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.

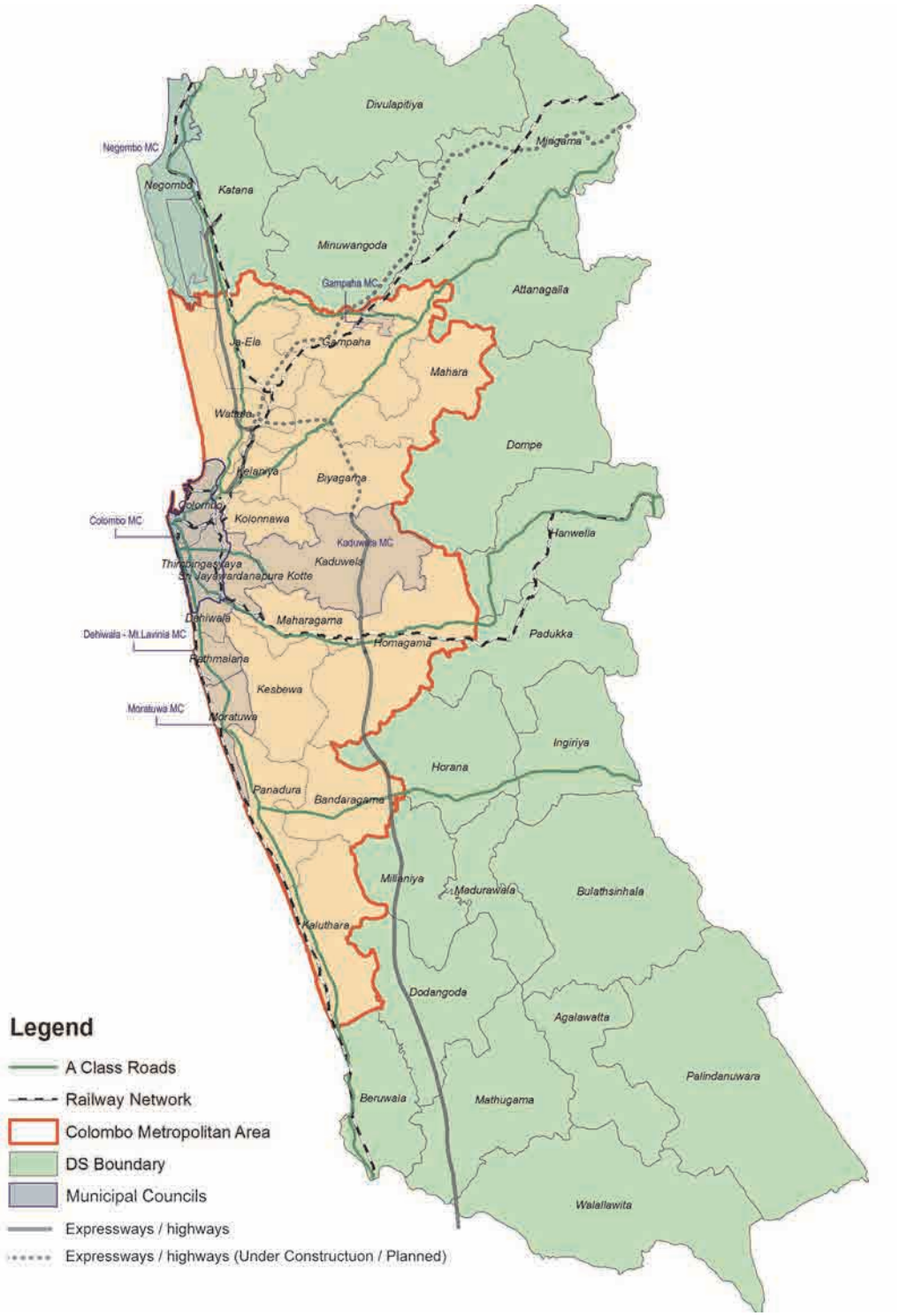
4.1.3 Identification of the Colombo Metropolitan Area(CMA)

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:

Scenario 1: High Growth with Rapid Urbanisation

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.

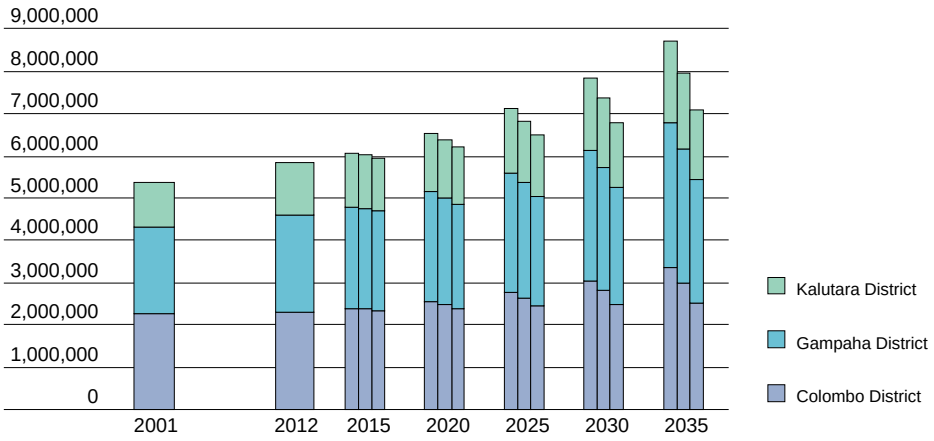
Population of the Western Province is now 5.8 million, and it is estimated to reach 8.7 million in the high growth scenario, 7.9 million in the medium growth scenario, and 7.1 million in the low growth scenario.

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

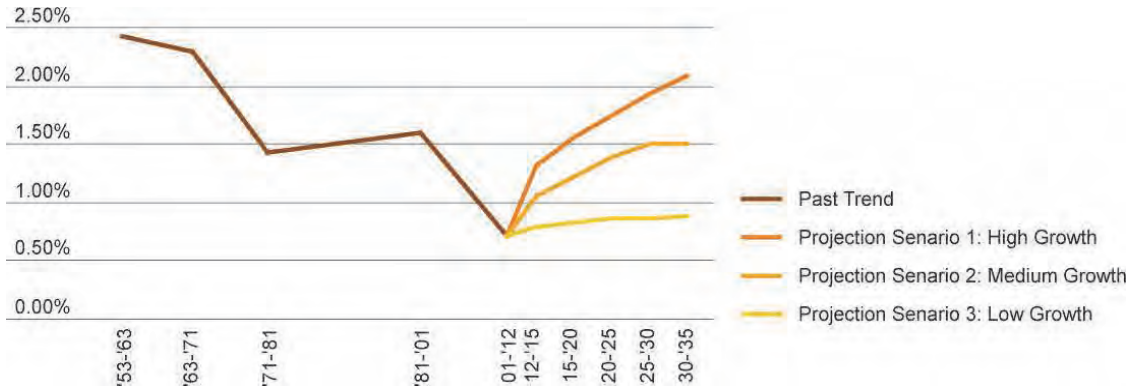
Scenario 1 High	**2001**	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
Colombo District	2,251,274	2,309,809	2,382,600	2,555,700	2,774,400	3,045,800	3,368,800
Gampaha District	2,063,684	2,294,641	2,393,200	2,586,000	2,821,400	3,101,800	3,435,900
Kalutara District	1,066,239	1,217,260	1,277,500	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

