promotion of the utilisation of public transport is an important task.
- While BRT can transport a comparatively large volume passengers with low construction cost, it could be an option to achieve the task.
- The public transport network will be improved efficiently, by installing BRT and connecting it with the other public transport modes.

CoMTrans PROPOSED PROJECT PROFILE

11. Environmental Impact

1) Social Environment

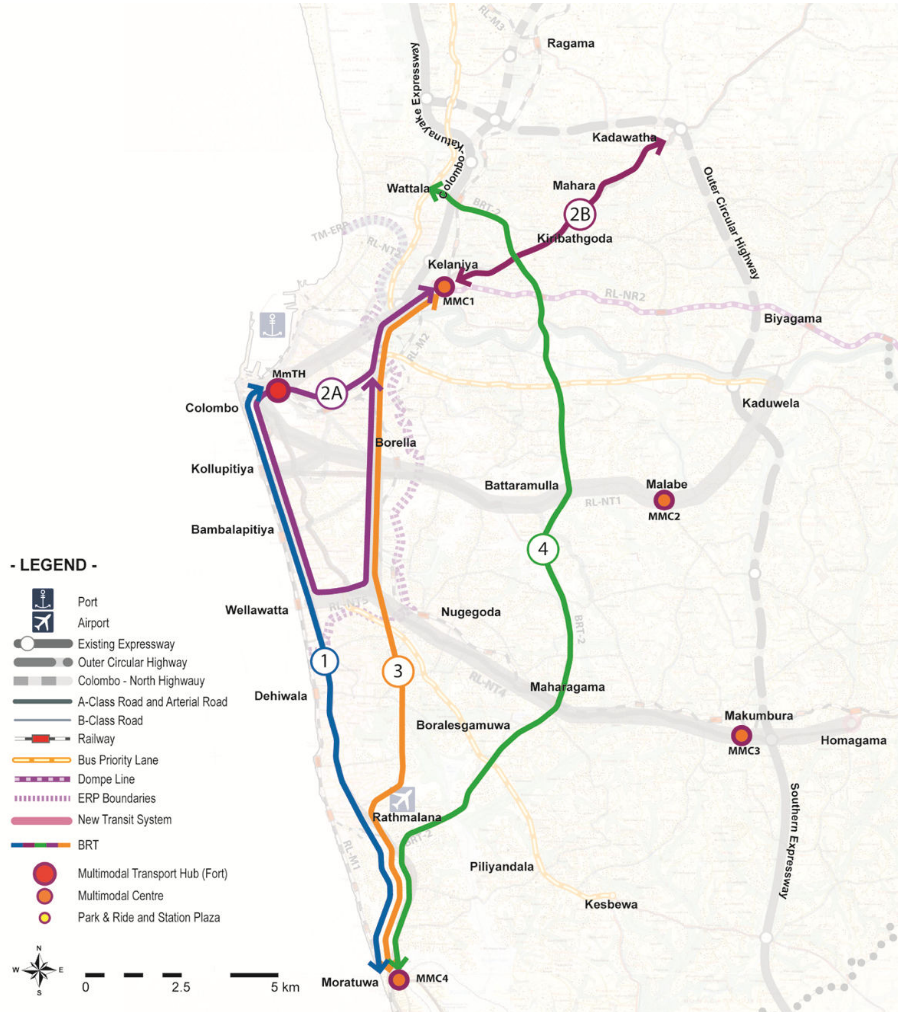
- Land Acquisition: Further detailed investigation is required, especially in bus station areas.
- Resettlement :B
- Other Social Impact: B

2) Natural Environment

- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



Project ID Code	**Project Name**	**Transport Sub Sector**
MM-1~5	Multi-modal Transport Hub (MMTH), Multi-modal Centre (MMC), and Park & Ride (P&R)	☑ Railway and New Transit ☐ Bus Transport ☐ Road ☐ Traffic Management ☐ Traffic Safety ☐ Environment ☑ Urban Planning ☐ Institution/Funding

Urban Transport Policy:

☑ Promotion of Public Transport
☐ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location	**Project Priority**	**Implementation Period**
MmTH: Fort/Pettah MMC: Kelaniya, Malabe, Moratuwa P&R: Several stations on the Monorail network	☑ Short-term ☐ Medium-term ☐ Long-term	Total 5 years

CoMTrans PROPOSED PROJECT PROFILE

1. Objectives of Project	**2. Expected Benefits**
- To promote the utilisation of public transport by improving the function of transport nodes	- Providing user-friendly public transport services to smooth mode transfer - Creating opportunities for commercial and attractive urban centre facilities as transport node with different transport mode. - Promoting a modal shift from private to public at P&R facilities
3. Project Description	**4. Linkages with Other Projects/Sectors**
- MmTH at Fort/Pettah: providing smooth/safety/comfort transport hub for passenger transfers between Monorail, Railway, BRT and ordinary bus, together with commercial facilities. - MMCs: Kelaniya and Malabe MMC is the terminal station of monorail line which connects the monorail and its feeder. Moratuwa is the multi-modal transfer points with railway, BRT and feeder bus services. - P&Rs: providing at major monorail stations in suburban areas to let commuters transfer from private vehicles to public transport	- Sri Lanka Railways - BRT and Ordinary Bus - Monorail - ERP (Electric Road Pricing) system for encouraging P&R - Urban planning and development around these transport facilities - Commercial developments (Kiosk, Shopping centre, restaurants and office/hotel buildings) especially at MmTH
5. Important Assumptions (Conditions for the Project)	**6. Implementing Agency**
Land preparation for MmTH is essential, because the relocation plan of the Manning market and other shops are still under enforcement. Institutional coordination is required.	- Ministry of Transport together with following institutions; - Road Development Authority - Colombo Municipal Council and Local Authorities - Sri Lanka Railways - SLTB, WP-RPTA, NTC
7. Financing Scheme	**8. Expected Operator (if any)**
☑ Public Sector ☑ Public Private Partnership ☐ Private Sector Initiative	To be determined (for bus terminal operation, terminal facility operation and commercial area operation)
9. Project Cost (in 2013 Constant Price)	**10. Special Considerations**
Initial Investment Cost: US$ 195.7 Million Recurrent O & M: US$ 5.8 M/year	- Since the traffic congestion is getting severe in the CMC area, promotion of the utilisation of public transport is an important task. - To promote the utilisation of public transport, convenient transfer between other transport modes is a key factor. - With the installation of MMTH, MMC and P&R facilities, the connectivity between each transport mode will be substantially improved. - By consolidating the transfer function, passengers can save their transfer time

11. Environmental Impact

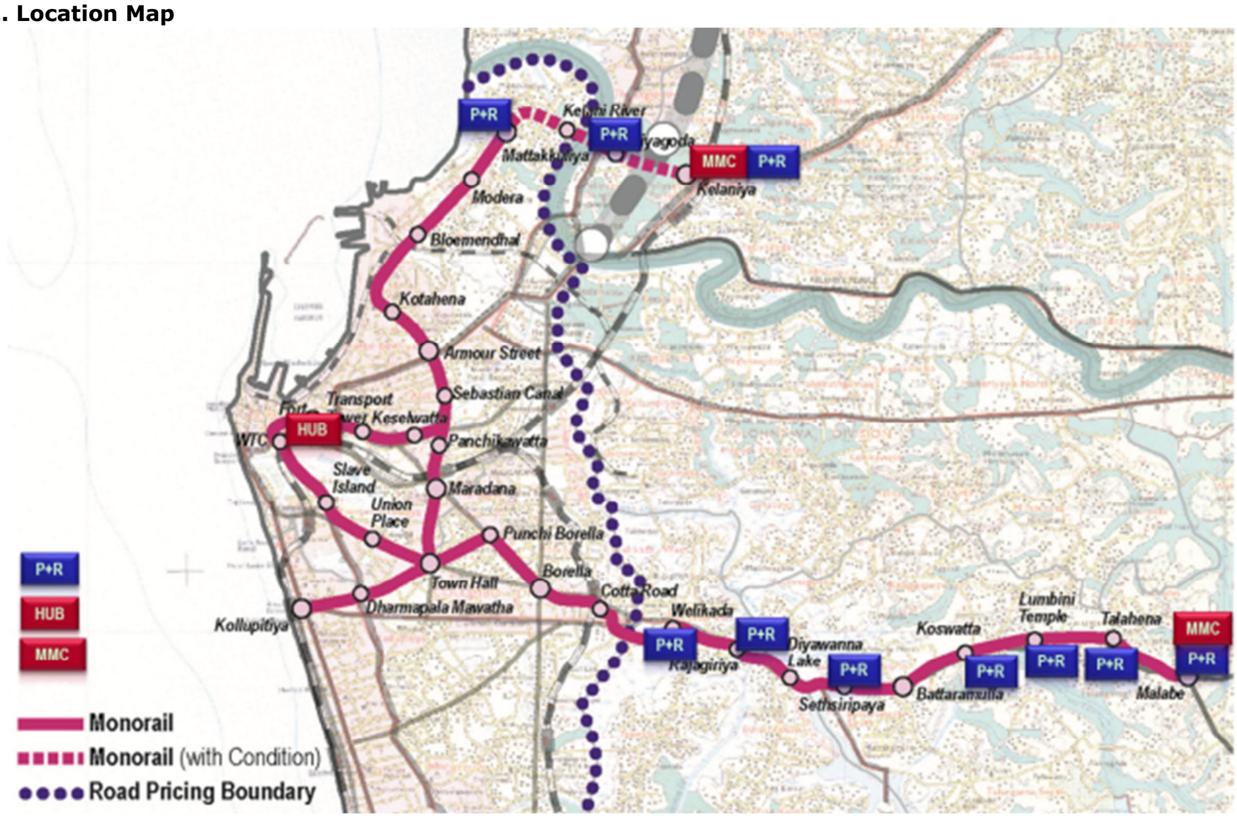
1) Social Environment
- Land Acquisition:
Further investigation is required
- Resettlement :
B or C, depend on the progress of the relocation plan for Manning market. In addition, further investigation is required for existing shops the area of MmTH. For MMC and P&R, further on-site investigation is required.
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

CoMTrans PROPOSED PROJECT PROFILE

12. Location Map



MMC at Moratuwa is also the candidate for mode transfer with Railway, BRT, feeder bus services.

CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	**Project Name**	**Transport Sub Sector**
RD-RN2	Securing Space for Future Development of BRT / Development of Middle Ring Road for BRT Corridor	☐ Railway and New Transit ☐ Bus Transport ☑ Road ☐ Traffic Management ☐ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:

☑ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location	**Project Priority**	**Implementation Period**
Middle Ring Roads, which will serve future BRT system through between Wattala, Kelaniya, Battaramulla, Maharagama and Rathamalana	☐ Short-term ☑ Medium-term ☐ Long-term	Total 5 years

1. Objectives of Project
- To secure space for the future development of BRT
- To encourage activities among sub-centres
- To provide alternative routes for distributing traffic volume

2. Expected Benefits
- For BRT users: savings in travel time costs and
- Alleviation of traffic congestion
- Increase of economic activities among sub-centre

3. Project Description
- Widening of existing road for securing the space for a dedicated lane for BRT
- Total length: 30.2km, Number of lanes: six
- Improvement of intersections

4. Linkages with Other Projects/Sectors
- BRT system on middle ring road

5. Important Assumptions (Conditions for the Project)
Large land acquisition (370,000 m^2) and resettlement are required.

6. Implementing Agency
- Road Development Authority

7. Financing Scheme
☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)
- Road Development Authority (for Road Maintenance)
- To be determined for BRT operation

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost:	US$ 267.5 Million
Recurrent O & M:	US$ 5.3 M/year

10. Special Considerations
Traffic volumes of existing arterial roads are almost at capacity at several points during the peak hours, the shortage of alternative routes for through traffic in CMC area is an emergency issue, an arterial ring road with the space for installation of BRT in the future as an alternative route is required.

Sub-centre development encourages the economic activities and reduces certain level of traffic volume to enter CMC.

11. Environmental Impact

1) Social Environment
- Land Acquisition:
  Approx. 370,000 m^2 of land acquisition is estimated.
- Resettlement :
  B or C, further detailed investigation is required.
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

CoMTrans PROPOSED PROJECT PROFILE

12. Location Map

CoMTrans PROPOSED PROJECT PROFILE

Project ID Code

RD-RN3

Project Name

Provision of Alternative Road for Introducing BRT / Baseline Road Extension

Transport Sub Sector

- ☐ Railway and New Transit
- ☐ Bus Transport
- ☑ Road
- ☐ Traffic Management
- ☐ Traffic Safety
- ☐ Environment
- ☐ Urban Planning
- ☐ Institution/Funding

Urban Transport Policy:

- ☑ Promotion of Public Transport
- ☑ Alleviation of Traffic Congestion
- ☐ Reduction of Pollution
- ☐ Reduction of Traffic Accident
- ☐ Promotion of Health

Project Location

Baseline Road (proposed extended section), which will serve future BRT system through between Pamankada junction and Rathmalana

Project Priority

- ☐ Short-term
- ☑ Medium-term
- ☐ Long-term

Implementation Period

Total 5 years

1. Objectives of Project

- To secure space for the future development of BRT
- To encourage activities among sub-centres
- To provide alternative routes for distributing traffic volume

2. Expected Benefits

- For BRT users: savings in travel time costs and
- Alleviation of traffic congestion
- Increase of economic activities among sub-centre

3. Project Description

- Extension of Baseline Road from B84 to A2 road
- Total length: 6.2km, Number of lanes: six
- Improvement of intersections

4. Linkages with Other Projects/Sectors

- BRT system

5. Important Assumptions (Conditions for the Project)

Large land acquisition (116,000 m^2) and resettlement are required.

6. Implementing Agency

- Road Development Authority

7. Financing Scheme

- ☑ Public Sector
- ☐ Public Private Partnership
- ☐ Private Sector Initiative

8. Expected Operator (if any)

- Road Development Authority (for Road Maintenance)
- To be determined for BRT operation

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 67.9 Million

Recurrent O & M: US$ 1.3 M/year

10. Special Considerations

Traffic volumes of existing arterial roads are almost at capacity at several points during the peak hours, the shortage of alternative routes for through traffic among Horana road, Galle road and northern areas of CMC is an emergency issue, the extension of Baseline Road is required as an alternative route.

11. Environmental Impact

1) Social Environment

- Land Acquisition: Approx. 116,000 m2 of land acquisition is estimated.
- Resettlement : B or C, further detailed investigation is required.
- Other Social Impact: B

2) Natural Environment

- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

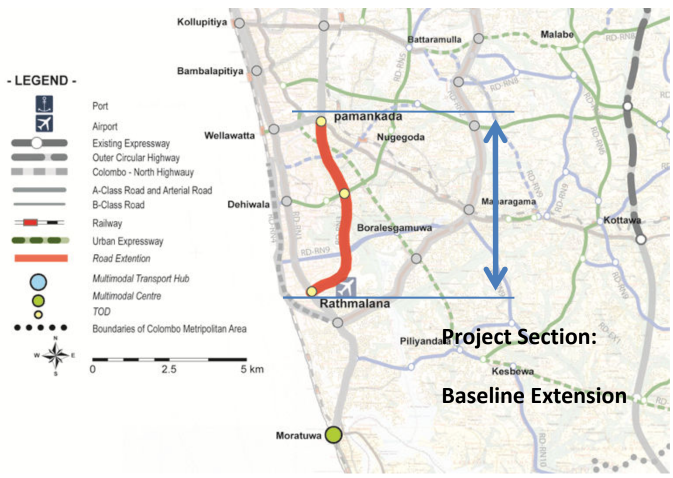
[Legend]:

A: No Impact

B: Moderate Impact

C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code

RD-RN4

Project Name

Provision of Alternative Road for introducing BRT / Extension of Marine Drive

Transport Sub Sector

☐ Railway and New Transit
☐ Bus Transport
☑ Road
☐ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding

Urban Transport Policy:

☑ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location

Proposed extended section of Marine Drive Road between Dehiwala to Rathmalana

Project Priority

☐ Short-term
☑ Medium-term
☐ Long-term

Implementation Period

Total 5 years

1. Objectives of Project

- To secure the road traffic capacity at Galle corridor section for the instalment of a future BRT system on Galle corridor
- To provide alternative routes for distributing traffic volume

2. Expected Benefits

- For BRT users on Galle corridor: savings in travel time costs and
- Alleviation of traffic congestion

3. Project Description

- Extension of Marine Drive Road from Dehiwala Railway Station to Rathmalana East
- Total length: 5.3km, Number of lanes: two
- Elevated structure on the railway ROW

4. Linkages with Other Projects/Sectors

- BRT system on Galle Corridor

5. Important Assumptions (Conditions for the Project)

Land acquisition (64,000 m^2) and limited resettlement are required due to utilization of the space above railway line.

6. Implementing Agency

- Road Development Authority

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

- Road Development Authority (for Road Maintenance)
- To be determined for BRT operation

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 210.9 Million
Recurrent O & M: US$ 4.2 M/year

10. Special Considerations

Traffic volumes of existing arterial roads are almost at their capacities, the shortage of alternative routes for through traffic between the southern area of CMC and the Port area is an emergency issue, the extension of Marine Drive is required as an alternative route.

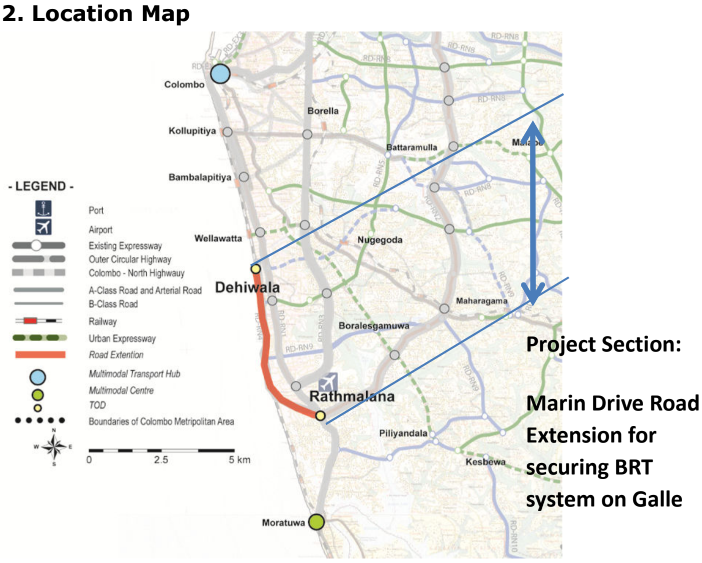
11. Environmental Impact

1) Social Environment
- Land Acquisition: Approx. 64,000 m^2 of land acquisition is estimated.
- Resettlement : B or C, further detailed investigation is required.
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	**Project Name**
RD-RN5	Enhancement of Traffic Distribution Function of Road Network / Development of Western Ring Road

Transport Sub Sector

☐ Railway and New Transit
☐ Bus Transport
☑ Road
☐ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding

Urban Transport Policy:

☐ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location

Piliyagoda – Rajagiriya - Dehiwala

Project Priority

☑ Short-term
☐ Medium-term
☐ Long-term

Implementation Period

Total 5 years

1. Objectives of Project

- To distribute traffic volume for mitigation of the existing traffic congestion in CMC and improve the accessibility between the suburbs around CMC.

2. Expected Benefits

- Savings in Travel Time Costs
- Alleviation of Traffic Congestion

3. Project Description

- Widening of existing road
- Total length: 22.8km, Number of lanes: 4 or 2
- Construction of connecting roads
- Improvement of intersections

4. Linkages with Other Projects/Sectors

- TOD developments

5. Important Assumptions (Conditions for the Project)

Large land acquisition (254,000 m^2) and resettlement are required.

6. Implementing Agency

- Road Development Authority

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost:	US$ 140.4 Million
Recurrent O & M:	US$ 2.8 M/year

10. Special Considerations

Traffic volumes of existing arterial roads are almost at capacity at several points during the peak hours, the shortage of alternative routes around the CMC boundary for through traffic in CMC area is an emergency issue, an arterial ring road as an alternative route is required.

11. Environmental Impact

1) Social Environment
- Land Acquisition: Approx. 254,000 m^2 of land acquisition is estimated.
- Resettlement: B or C, further detailed investigation is required.
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map

CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	Project Name	Transport Sub Sector
RD-RN6	Enhancement of Traffic Distribution Function of Road Network / Development of Eastern Ring Road	☐ Railway and New Transit ☐ Bus Transport ☑ Road ☐ Traffic Management ☐ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:

☐ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location	Project Priority	Implementation Period
Hendala - Hunupitiya – Warakanatta - Sapugaskanda – Bollegala – Malabe – Pannipitiya – Piliyandala - Moratuwa	☐ Short-term ☑ Medium-term ☐ Long-term	Total 5 years

1. Objectives of Project

- To distribute traffic volume for the mitigation of the existing traffic congestion in CMC and improve the accessibility between the suburbs around OCH.

2. Expected Benefits

- Savings in Travel Time Costs
- Alleviation of Traffic Congestion

3. Project Description

- Widening of existing road
- Total length: 50.6km, Number of lanes: 4 or 2
- Construction of connecting roads between major arterial roads and the suburbs around OCH
- Improvement of intersections

4. Linkages with Other Projects/Sectors

- TOD developments

5. Important Assumptions (Conditions for the Project)

Large land acquisition (725,000 m^2) and resettlement are required.

6. Implementing Agency

- Road Development Authority

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 421.6 Million
Recurrent O & M: US$ 8.4 M/year

10. Special Considerations

Traffic volumes of existing arterial roads are almost at capacity at several points during the peak hours, the shortage of alternative routes in a north-south direction for through traffic between the CMC boundary and the OCH is an emergency issue, an arterial ring road as an alternative route is required.

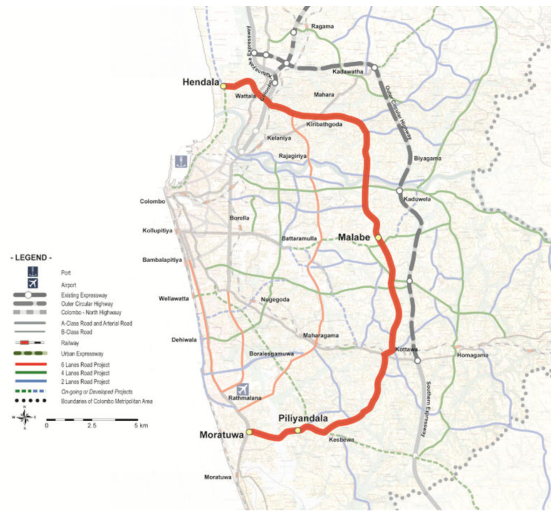
11. Environmental Impact

1) Social Environment
- Land Acquisition: Approx. 254,000 m^2 of land acquisition is estimated.
- Resettlement: B or C, further detailed investigation is required.
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code

RD-EX1

Project Name

Construction of New Urban Expressway / Connection Between the SEW and the CKE

Transport Sub Sector

☐ Railway and New Transit
☐ Bus Transport
☑ Road
☐ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding

Urban Transport Policy:

☐ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location

Orugodawatta – Borella – Nugegoda – Boralesgamuwa - Kathathuduwa

Project Priority

☐ Short-term
☑ Medium-term
☐ Long-term

Implementation Period

Total 5 years

1. Objectives of Project

- To form an urban expressway network connected with south side (Southern Expressway) and CMC central area with a high capacity expressway network.

2. Expected Benefits

- Savings in Travel Time Costs
- Alleviation of Traffic Congestion due to long distance trips

3. Project Description

- Connection between the SEW and the CKE as an urban expressway (Elevated, dedicated road)
- Total length: 25.5km, Number of lanes: 4
- 4 interchanges with on/off ramp

4. Linkages with Other Projects/Sectors

- Southern Expressway
- New Kelani bridge – Kelanitissa JCT
- Port Access Road

5. Important Assumptions (Conditions for the Project)

Large land acquisition (391,000 m^2) and resettlement are required, even the alignment is planned on paddy field.

6. Implementing Agency

- Road Development Authority

7. Financing Scheme

☑ Public Sector
☑ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

- To be discussed, Private operator is possible

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 1,051.9 Million
Recurrent O & M: US$ ______ M/year

10. Special Considerations

- In order to improve the low accessibility between the northern and southern areas of CMC and expressways, additional lines are required as urban expressways to use the existing expressways effectively.

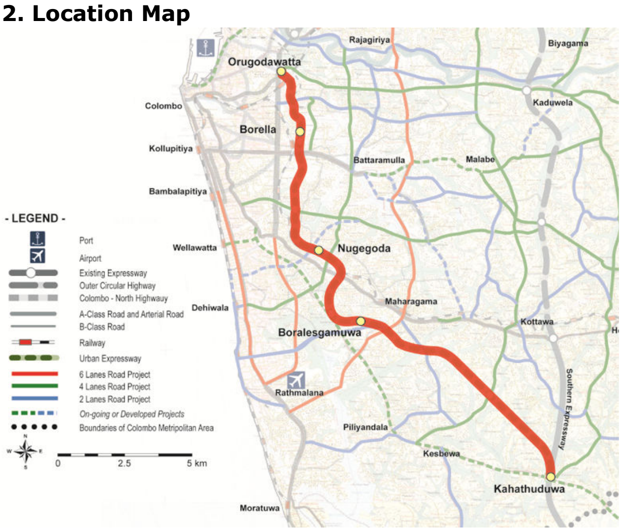
11. Environmental Impact

1) Social Environment
- Land Acquisition: Approx. 391,000 m^2 of land acquisition is estimated.
- Resettlement: B or C, further detailed investigation is required.
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	Project Name	Transport Sub Sector
RD-EX3	Construction of New Urban Expressway / Connection Between New Urban Expressway (RD-EX1) and Port Area	☐ Railway and New Transit ☐ Bus Transport ☑ Road ☐ Traffic Management ☐ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:

☐ Promotion of Public Transport ☑ Alleviation of Traffic Congestion
☐ Reduction of Pollution ☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location	Project Priority	Implementation Period
Colombo Port – Port Access Road	☑ Short-term ☐ Medium-term ☐ Long-term	Total 5 years

1. Objectives of Project
- To form an urban expressway network with a connection from the Colombo Port area to CKE and other expressways via RD-EX1.
- To provide heavy truck and container trailer dedicated route on an elevated road.

2. Expected Benefits
- Savings in Travel Time Costs
- Alleviation of Traffic Congestion
- Reducing number of heavy trucks and container trailers on an urban area
- Direct connection for inter-city bus

3. Project Description
- Connection between port area and the new urban expressway (RD-EX1)
- Total length: 5.0km, Number of lanes: 4
- 1 interchange and 1 junction are planned

4. Linkages with Other Projects/Sectors
- MmTH direct access ramp
- RD-EX1 (Orugodawatta – Kathathuduwa
- New Kelani bridge – Kelanitissa JCT

5. Important Assumptions (Conditions for the Project)
Land acquisition and resettlement can be minimised if the alignment is passed within the premises of port

6. Implementing Agency
- Road Development Authority

7. Financing Scheme
☑ Public Sector
☑ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)
- To be discussed, Private operator is possible

9. Project Cost (in 2013 Constant Price)
Initial Investment Cost: US$ 139.0 Million
Recurrent O & M: US$ _____ M/year

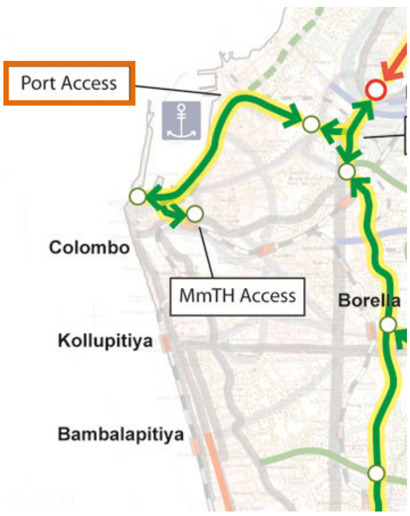
10. Special Considerations
Installation of custom clearance area within port side.

11. Environmental Impact
1) Social Environment
- Land Acquisition: minimum by using the area of port premises.
- Resettlement: B, further investigation is required
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code

RD-EX4

Project Name

Construction of New Urban Expressway /
Connection Between New Urban Expressway (RD-EX3) and New Fort Station

Transport Sub Sector

☐ Railway and New Transit
☐ Bus Transport
☑ Road
☐ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding

Urban Transport Policy:

☑ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location

Port Access Expressway –
MmTH (Multi-modal Transport Hub)

Project Priority

☑ Short-term
☐ Medium-term
☐ Long-term

Implementation Period

Total 3 years

1. Objectives of Project

- To prepare an inter-city bus route from a Multi-modal Transport Hub (MmTH) at Fort station connected to a port access elevated road and further expressway network

2. Expected Benefits

- Savings in Travel Time Costs (Inter-city bus)
- Alleviation of Traffic Congestion due to inter-city bus

3. Project Description

- Direct ramp connection between port area and the new urban expressway (RD-EX3)
- Total length: 0.8km, Number of lanes: 2 for only limited use
- 1 interchange is planned

4. Linkages with Other Projects/Sectors

- Multi-modal Transport Hub (MmTH), especially inter-city bus departure/arrivals

5. Important Assumptions (Conditions for the Project)

Enforcement of restriction for entering the access ramp only for inter-city bus

6. Implementing Agency

- Road Development Authority

7. Financing Scheme

☑ Public Sector
☑ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

- To be discussed, Private operator is possible

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 22.2 Million
Recurrent O & M: US$ ____ M/year