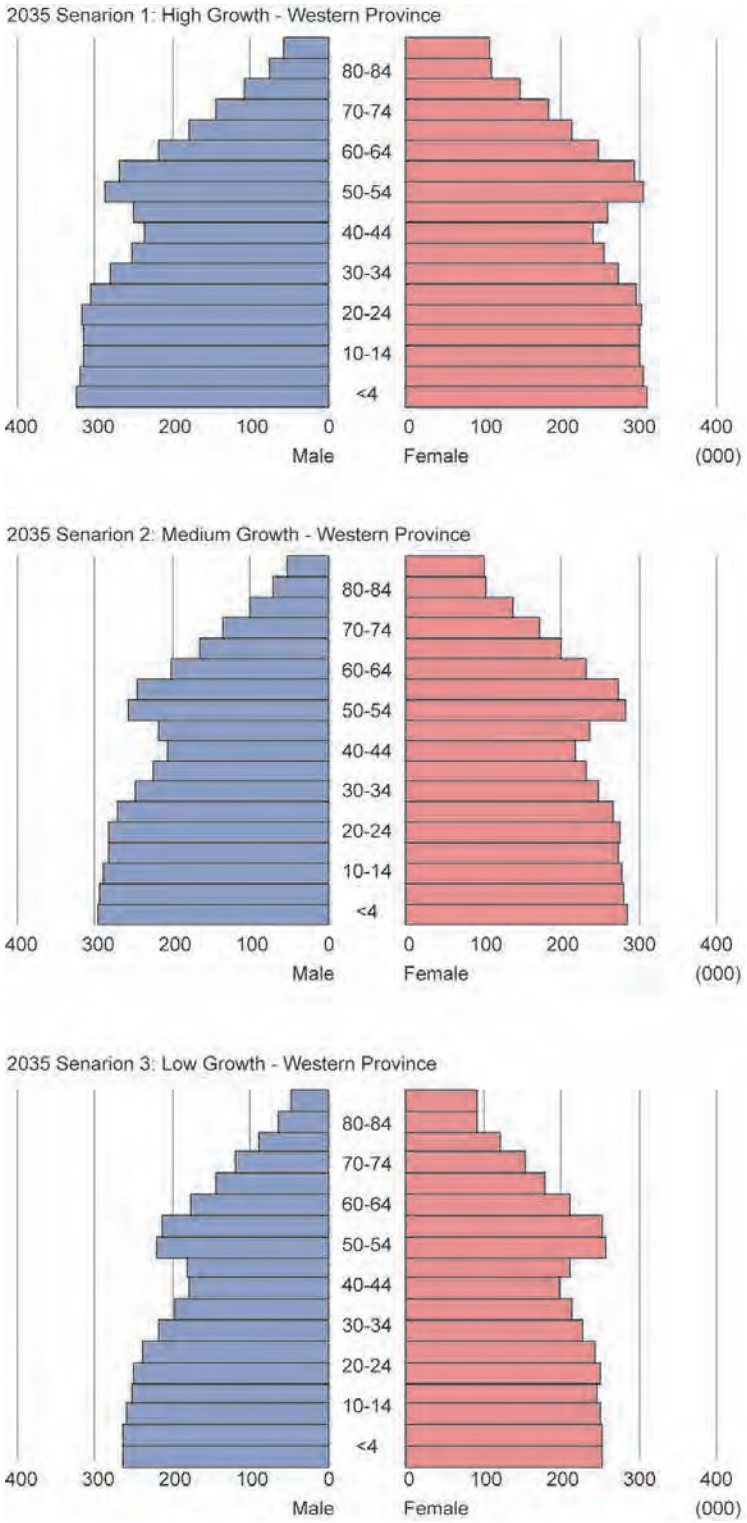


Source: CoMTrans Study Team

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.

GDP Growth

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

GRDP Growth

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

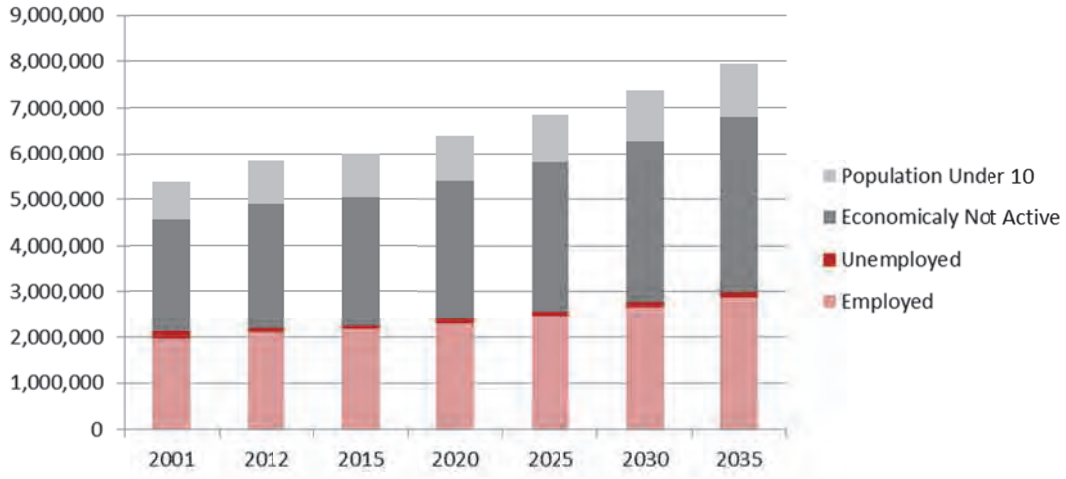


Figure 4.2.4 Proportion of Forecast Employed Population in Western Province

(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

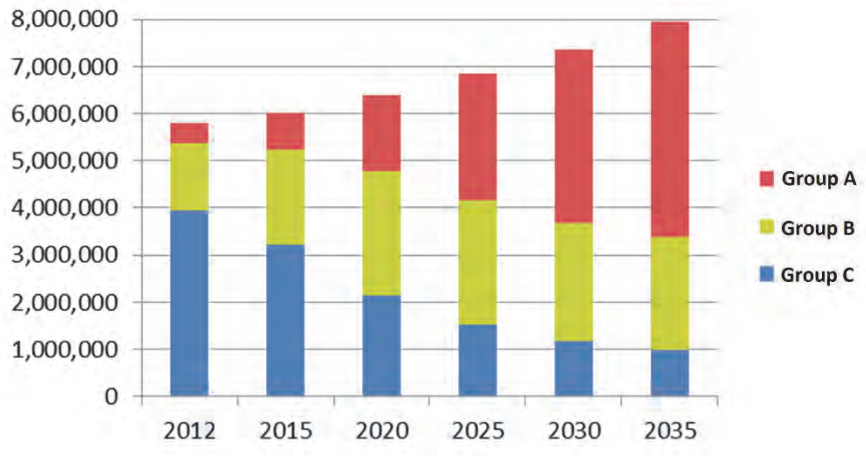
4.2.5 Forecast of Population by Income Group