10. Special Considerations

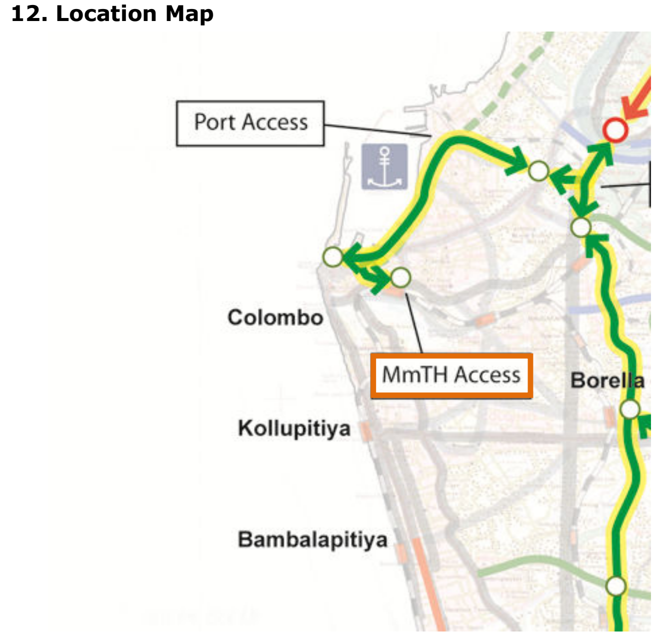
11. Environmental Impact

1) Social Environment
- Land Acquisition: Further investigation is required
- Resettlement: Further investigation is required.
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	Project Name	Transport Sub Sector
RD-FO	Fly-over Installation	☐ Railway and New Transit ☐ Bus Transport ☑ Road ☐ Traffic Management ☐ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:

☐ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location	Project Priority	Implementation Period
Total 25 points Detailed locations are shown in the location map	☑ Short-term ☑ Medium-term ☐ Long-term	2 years/point

1. Objectives of Project
- To increase traffic capacity at intersections with free flow

2. Expected Benefits
- Alleviating traffic congestion at each intersection

3. Project Description
- Installation of Fly-over (25 points)
- Number of lanes: 4 lanes for both directions

4. Linkages with Other Projects/Sectors
- Development of Western Ring Road
- Development of Middle Ring Road for BRT Corridor
- Development of Eastern Ring Road
- Baseline Road Extension

5. Important Assumptions (Conditions for the Project)

The construction period should be determined by monitoring future traffic demand and the progress of road development plans. Coordination with public transport service is also essential.

6. Implementing Agency
- Road Development Authority

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)
- n.a.

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 57,900 Million
Recurrent O & M: US$ 1,150 M/year

10. Special Considerations

Installations of fly-over shall be carried out at the same time that other development plans mentioned above are constructed in the suburban area.

Regarding in the CMC, they shall be determined and carried out considering increasing traffic volumes.

11. Environmental Impact

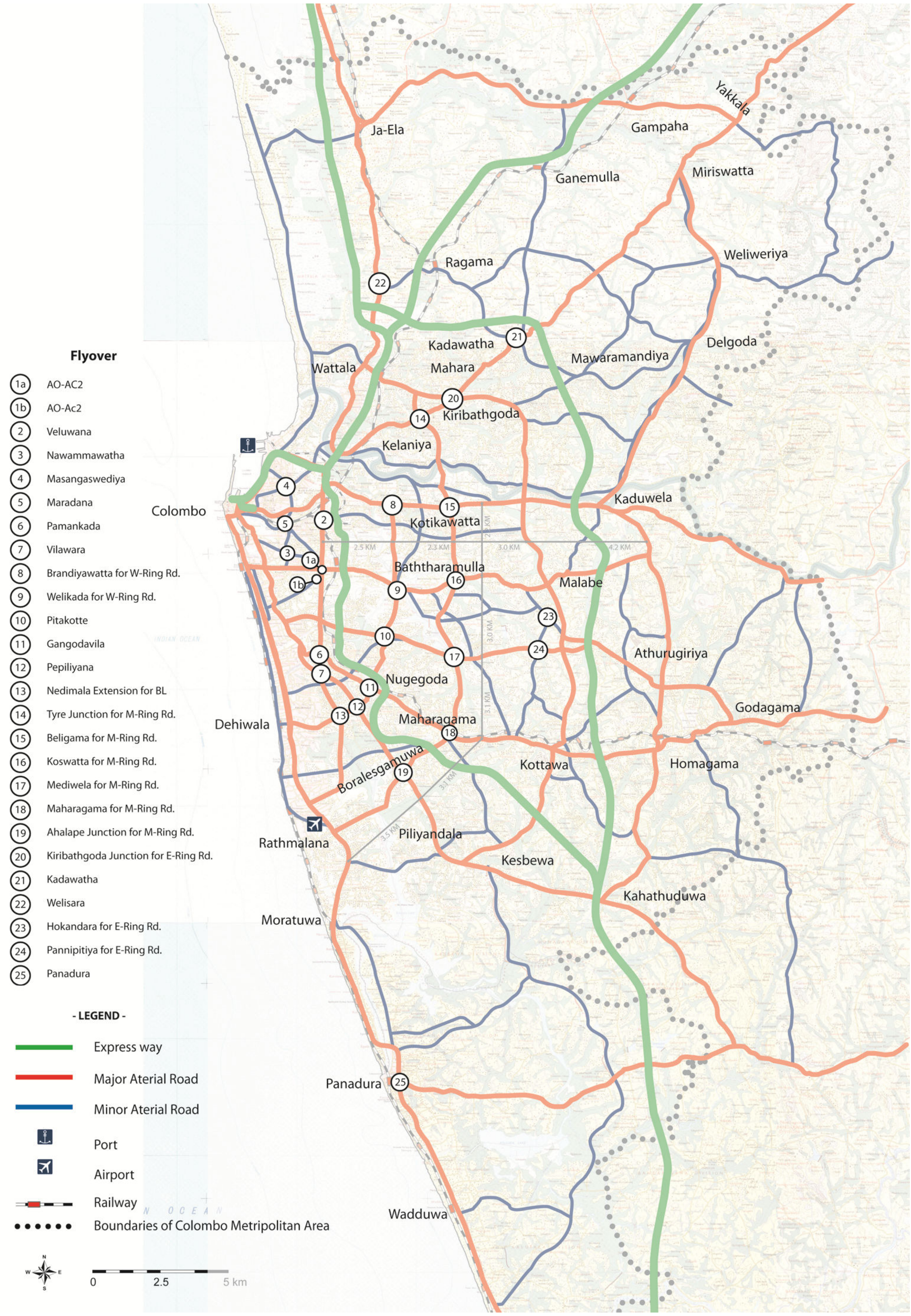
1) Social Environment
- Land Acquisition: 1,400 ~ 4,200 m^2/point
- Resettlement: B or C, further investigation is required.
- Other Social Impact: B

2) Natural Environment
- Air pollution: B
- Noise and vibration: B
- Flooding: B
- Biodiversity: B
- Flora and Fauna: B

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

CoMTrans PROPOSED PROJECT PROFILE

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code

TM-S1~S3

Project Name

Traffic Signal Control Improvement

Transport Sub Sector

☐ Railway and New Transit
☐ Bus Transport
☐ Road
☑ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding

Urban Transport Policy:

☐ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☑ Reduction of Pollution
☐ Reduction of Traffic Accident
☑ Promotion of Health

Project Location

Congestion points in Colombo Metropolitan Area

Project Priority

☑ Short-term
☑ Medium-term
☑ Long-term

Implementation Period

1. Objectives of Project

- To alleviate traffic congestion by optimised traffic signal control with an area-wide signal control system

2. Expected Benefits

- Reducing in traffic congestion by optimised signal control
- Increase in traffic capacity of intersections by signalization at No-signal / Roundabout
- Improvement of the environment (noise, air) by reduction of traffic congestion

3. Project Description

<u>Phase1(S1):14.5 Million USD [Short-term]</u>

- Development of the central control room.
- Improvement of traffic signal control along The Priority Route (Improvement:28 locations, New:25 locations)

<u>Phase2(S2) :27.4 Million USD [Middle-term]</u>

- Improvement of traffic signal control along to The 2nd Priority Route (Improvement:37 locations, New:93 locations)

<u>Other(S3) :32.8 Million USD [Long-term]</u>

- Installation of spot traffic signal control associated with road improvement
- Short term Period:16 locations(3.3 Million USD), Intermediate term Period:43 locations(8.8 Million USD), Long term Period 101 locations(20.7 Million USD)

4. Linkages with Other Projects/Sectors

- Road improvement (Widening, New Construction)

5. Important Assumptions **(Conditions for the Project)**

6. Implementing Agency

- Road Development Authority
- Colombo Municipal Council

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

- Road Development Authority
- Colombo Municipal Council

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 75.0 Million
Recurrent O & M: US$ ____ M/year

10. Special Considerations

CoMTrans PROPOSED PROJECT PROFILE

11. Environmental Impact

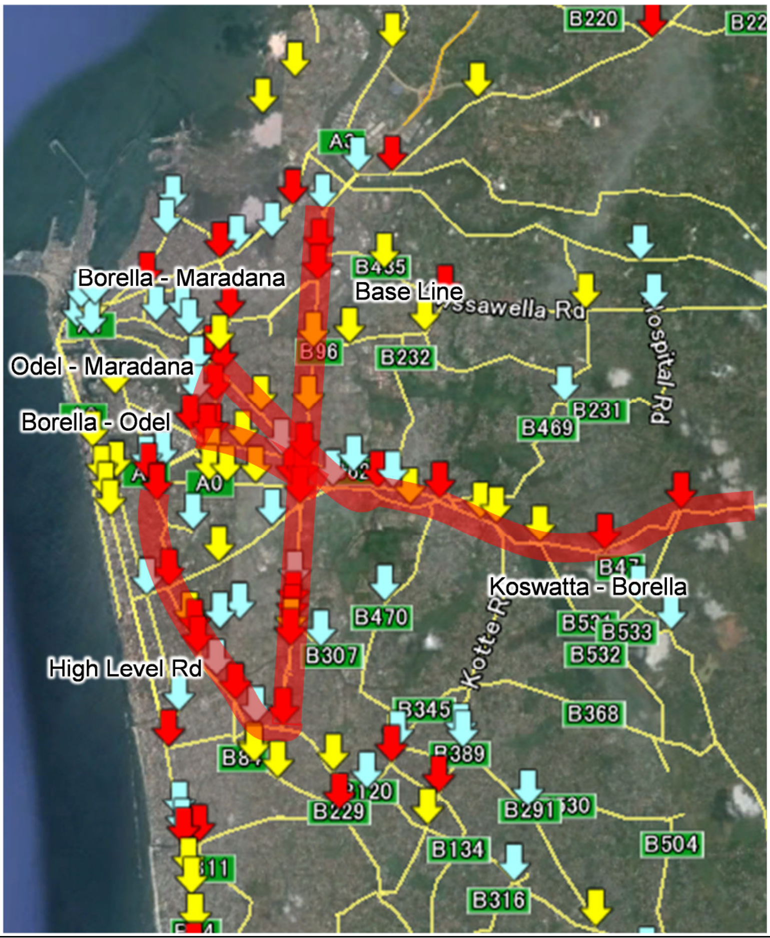
1) Social Environment
- Land Acquisition: not major acquisition
- Resettlement: A
- Other Social Impact: B or C, further investigation is required in case of roundabout with bore tree and religious monuments.

2) Natural Environment
- Air pollution: A
- Noise and vibration: A
- Flooding: B
- Biodiversity: A
- Flora and Fauna: A

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map

The red colour route shows the Priority Routes for improvement of signal control.



CoMTrans PROPOSED PROJECT PROFILE

<table>
<tr><td>Project ID Code

TM-TI1</td><td colspan="3">Project Name

Traffic Information System</td><td rowspan="3">Transport Sub Sector
☐ Railway and New Transit
☐ Bus Transport
☐ Road
☑ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding</td></tr>
<tr><td colspan="4">Urban Transport Policy:
☐ Promotion of Public Transport
☑ Reduction of Pollution
☑ Promotion of Health
☑ Alleviation of Traffic Congestion
☐ Reduction of Traffic Accident</td></tr>
<tr><td colspan="2">Project Location
Colombo Metropolitan Area</td><td>Project Priority
☐ Short-term
☑ Medium-term
☑ Long-term</td><td>Implementation Period</td></tr>
</table>

<table>
<tr><td>1. Objectives of Project
- To maximise the transportation network function by real-time traffic information, road closure information and taffic regulation information.
- To guide the driver to select an appropriate route
- To optimise traffic flow and distribute traffic to alternative routes</td><td>2. Expected Benefits
- Reducing in travel time by selecting the optimal route
- Increase in drivers' understanding where the congested points are and where the accidents occur.</td></tr>
<tr><td>3. Project Description
<u>Collecting Information</u>
- Installation of CCTV cameras to detect the traffic situation, especially for sudden events (congestion, accidents) with image processing program at approx. 200 location
<u>Development of data analysis and equipment to accumulate the data</u>
- Development of system for detecting sudden events
- Development of collection system on accumulated accurate congestion information, road closure information and Traffic regulation information.
<u>Provision of information</u>
- Development of dissemination system through internet/SMS/information board on road for reporting traffic congestion information and guiding the alternative route</td><td>4. Linkages with Other Projects/Sectors
- Current CCTV system
- Flyover projects
- Monorail alignment at intersections
- BRT alignment at intersections
- Elevated expressways
- Road improvements (Widening, Construction)
- Common transport card (IC card) system</td></tr>
<tr><td>5. Important Assumptions (Conditions for the Project)
The current CCTV's optical cable spread by Traffic Police would be utilised for this system.</td><td>6. Implementing Agency
- Road Development Authority
- Colombo Municipal Council</td></tr>
<tr><td>7. Financing Scheme
☑ Public Sector
☑ Public Private Partnership
☐ Private Sector Initiative</td><td>8. Expected Operator (if any)
- Road Development Authority
- Colombo Municipal Council</td></tr>
<tr><td>9. Project Cost (in 2013 Constant Price)
Initial Investment Cost: US$ 33.0 Million
Recurrent O & M: US$ M/year</td><td>10. Special Considerations</td></tr>
</table>

CoMTrans PROPOSED PROJECT PROFILE

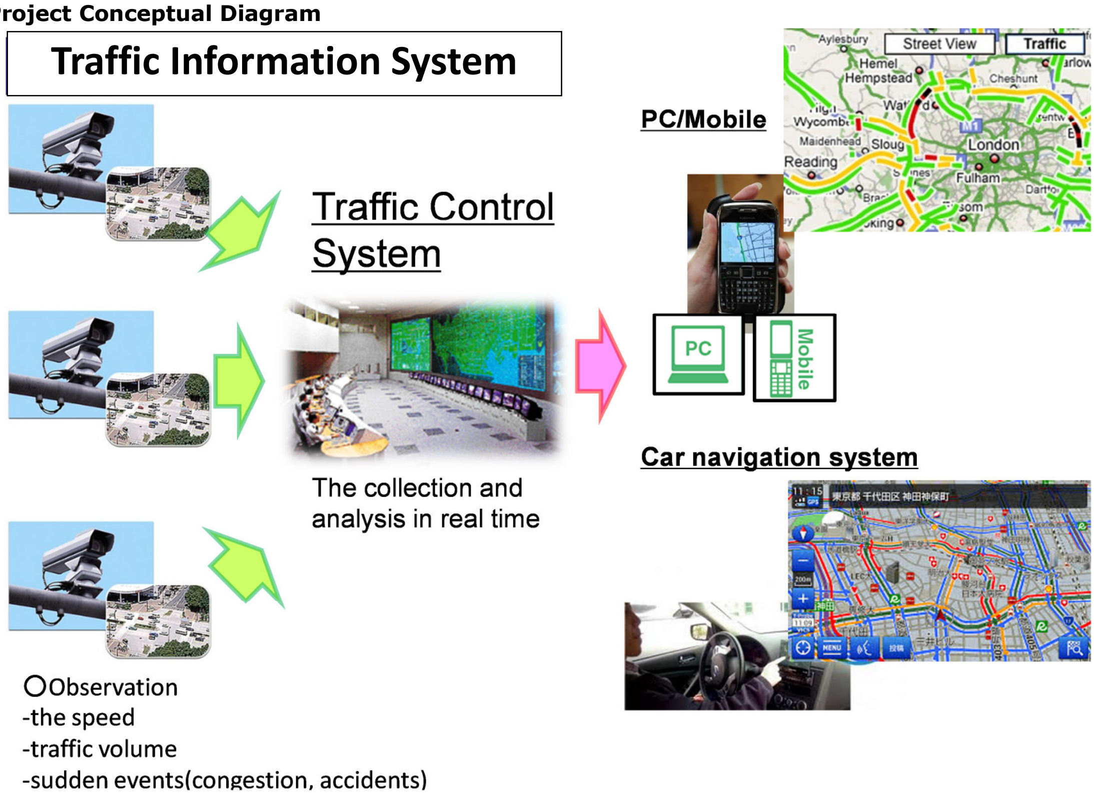
11. Environmental Impact

1) Social Environment
- Land Acquisition: Not major required
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: A
- Noise and vibration: A
- Flooding: A
- Biodiversity: A
- Flora and Fauna: A

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Project Conceptual Diagram



CoMTrans PROPOSED PROJECT PROFILE

<table>
<tr><td>Project ID Code
TM-BL1,BL2</td><td colspan="3">Project Name
Bus Priority System + Bus Location System for BRT</td><td rowspan="3">Transport Sub Sector
☐ Railway and New Transit
☐ Bus Transport
☐ Road
☑ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding</td></tr>
<tr><td colspan="4">Urban Transport Policy:
☑ Promotion of Public Transport ☑ Alleviation of Traffic Congestion
☑ Reduction of Pollution ☐ Reduction of Traffic Accident
☑ Promotion of Health</td></tr>
<tr><td colspan="2">Project Location
Development in accordance with the development of BRT (BRT; Phase1, Phase2)</td><td>Project Priority
☑ Short-term
☑ Medium-term
☐ Long-term</td><td>Implementation Period</td></tr>
<tr><td colspan="3">1. Objectives of Project
[Bus Priority System]
- To improve the bus service level for users by ensuring punctual bus operation and operational speeds
[BRT Bus Location System]
- To ensure an appropriate traffic control for BRT
- To disseminate accurate information for BRT services such as bus arrival time, delayed schedule
- To promote a modal shift to public transport service</td><td colspan="2">2. Expected Benefits
- Realisation of BRT system by ensuring travel speed and reliability
- Reduction of traffic congestion
- Improvement of the environment (noise, air) and time loss by promotion of change to public transport</td></tr>
<tr><td colspan="3">3. Project Description
<u>Collecting Information</u>
- Installation of RFID tag on each BRT bus (Phase1:121 buses, Phase2: 78 buses)
- Installation of RFID receiving equipment at the Bus stops and the major intersections (Phase1: about 90 locations, Phase2: about 70 locations)
<u>Development of data analysis and equipment to accumulate the data</u>
- Development of system to adjust the phasing time of the signals
・This system is to analyse "extend/ shorten" the signal time in the direction of travel of the BRT for priority passage, and to control the signals by communicating information to each signal controller
- Development of system for the collection of the travelling status information (Location, Pathway, Travel speed)
<u>Provision of information</u>
- Development of a system for providing traffic information on the web/SMS
- User: WEB (PC, Mobile), Bus stop: information board, Bus user :information board, Operation Manager: WEB (PC, Mobile)</td><td colspan="2">4. Linkages with Other Projects/Sectors
- BRT system and operation
- Traffic Information system
-</td></tr>
<tr><td colspan="3">5. Important Assumptions (Conditions for the Project)</td><td colspan="2">6. Implementing Agency
- Road Development Authority
- Colombo Municipal Council
- Ministry of Transport
- Western Province Road Passenger Transport Authority
- Traffic police</td></tr>
</table>

CoMTrans PROPOSED PROJECT PROFILE

7. Financing Scheme

☑ Public Sector

☑ Public Private Partnership

☐ Private Sector Initiative

8. Expected Operator (if any)

- To be discussed.

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 5.0 Million

Recurrent O & M: US$ ______ M/year

10. Special Considerations

Traffic congestion on the minor roads along BRT route should be carefully discussed.