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

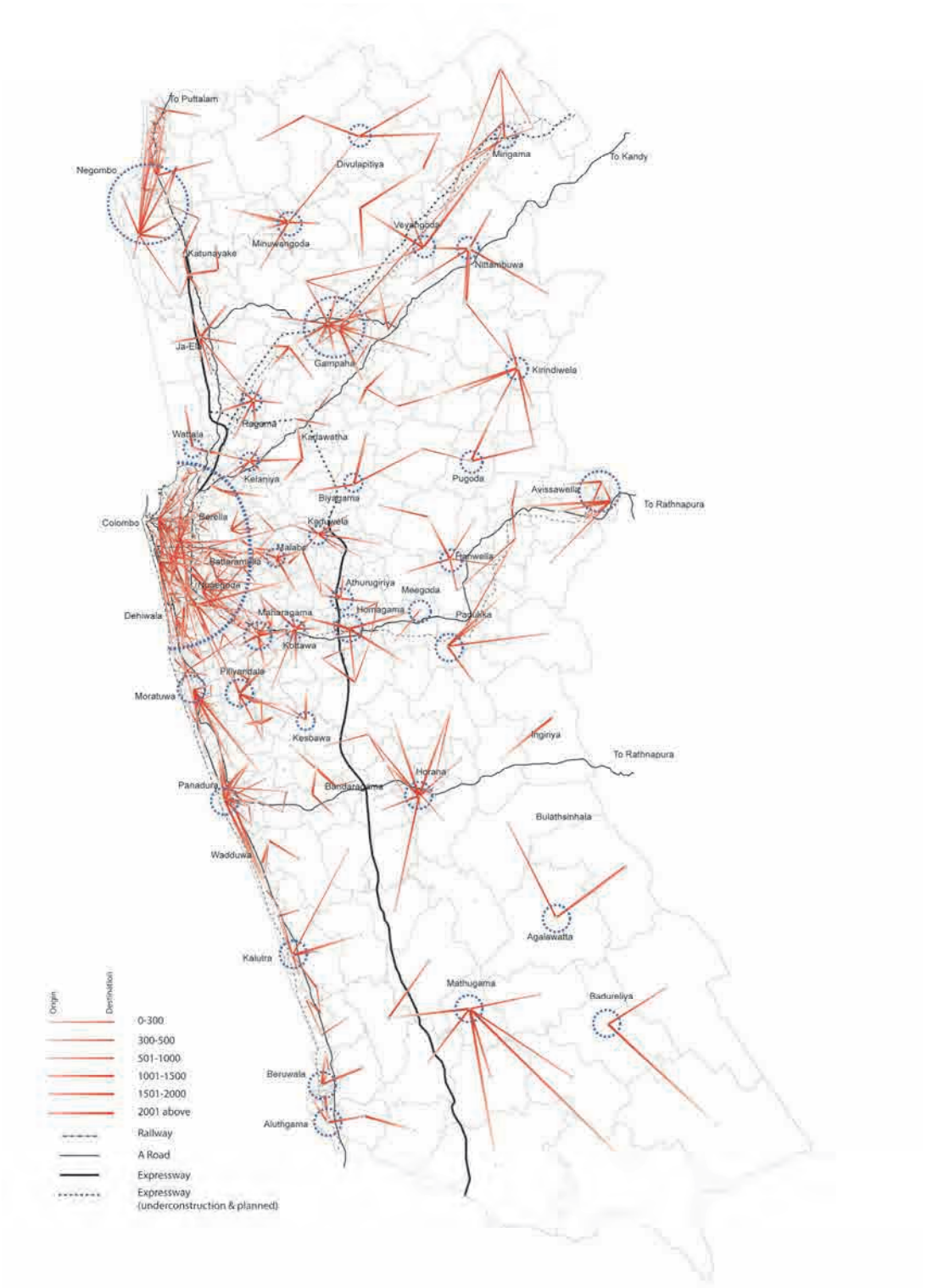
In the same way that urban structures were considered based on the factors mentioned in section 4.1, identifying urban centres is an essential step to formulate the urban structure.

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.

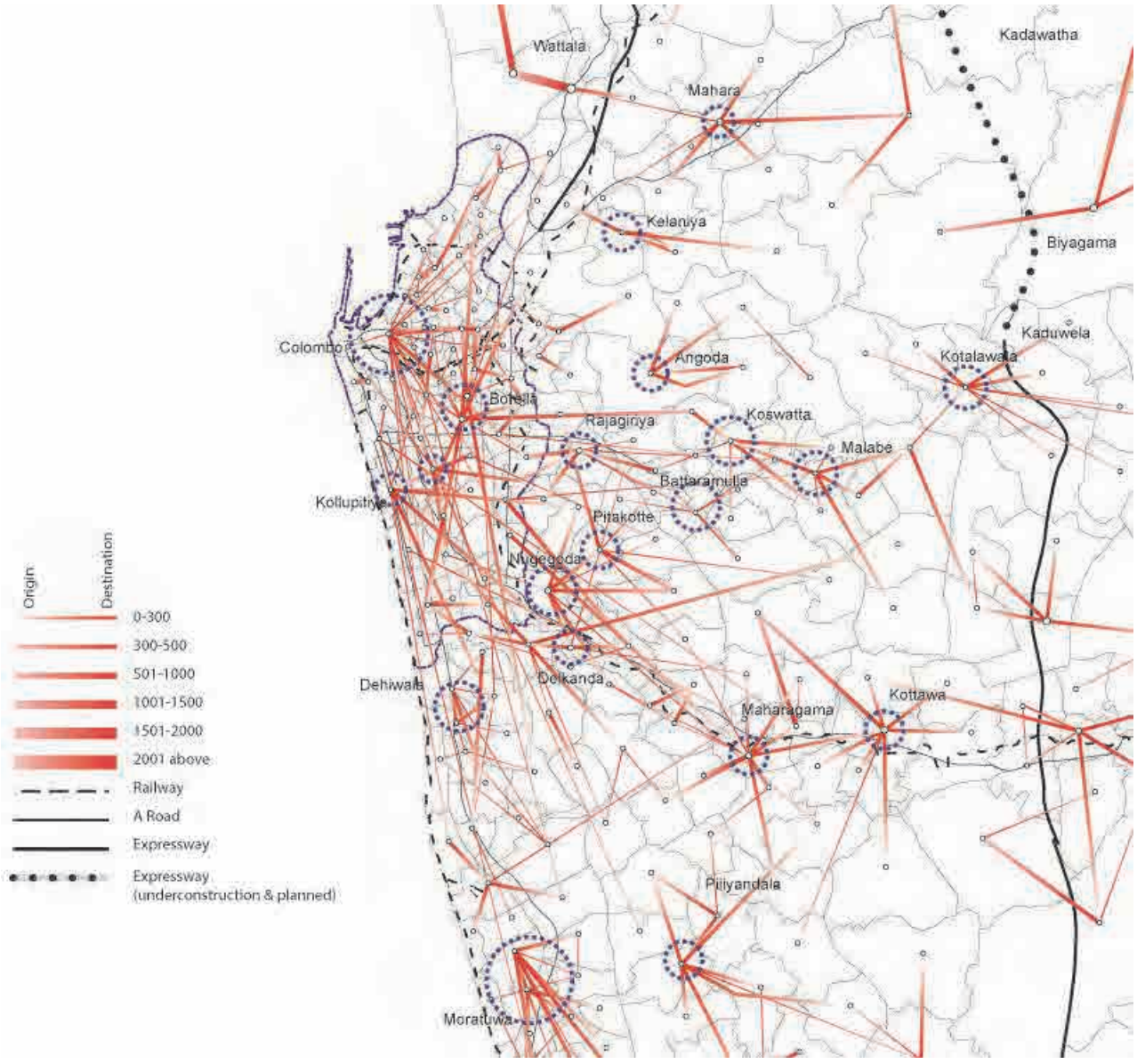
In the Kalutara District, the trips show urban centres along the Galle Road. At the same time, concentration in Horana is also found in the northern part of Kalutara District. Matugama is assumed to be the centre of the rural area having a concentration of trips.



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.