11. Environmental Impact

1) Social Environment

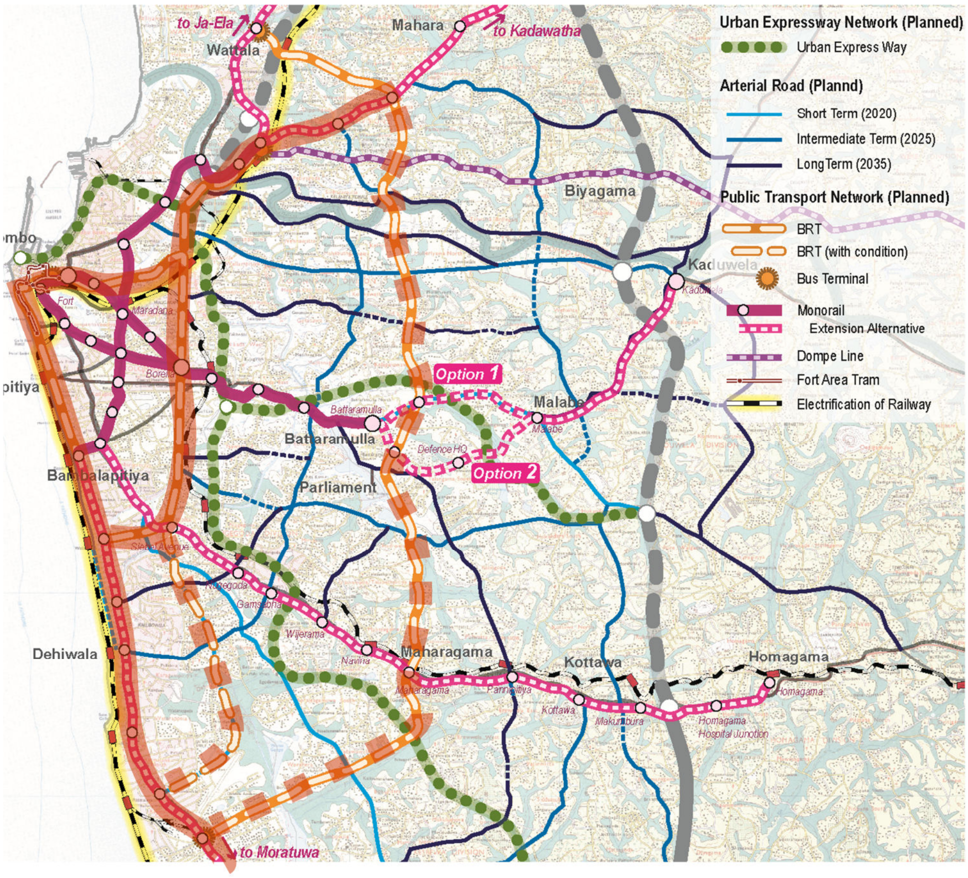
- Land Acquisition: Not major required
- Resettlement :B
- Other Social Impact: B

2) Natural Environment

- Air pollution: A
- Noise and vibration: A
- Flooding: A
- Biodiversity: A
- Flora and Fauna: A

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	**Project Name**	**Transport Sub Sector**
TM-BL3	Bus Location System for Public/Private Buses	☐ Railway and New Transit ☐ Bus Transport ☐ Road ☑ Traffic Management ☐ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:
- ☑ Promotion of Public Transport
- ☑ Alleviation of Traffic Congestion
- ☑ Reduction of Pollution
- ☐ Reduction of Traffic Accident
- ☑ Promotion of Health

Project Location	**Project Priority**	**Implementation Period**
Colombo Metropolitan Area	☐ Short-term ☑ Medium-term ☐ Long-term	

1. Objectives of Project

[Operation Manager]

- To understand the current situation of each bus operational status (GPS positioning system, Pathway, and Travel speed with driving record system)
- To analysis appropriate bus routes and instruct its route by an operation manager

[Bus User]

- To improve the level of bus services such as dissemination of bus arrival time and ensure punctual bus operation
- To promote bus transport services from private mode

2. Expected Benefits

- Improvement of convenience to the users of Public buses by Development of optimised bus routes
- Reduction of traffic congestion
- Improvement of the environment (noise, air) and time loss by promotion of change to public transport

3. Project Description

<u>Collecting Information</u>

- Installation of equipment for transmitting location information on each bus (about 1,000 buses)

<u>Development of data analysis and equipment to accumulate the data</u>

- Development of a system for the collection of the travelling status information (Location, Pathway, Travel speed)

<u>Provision of information</u>

- Development of a system for providing traffic information on the web
- User: WEB (PC, Mobile), Operation Manager : WEB (PC, Mobile)

4. Linkages with Other Projects/Sectors

- BRT Installation
- Traffic information system
- Common transport card (IC card) system

5. Important Assumptions (Conditions for the Project)

6. Implementing Agency

- Ministry of Transport
- CMC
- Traffic police

7. Financing Scheme

- ☑ Public Sector
- ☑ Public Private Partnership
- ☐ Private Sector Initiative

8. Expected Operator (if any)

- To be discussed

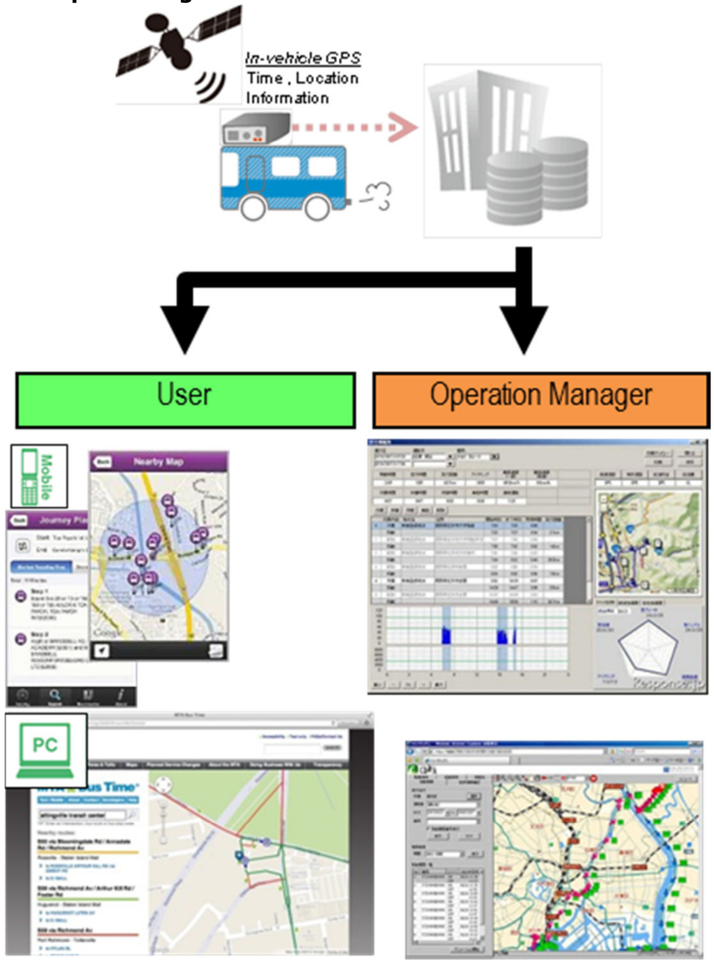
9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 1.0 Million
Recurrent O & M: US$ ____ M/year

10. Special Considerations

Institutional arrangement should be carefully designed.

CoMTrans PROPOSED PROJECT PROFILE

11. Environmental Impact	12. Project Conceptual Diagram
1) Social Environment - Land Acquisition: A - Resettlement: A - Other Social Impact: B 2) Natural Environment - Air pollution: A - Noise and vibration: A - Flooding: A - Biodiversity: A - Flora and Fauna: A [Legend]: A: No Impact B: Moderate Impact C: Serious Impact	

CoMTrans PROPOSED PROJECT PROFILE

Project ID Code
TM-P1

Project Name
Parking Information System

Transport Sub Sector
☐ Railway and New Transit
☐ Bus Transport
☐ Road
☑ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding

Urban Transport Policy:
☐ Promotion of Public Transport
☑ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☐ Reduction of Traffic Accident
☐ Promotion of Health

Project Location
Public parking and P&R station, possibility to link to private car parking

Project Priority
☐ Short-term
☐ Medium-term
Long-term

Implementation Period

1. Objectives of Project
- To prevent cars from prowling for looking for parking area by providing parking location information and full/empty status of each parking facility

2. Expected Benefits
- Reduction of traffic congestion in the around parking areas by reduction of traffic prowling

3. Project Description
Collecting Information/ Data Clearing House
- Development of a system for collection of parking Full/Empty information system for transmission of information from each parking administrator (The use of PC, and Mobile), and of processing guidance information based on the collected data

Provision of information
- Development of system for providing information via road side display board and internet/SMS

4. Linkages with Other Projects/Sectors
-

5. Important Assumptions (Conditions for the Project)

6. Implementing Agency
- To be discussed among Ministry of Transport, CMC, RDA and traffic police

7. Financing Scheme
☑ Public Sector
☑ Public Private Partnership
☑ Private Sector Initiative

8. Expected Operator (if any)
- To be discussed

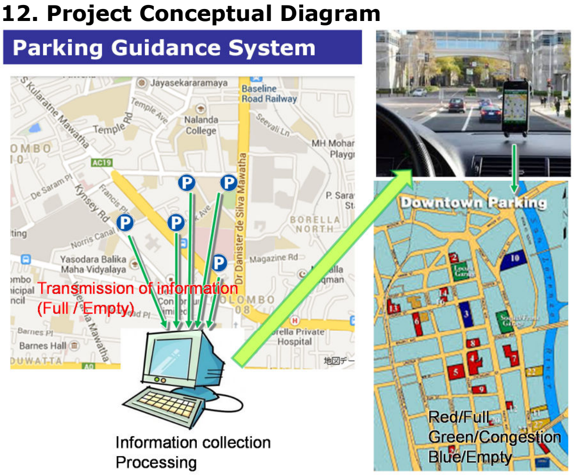
9. Project Cost (in 2013 Constant Price)
Initial Investment Cost: US$ 25.0 Million
Recurrent O & M: US$ ____ M/year

10. Special Considerations
Institutional arrangement should be carefully designed

11. Environmental Impact
1) Social Environment
- Land Acquisition: Not Required
- Resettlement :A
- Other Social Impact: B
2) Natural Environment
- Air pollution: A
- Noise and vibration: A
- Flooding: A
- Biodiversity: A
- Flora and Fauna: A

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Project Conceptual Diagram



CoMTrans PROPOSED PROJECT PROFILE

<table>
<tr><td>Project ID Code
TM-ERP</td><td colspan="3">Project Name
ERP (Electric Road Pricing) System</td><td rowspan="3">Transport Sub Sector
☐ Railway and New Transit
☐ Bus Transport
☐ Road
☑ Traffic Management
☐ Traffic Safety
☐ Environment
☐ Urban Planning
☐ Institution/Funding</td></tr>
<tr><td colspan="4">Urban Transport Policy:
☐ Promotion of Public Transport ☑ Alleviation of Traffic Congestion
☑ Reduction of Pollution ☐ Reduction of Traffic Accident
☑ Promotion of Health</td></tr>
<tr><td colspan="2">Project Location
CMC Boundary</td><td>Project Priority
☐ Short-term
☑ Medium-term
☐ Long-term</td><td>Implementation Period</td></tr>
<tr><td colspan="3">1. Objectives of Project
- To reduce vehicles entering the city of Colombo
- To promote a modal shift from private car use to public transport by charging a fee for entering CMC</td><td colspan="2">2. Expected Benefits
- Modal shift for current private mode user to public transport
- Improvement of the environment (noise, air) and reduction of travel time by alleviation of traffic congestion</td></tr>
<tr><td colspan="3">3. Project Description
<u>Collecting Information</u>
- Construction of non-stop toll gates at main routes through the CMC Boundary (15 locations: see location map).
- Development of recognition system with passed vehicle at toll gate
- Development of violated vehicle tracking system
<u>Charging system</u>
- Installation of fee payment machines
- Installation of fee payment instruments in Colombo city (about 100 locations)</td><td colspan="2">4. Linkages with Other Projects/Sectors
- Monorail
- Railway
- BRT
- P&R facilities
- Multi-modal Centres (MMCs)
- Bus services</td></tr>
<tr><td colspan="3">5. Important Assumptions (Conditions for the Project)
Acceptance of ERP system within a civil society
Legalisation of traffic regulation and penalty system</td><td colspan="2">6. Implementing Agency
- Road Development Authority
- Colombo Municipal Council
- Traffic police</td></tr>
<tr><td colspan="3">7. Financing Scheme
☑ Public Sector
☑ Public Private Partnership
☐ Private Sector Initiative</td><td colspan="2">8. Expected Operator (if any)
- To be discussed</td></tr>
<tr><td colspan="3">9. Project Cost (in 2013 Constant Price)
Initial Investment Cost: US$ 19.0 Million
Recurrent O & M: US$ ______ M/year</td><td colspan="2">10. Special Considerations
It should be discussed whether the revenue from ERP system could be earmarked for the budget of the public transport system.</td></tr>
</table>

CoMTrans PROPOSED PROJECT PROFILE

11. Environmental Impact

1) Social Environment

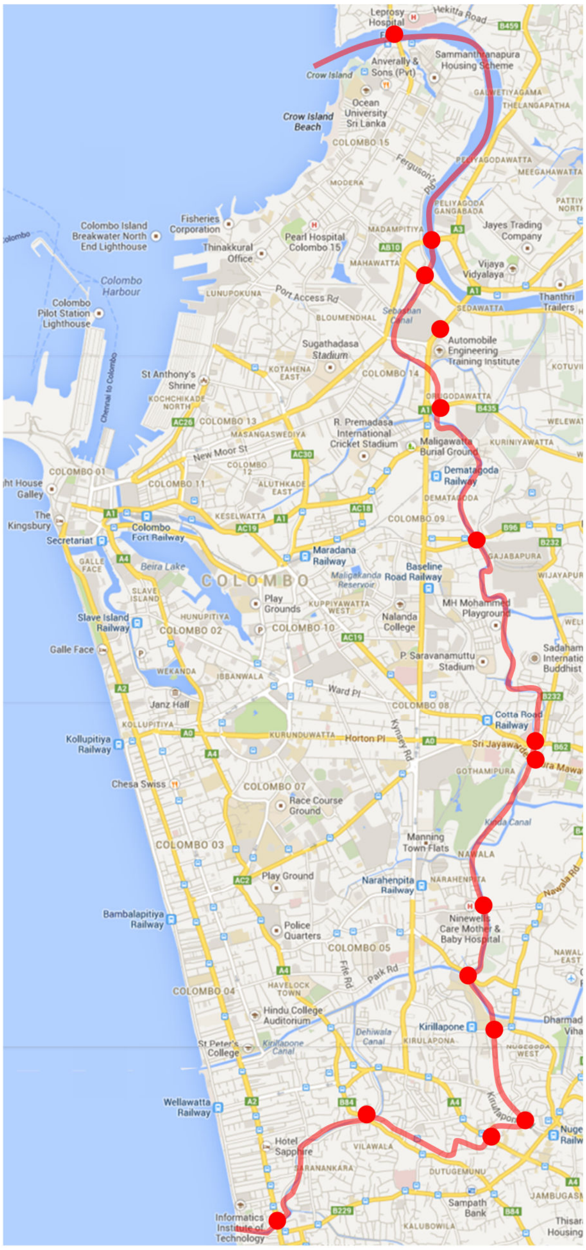
- Land Acquisition: Not major required
- Resettlement :B
- Other Social Impact: B

2) Natural Environment

- Air pollution: B
- Noise and vibration: A
- Flooding: A
- Biodiversity: A
- Flora and Fauna: A

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	**Project Name**	**Transport Sub Sector**
RS-1	Education for Road Safety / Tight Control of Driver’s Licence	☐ Railway and New Transit ☐ Bus Transport ☐ Road ☐ Traffic Management ☑ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:
☐ Promotion of Public Transport
☐ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☑ Reduction of Traffic Accident
☐ Promotion of Health

Project Location	**Project Priority**	**Implementation Period**
Colombo Metropotitan Area	☑ Short-term ☐ Medium-term ☐ Long-term	Total 5 years

1. Objectives of Project
- To improve drivers’ skill and manner
- To improve traffic manner of pedestrians

2. Expected Benefits
- Reduction of fatalities in traffic accident

3. Project Description
- Road Safety education in school
- Awareness programs for public transport drivers (Bus, Three wheeler)
- Awareness programs for young riders and old pedestrians
- Improve education before issuing driver's license
- Tightening driver's license examination
- Tight controls on drivers without a license
-

4. Linkages with Other Projects/Sectors

5. Important Assumptions (Conditions for the Project)

6. Implementing Agency
- Ministry of Transport, Department of Motor Traffic and National Council for Road Safety
- Traffic Police

7. Financing Scheme
☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

9. Project Cost (in 2013 Constant Price)
Initial Investment Cost: US$_____ Million
Recurrent O & M: US$_____ M/year

10. Special Considerations
Fatalities of young riders and older pedestrians in traffic accidents are comparatively high in the Western Province. Young drivers and riders are primary responsible offender of fatal accidents.

11. Environmental Impact

1) Social Environment
- Land Acquisition: Not necessary
- Resettlement: A
- Other Social Impact: A

2) Natural Environment
- Air pollution: A
- Noise and vibration: A
- Flooding: A
- Biodiversity: A
- Flora and Fauna: A

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map
n.a.

CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	Project Name	Transport Sub Sector
RS-2	Installation or Improvement of Pedestrian Crossing and Sidewalk	☐ Railway and New Transit ☐ Bus Transport ☑ Road ☐ Traffic Management ☑ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:

☐ Promotion of Public Transport
☐ Alleviation of Traffic Congestion
☐ Reduction of Pollution
☑ Reduction of Traffic Accident
☐ Promotion of Health

Project Location	Project Priority	Implementation Period
Location where the frequent traffic accident with pedestrian happens. (CMC, Negombo Road, etc.)	☑ Short-term ☑ Medium-term ☐ Long-term	Total 5 years

1. Objectives of Project
- To decrease pedestrian accidents on roadside
- To decrease pedestrian accidents when they are crossing a road

2. Expected Benefits
- Reduction of pedestrian fatalities

3. Project Description
- Improvement of sidewalks
- Installation of guardrails
- Installation of pedestrian crossings
- Installation of traffic light at intersection and pedestrian crossing
- Installation of road traffic signs and warning board of a pedestrian crossing

4. Linkages with Other Projects/Sectors
- Development/improvement of roads

5. Important Assumptions (Conditions for the Project)

6. Implementing Agency
- Traffic Police
- Road Development Authority
- CMC

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$_____ Million
Recurrent O & M: US$_____ M/year

10. Special Considerations

43% of fatalities in traffic accidents involved pedestrians in the Western Province in 2012.

11. Environmental Impact

1) Social Environment
- Land Acquisition: Not major required
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: A
- Noise and vibration: A
- Flooding: A
- Biodiversity: A
- Flora and Fauna: A

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map

n.a.

CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	**Project Name**	**Transport Sub Sector**
RS-3	Enforcement of Safety Measures on 7 Corridors to Reduce Traffic Accidents	☐ Railway and New Transit ☐ Bus Transport ☑ Road ☐ Traffic Management ☑ Traffic Safety ☐ Environment ☐ Urban Planning ☐ Institution/Funding

Urban Transport Policy:

☐ Promotion of Public Transport ☐ Alleviation of Traffic Congestion
☐ Reduction of Pollution ☑ Reduction of Traffic Accident
☐ Promotion of Health

Project Location	**Project Priority**	**Implementation Period**
Location where the frequent traffic accident happens. (e.g. 7 Corridors)	☑ Short-term ☑ Medium-term ☐ Long-term	Total 5 years

1. Objectives of Project
- To decrease head on accidents
- To decrease accidents during overtaking
- To decrease accidents during night time

2. Expected Benefits
- Reduction of fatalities in vehicle traffic accidents

3. Project Description
- Installation of Centre Median
- Installation of Ramble Strip
- Introducing Fast lane
- Introducing No-passing zone
- Increase and improve roadside lights

4. Linkages with Other Projects/Sectors
- Development/improvement of roads

5. Important Assumptions (Conditions for the Project)

6. Implementing Agency
- Traffic Police
- Road Development Authority

7. Financing Scheme

☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative

8. Expected Operator (if any)

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$_____ Million
Recurrent O & M: US$_____ M/year

10. Special Considerations

Except pedestrian related accidents, the major types of fatal accidents are "head on crash" and "in conjunction with overtaking" in the Western Province.

11. Environmental Impact

1) Social Environment
- Land Acquisition: Not major required
- Resettlement :B
- Other Social Impact: B

2) Natural Environment
- Air pollution: A
- Noise and vibration: A
- Flooding: A
- Biodiversity: A
- Flora and Fauna: A

[Legend]:
A: No Impact
B: Moderate Impact
C: Serious Impact

12. Location Map

n.a.