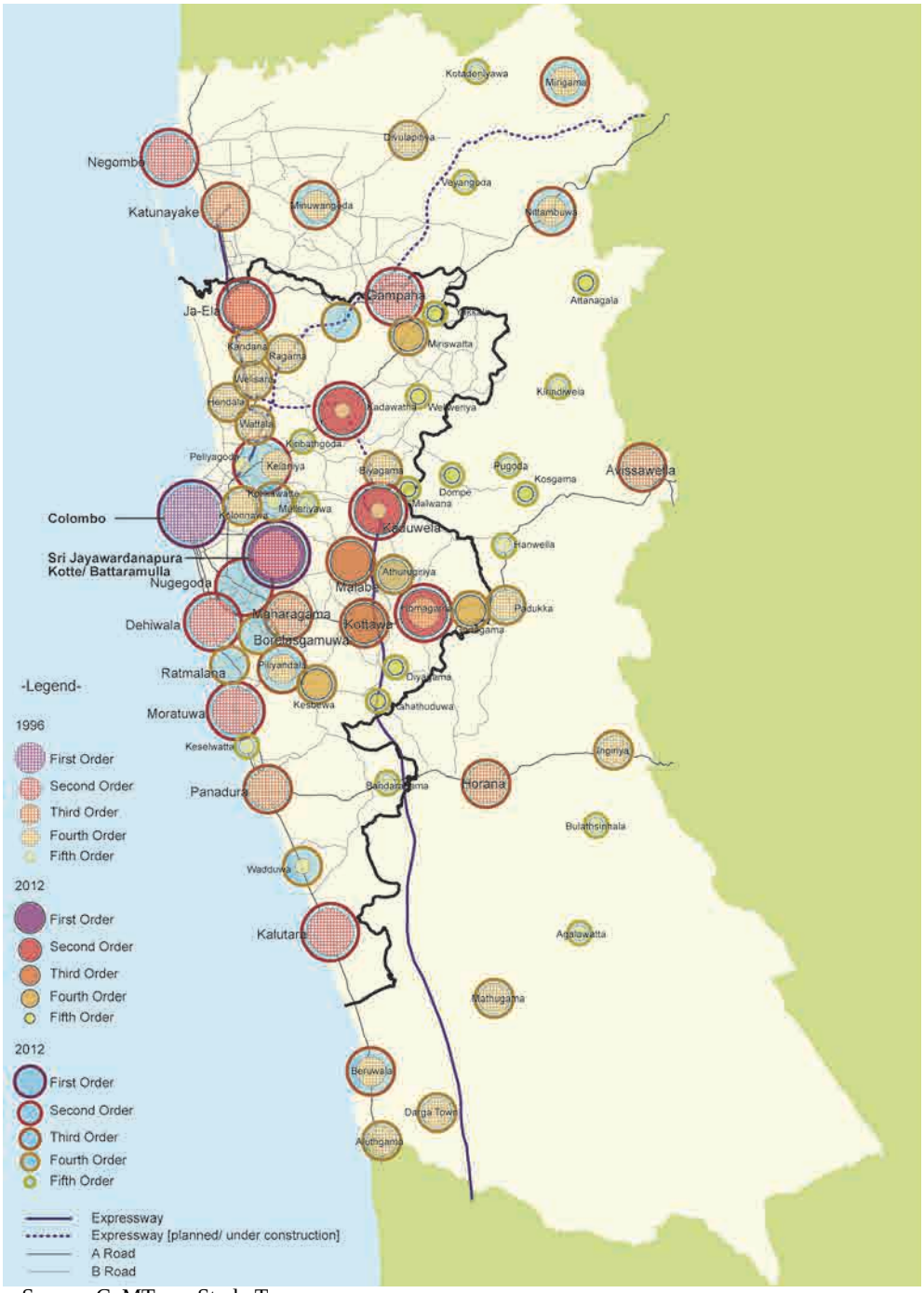
Source: CoMTrans Home Visit Survey 2013

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.

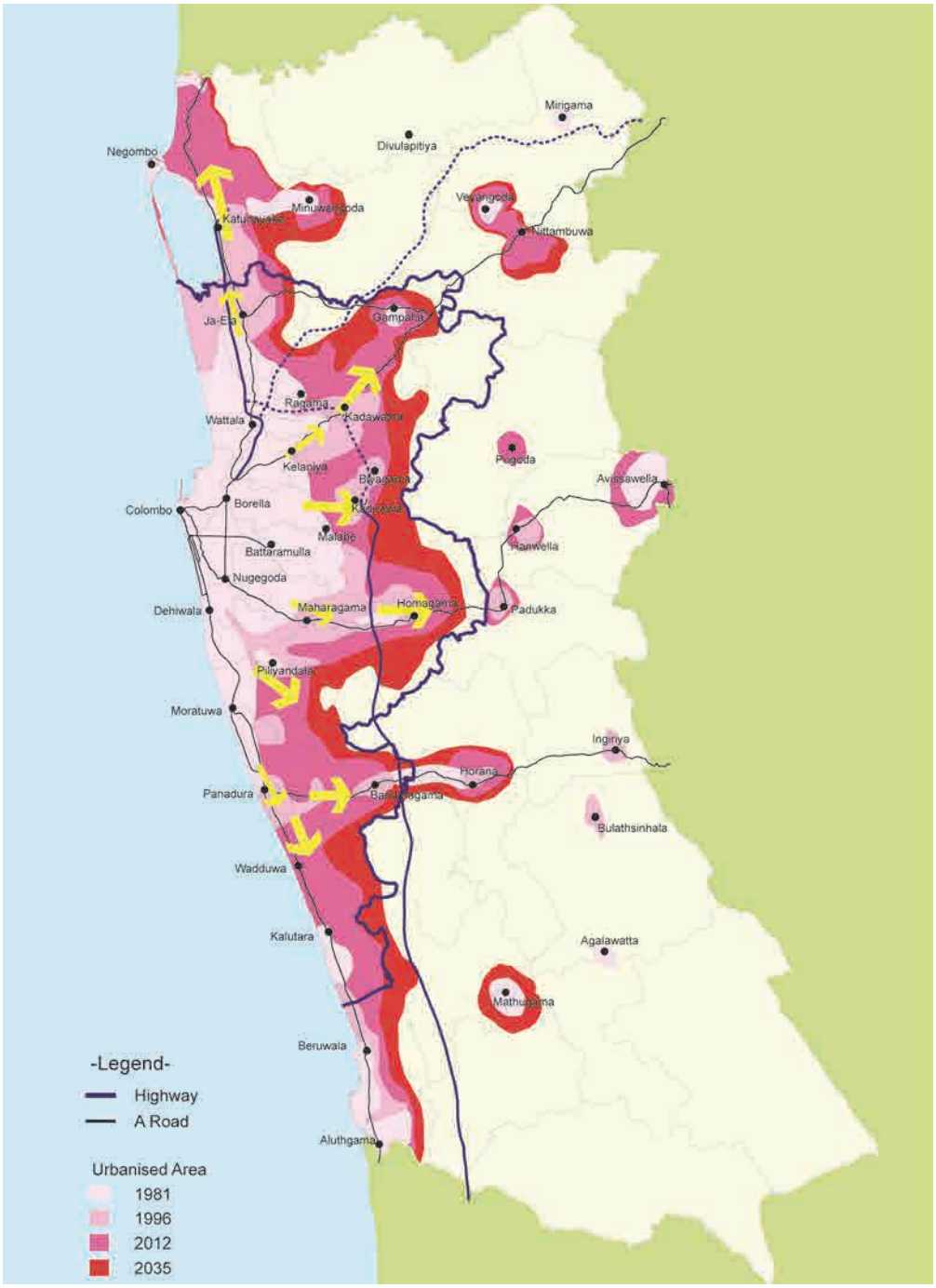
Based on the envisioned urban centres, the population forecast, and past trend of the expansion of urbanised area, the future urbanised area for 2035 is presumed as shown Figure 4.3.4

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

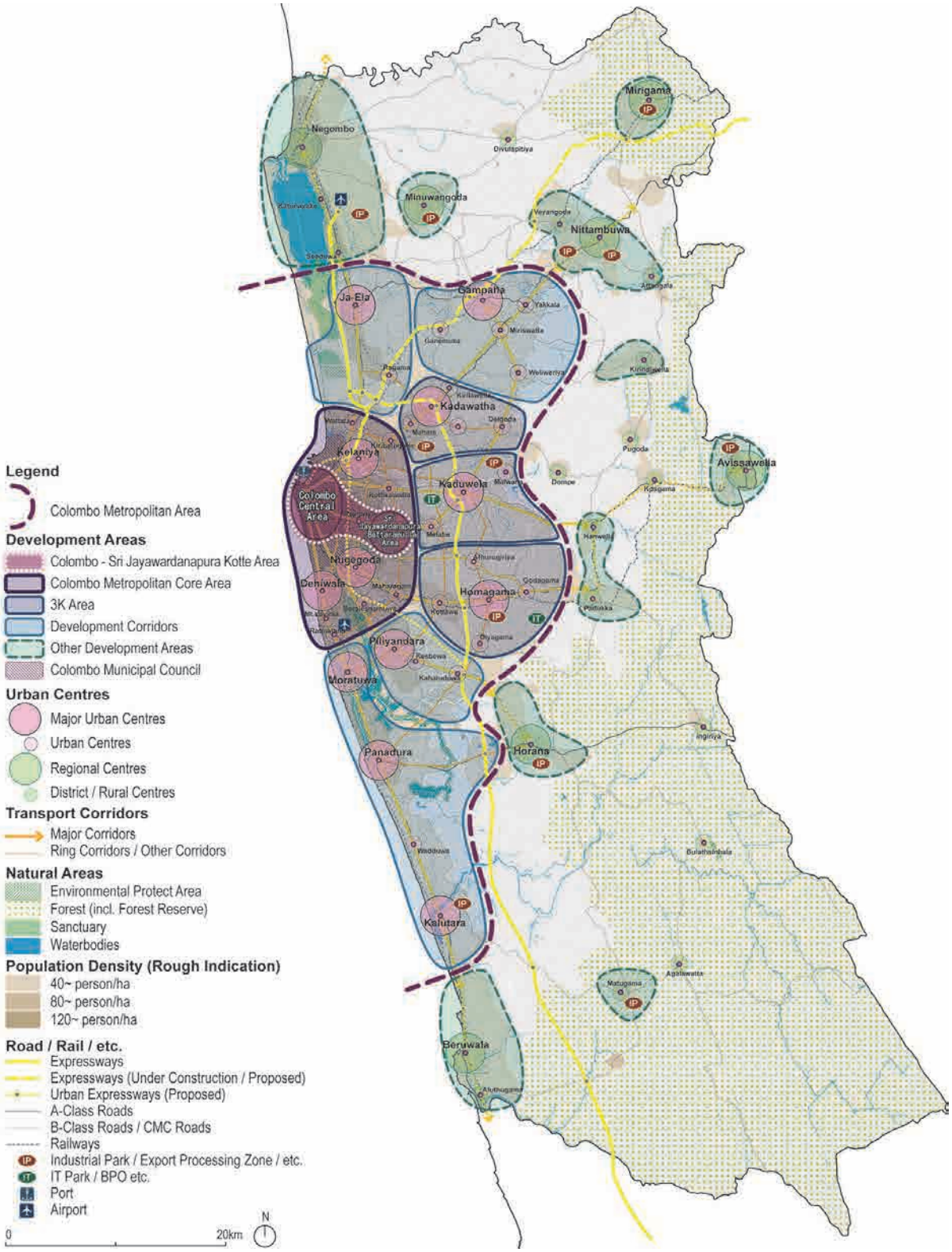


Source: CoMTrans Study Team

Figure 4.3.4 Envisioned Urbanised Area for 2035

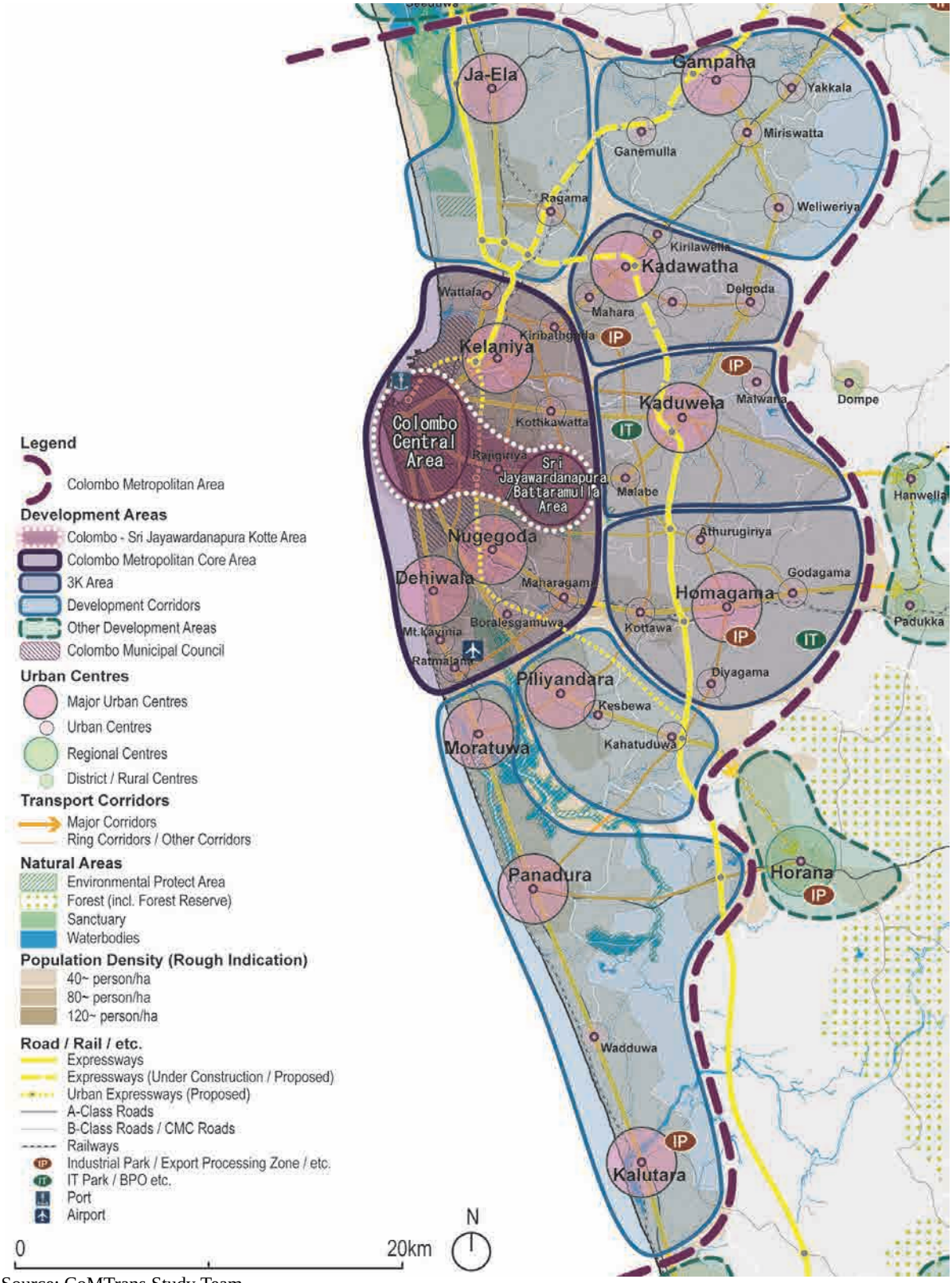
4.3.2 Urban Structure

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

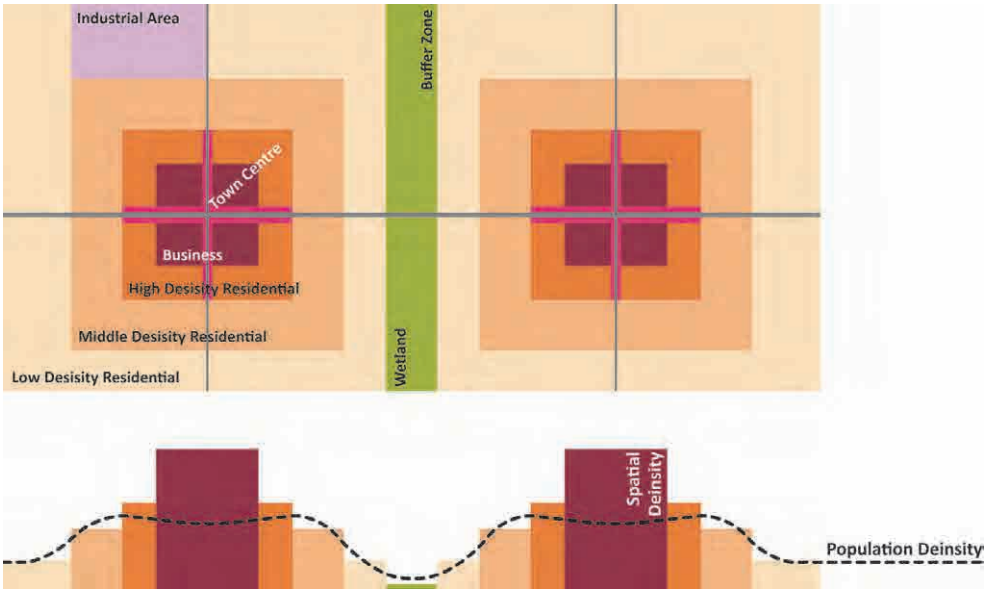
Land use is one of the most important elements of an urban structure. For the urban structure in the future, land use planning should directly guide the development. In the planning system in Sri Lanka, Development Plans of Local Authorities include land use zoning plans and building regulations. Therefore, 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