CoMTrans PROPOSED PROJECT PROFILE

<table>
<tr><td>Project ID Code
EN-01</td><td colspan="2">Project Name
Air Emission Standard for Vehicles</td><td rowspan="3">Transport Sub Sector
☐ Railway and New Transit
☐ Bus Transport
☐ Road
☐ Traffic Management
☐ Traffic Safety
☒ Environment
☐ Urban Planning
☒ Institution/Funding</td></tr>
<tr><td colspan="3">Urban Transport Policy:
☐ Promotion of Public Transport ☐ Alleviation of Traffic Congestion
☒ Reduction of Pollution/ Promotion of Health ☐ Reduction of Traffic Accident</td></tr>
<tr><td>Project Location
n.a.</td><td>Project Priority
☑ Short-term
☐ Medium-term
☐ Long-term</td><td>Implementation Period
3 years</td></tr>
<tr><td colspan="2">1. Objectives of Project
- To establish and enhance of emission standard for vehicles.
- To reduce air emission generated from transport sector.</td><td colspan="2">2. Expected Benefits
- Contributing to improvement of air quality in Colombo area</td></tr>
<tr><td colspan="2">3. Project Description
- Review of existing emission standards
- Establishing and enhancement of emission standards for newly manufactured vehicles and for vehicles newly imported to the country.</td><td colspan="2">4. Linkages with Other Projects/Sectors
Vehicles inspection and maintenance programmes (EN-02)</td></tr>
<tr><td colspan="2">5. Important Assumptions (Conditions for the Project)
None</td><td colspan="2">6. Implementing Agency
Air Resource Management Centre (AirMAC)</td></tr>
<tr><td colspan="2">7. Financing Scheme
☐ Public Sector</td><td colspan="2">8. Expected Operator (if any)
n.a.</td></tr>
<tr><td colspan="2">9. Project Cost (in 2013 Constant Price)
Management cost</td><td colspan="2">10. Special Considerations
None</td></tr>
<tr><td colspan="2">11. Environmental Impact
Positive</td><td colspan="2">12. Location Map
n.a.</td></tr>
</table>

<table>
<tr><td>Project ID Code
EN-02</td><td colspan="2">Project Name
Vehicles Inspection and Maintenance Programmes</td><td rowspan="3">Transport Sub Sector
☐ Railway and New Transit
☐ Bus Transport
☐ Road
☐ Traffic Management
☐ Traffic Safety
☒ Environment
☐ Urban Planning
☒ Institution/Funding</td></tr>
<tr><td colspan="3">Urban Transport Policy:
☐ Promotion of Public Transport ☐ Alleviation of Traffic Congestion
☒ Reduction of Pollution/ Promotion of Health ☐ Reduction of Traffic Accident</td></tr>
<tr><td>Project Location
n.a.</td><td>Project Priority
☒ Short-term
☐ Medium-term
☐ Long-term</td><td>Implementation Period
3 years</td></tr>
<tr><td colspan="2">1. Objectives of Project
- To improve a vehicle inspection and maintenance programme for the checking of air emissions.</td><td colspan="2">2. Expected Benefits
- Air emissions from vehicles shall be within the vehicle emission standards resulting in improvement of air quality.</td></tr>
<tr><td colspan="2">3. Project Description
- Capacity building for VET centre technicians
- Improvement of inspection and maintenance facilities
- Audit the performance of inspectors
- Increase the awareness of the public</td><td colspan="2">4. Linkages with Other Projects/Sectors
Air emission standard for vehicles (EN-01)</td></tr>
<tr><td colspan="2">5. Important Assumptions (Conditions for the Project)
None</td><td colspan="2">6. Implementing Agency
- Department of Motor Traffic
- Air Resource Management Centre (AirMAC)</td></tr>
<tr><td colspan="2">7. Financing Scheme
☐ Public Private Partnership</td><td colspan="2">8. Expected Operator (if any)
Private Sector Participation</td></tr>
</table>

CoMTrans PROPOSED PROJECT PROFILE

9. Project Cost (in 2013 Constant Price) Management cost	**10. Special Considerations** None
11. Environmental Impact Positive	**12. Location Map** n.a.

Project ID Code EN-03	**Project Name** Low Sulphur Diesel Programmes			**Transport Sub Sector** ☐ Railway and New Transit ☐ Bus Transport ☐ Road ☐ Traffic Management ☐ Traffic Safety ☒ Environment ☐ Urban Planning ☐ Institution/Funding
Urban Transport Policy: ☐ Promotion of Public Transport ☒ Reduction of Pollution/ Promotion of Health ☐ Alleviation of Traffic Congestion ☐ Reduction of Traffic Accident				
Project Location n.a.		**Project Priority** ☐ Short-term ☒ Medium-term ☐ Long-term	**Implementation Period** 5 - 10 years	

1. Objectives of Project - To improve a fuel quality, by reducing a sulphur content in diesel.	**2. Expected Benefits** - Improvement of air quality
3. Project Description Establishment of a mechanism to collaborate with the refinery sector to supply low sulpher diesel fuel	**4. Linkages with Other Projects/Sectors** Air emission standard for vehicles (EN-01)
5. Important Assumptions (Conditions for the Project) None	**6. Implementing Agency** Ministry of Environment/Ministry of Petroleum Resource
7. Financing Scheme ☐ Public Private Partnership	**8. Expected Operator (if any)** n.a.
9. Project Cost (in 2013 Constant Price) Project cost will include an upgrade of a refinery. The cost shall be further refined.	**10. Special Considerations** None
11. Environmental Impact Positive	**12. Location Map** n.a.

Project ID Code EN-04	**Project Name** Promotion of Natural Gas Vehicles			**Transport Sub Sector** ☐ Railway and New Transit ☐ Bus Transport ☐ Road ☐ Traffic Management ☐ Traffic Safety ☒ Environment ☐ Urban Planning ☐ Institution/Funding
Urban Transport Policy: ☐ Promotion of Public Transport ☒ Reduction of Pollution/ Promotion of Health ☐ Alleviation of Traffic Congestion ☐ Reduction of Traffic Accident				
Project Location n.a.		**Project Priority** ☐ Short-term ☒ Medium-term ☐ Long-term	**Implementation Period** 5 - 10 years	

1. Objectives of Project - To promote Natural Gas Vehicles in order to reduce air pollutants	**2. Expected Benefits** - Improvement of air quality
3. Project Description Establish a strategy for a promotion of Natural Gas Vehicles including - Conversion of engine configuration for Natural Gas	**4. Linkages with Other Projects/Sectors** n.a.

- Promotion of sufficient refueling stations	
5. Important Assumptions (Conditions for the Project) None	**6. Implementing Agency** Ministry of Environment
7. Financing Scheme ☐ Public Sector ☐ Private Sector Initiative	**8. Expected Operator (if any)** n.a.
9. Project Cost (in 2013 Constant Price) Project cost will include the installation of refueling stations. The cost shall be further refined.	**10. Special Considerations** None
11. Environmental Impact Positive	**12. Location Map** n.a.

Project ID Code EN-05	**Project Name** Promotion of Hybrid Cars and Electric Vehicles		**Transport Sub Sector** ☐ Railway and New Transit ☐ Bus Transport ☐ Road ☐ Traffic Management ☐ Traffic Safety ☒ Environment ☐ Urban Planning ☐ Institution/Funding
Urban Transport Policy: ☐ Promotion of Public Transport ☒ Reduction of Pollution/ Promotion of Health ☐ Alleviation of Traffic Congestion ☐ Reduction of Traffic Accident			
Project Location n.a.	**Project Priority** ☒ Short-term ☐ Medium-term ☐ Long-term	**Implementation Period** 1-3 years	

1. Objectives of Project - To promote Hybrid Cars and Electric vehicles in order to reduce air pollutants	**2. Expected Benefits** - Improvement of air quality - Efficient use of natural resource
3. Project Description Establish a strategy for the promotion of Hybrid Cars and Electric vehicles including - Detail study for economic benefit - Enhance tax incentive	**4. Linkages with Other Projects/Sectors** n.a.
5. Important Assumptions (Conditions for the Project) None	**6. Implementing Agency** Ministry of Environment
7. Financing Scheme ☐ Public Sector ☐ Private Sector Initiative	**8. Expected Operator (if any)** n.a.
9. Project Cost (in 2013 Constant Price) Project cost will include installation of battery charging stations. The cost shall be further refined.	**10. Special Considerations** None
11. Environmental Impact Positive	**12. Location Map** n.a.

CoMTrans PROPOSED PROJECT PROFILE

Project ID Code
EN-06

Project Name
Promotion of Walking and Bicycles

Transport Sub Sector
- ☐ Railway and New Transit
- ☐ Bus Transport
- ☐ Road
- ☒ Traffic Management
- ☐ Traffic Safety
- ☒ Environment
- ☐ Urban Planning
- ☐ Institution/Funding

Urban Transport Policy:
- ☐ Promotion of Public Transport
- ☐ Alleviation of Traffic Congestion
- ☒ Reduction of Pollution/ Promotion of Health
- ☐ Reduction of Traffic Accident

Project Location
n.a.

Project Priority
- ☐ Short-term
- ☒ Medium-term
- ☐ Long-term

Implementation Period
5 years

1. Objectives of Project
- To promote Walking and Bicycle for energy saving in transport and for promoting health

2. Expected Benefits
- Promoting non-motorised modes of transport (sustainable transport)
- Contribution to reduction of net traffic
- Improving public health

3. Project Description
Development of a pedestrian path network as well as a pedestrian/bicycle road network, connecting key features including parks, wetland, coastal line and a river.

4. Linkages with Other Projects/Sectors
n.a.

5. Important Assumptions (Conditions for the Project)
None

6. Implementing Agency
CMC and relevant municipalities

7. Financing Scheme
☐ Public Sector

8. Expected Operator (if any)
n.a.

9. Project Cost (in 2013 Constant Price)
Minor to medium cost for the establishment of pedestrian and/or bicycle paths.

10. Special Considerations
None

11. Environmental Impact
Positive

12. Location Map
n.a.