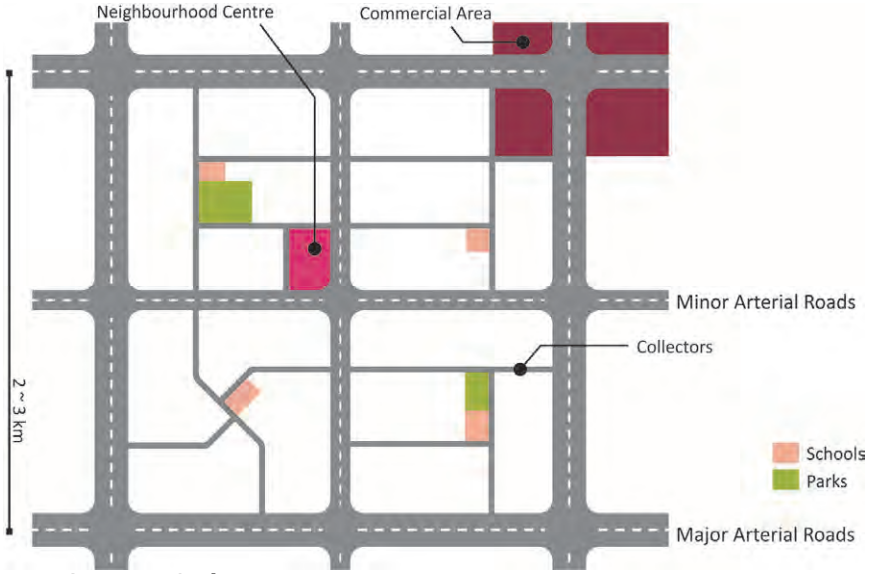
Figure 4.3.7 Conceptual Model of Land Use Zoning

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.

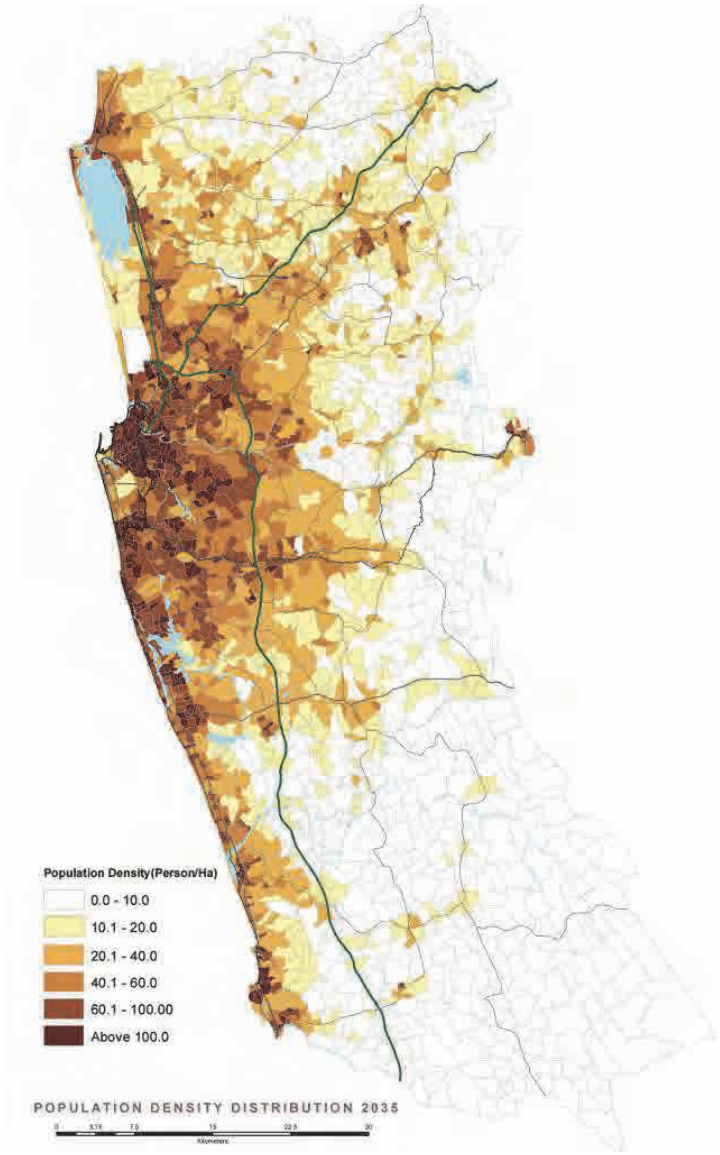
Although this area development structure model is a theoretical idea in order to separate through

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.

   TOD Model: 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.

   3K Area: 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.

   Administrative Centre: 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.

   Since the sub centre structure is proposed and employed population would follow the structure, 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

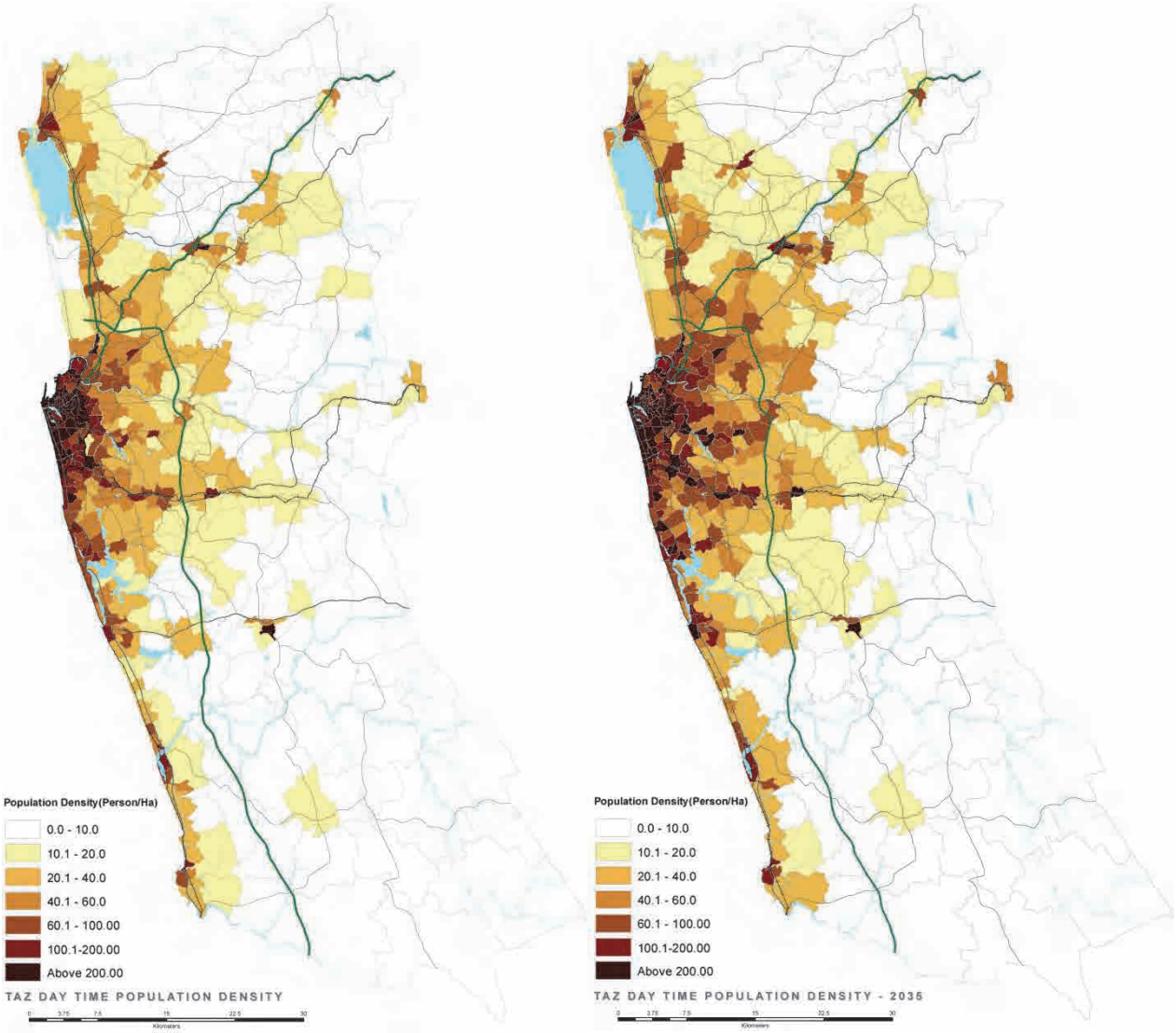
4.4.3 Daytime Population

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.

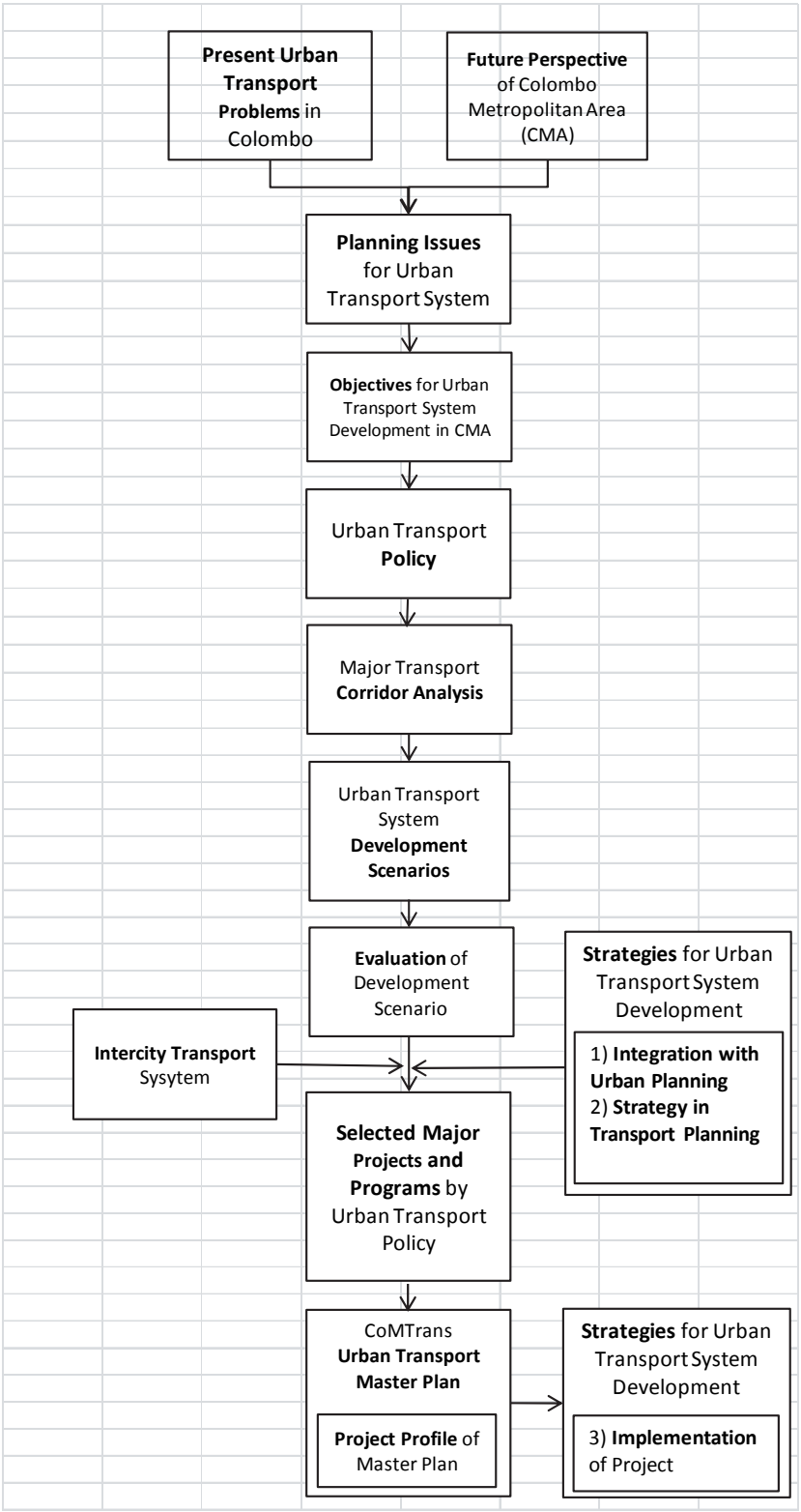
(13) Strategies for Urban Transport System Development (see Sub-section 5.11)

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.

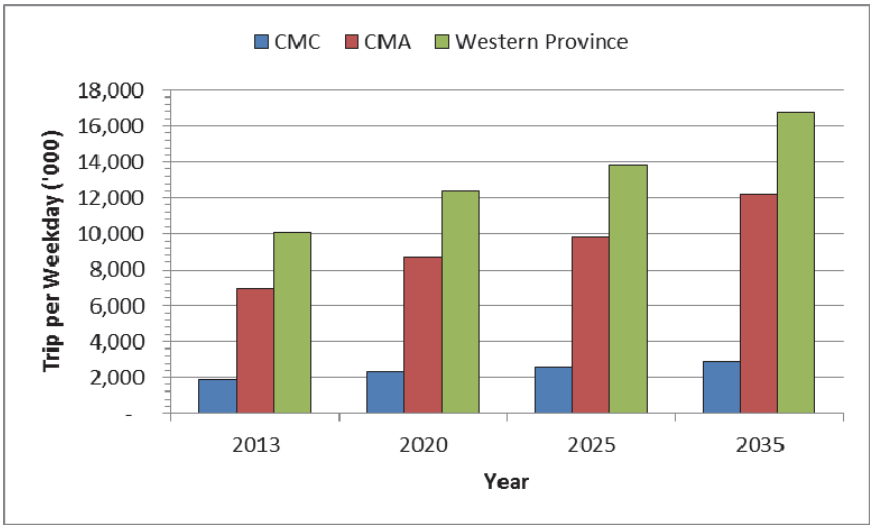
(4) Increase in Ownership of Private Modes of Transport

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

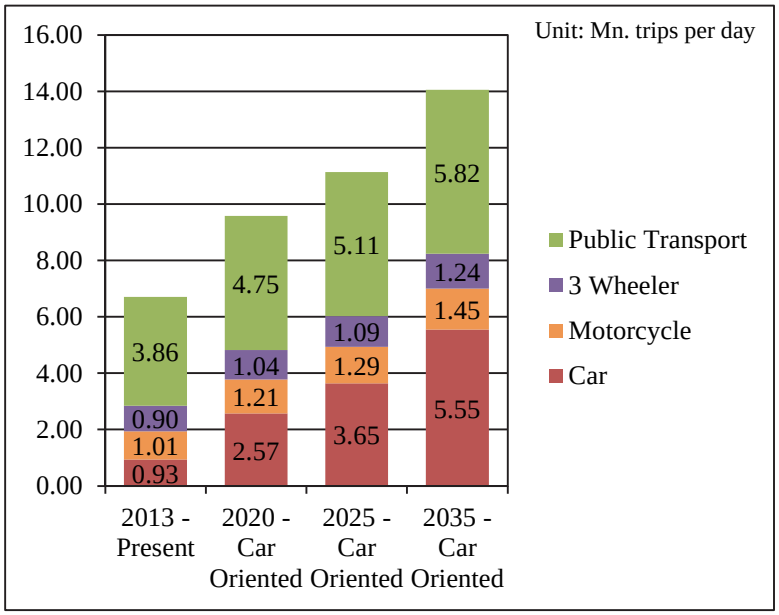


Source: CoMTrans Estimate

Figure 5.2.1 Increase of Person Trip Demand by Region: 2013 – 2035

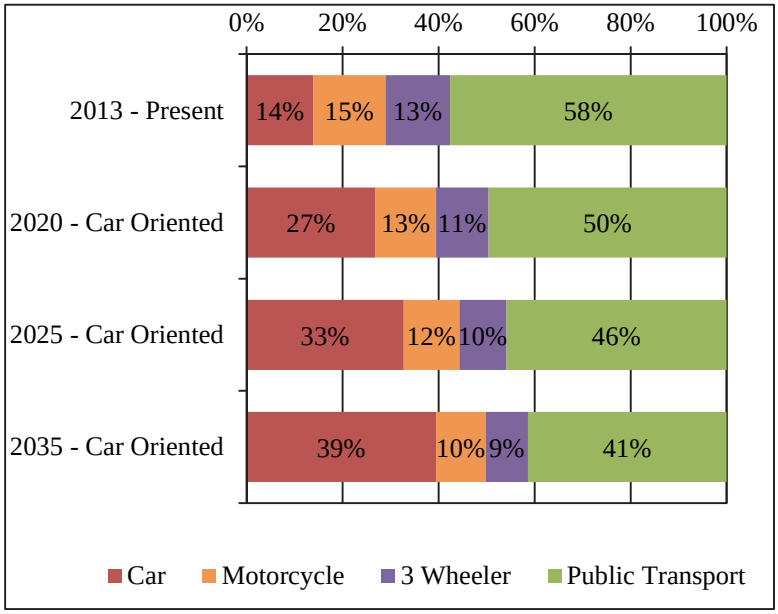
Total person trip demand would increase by 1.75 times from 2013 to 2035 however it should be noted that the trips made by private cars would increase from 0.93 million trips in 2013 to 5.55 million trips in 2035, which implies that the growth of trips by cars accounts for almost six times of the increase 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.

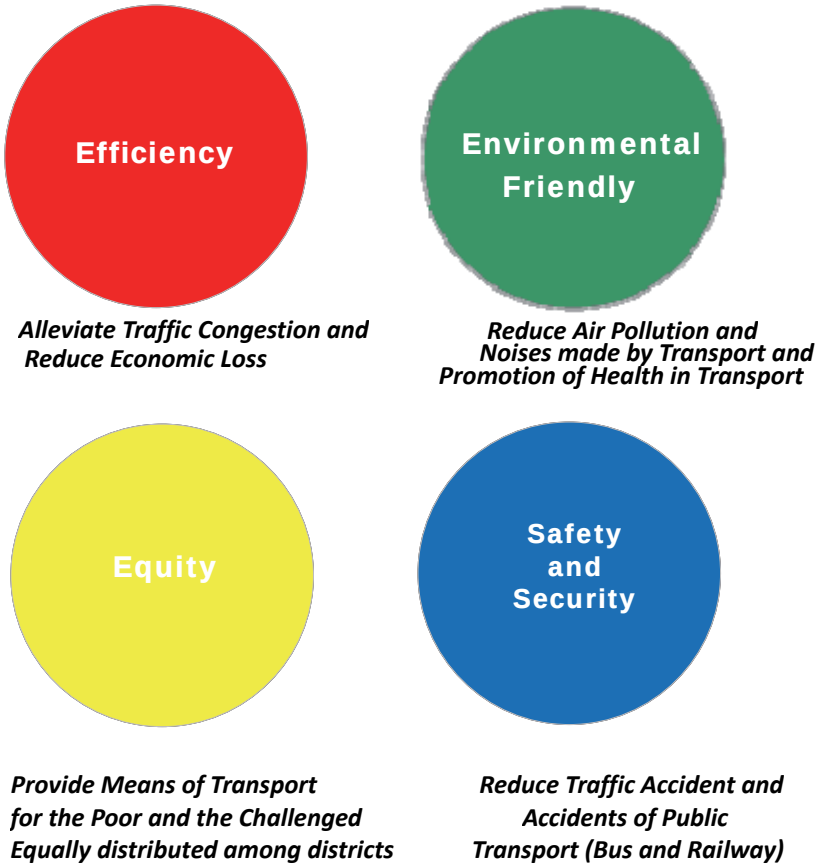
(3) Environmental Improvement and Health Promotion related to Transport

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

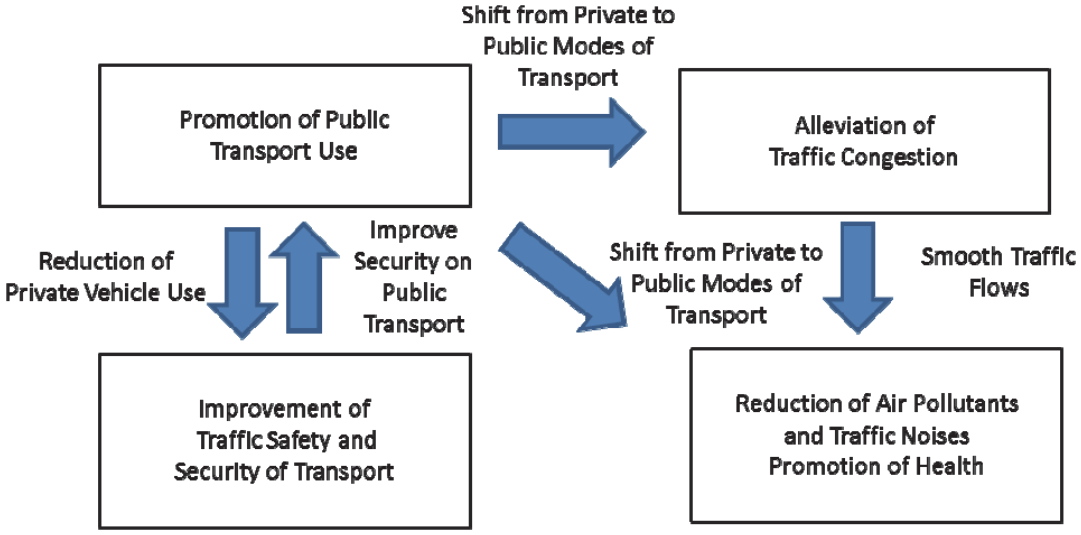
3) Reduction of Air Pollutants/Traffic Noise and Promotion of Health

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

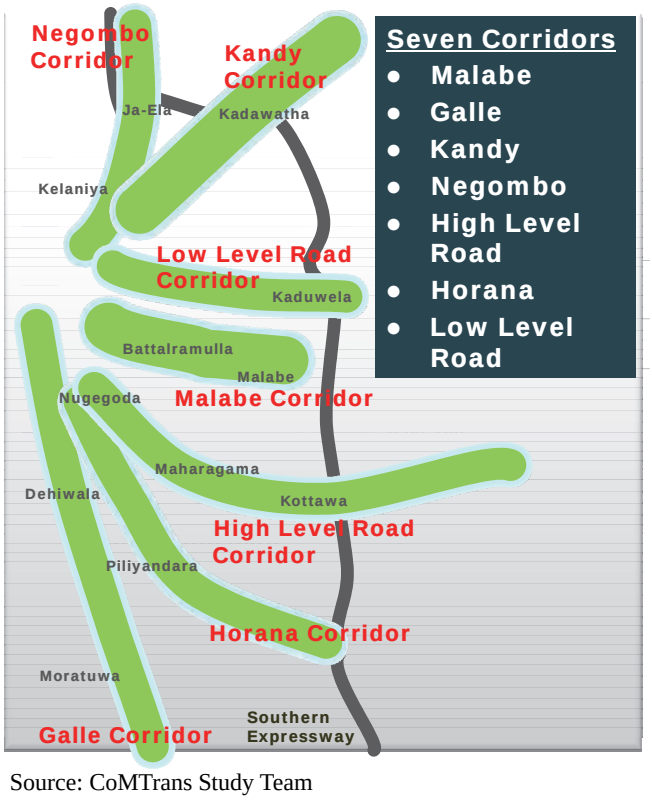
- Establishment of Urban Road Design Standard including Sidewalk
- Improvement of Security of Women and Children in Public Transport

5.7 Analysis on Major Transport Corridors

5.7.1 Seven Major Transport Corridors

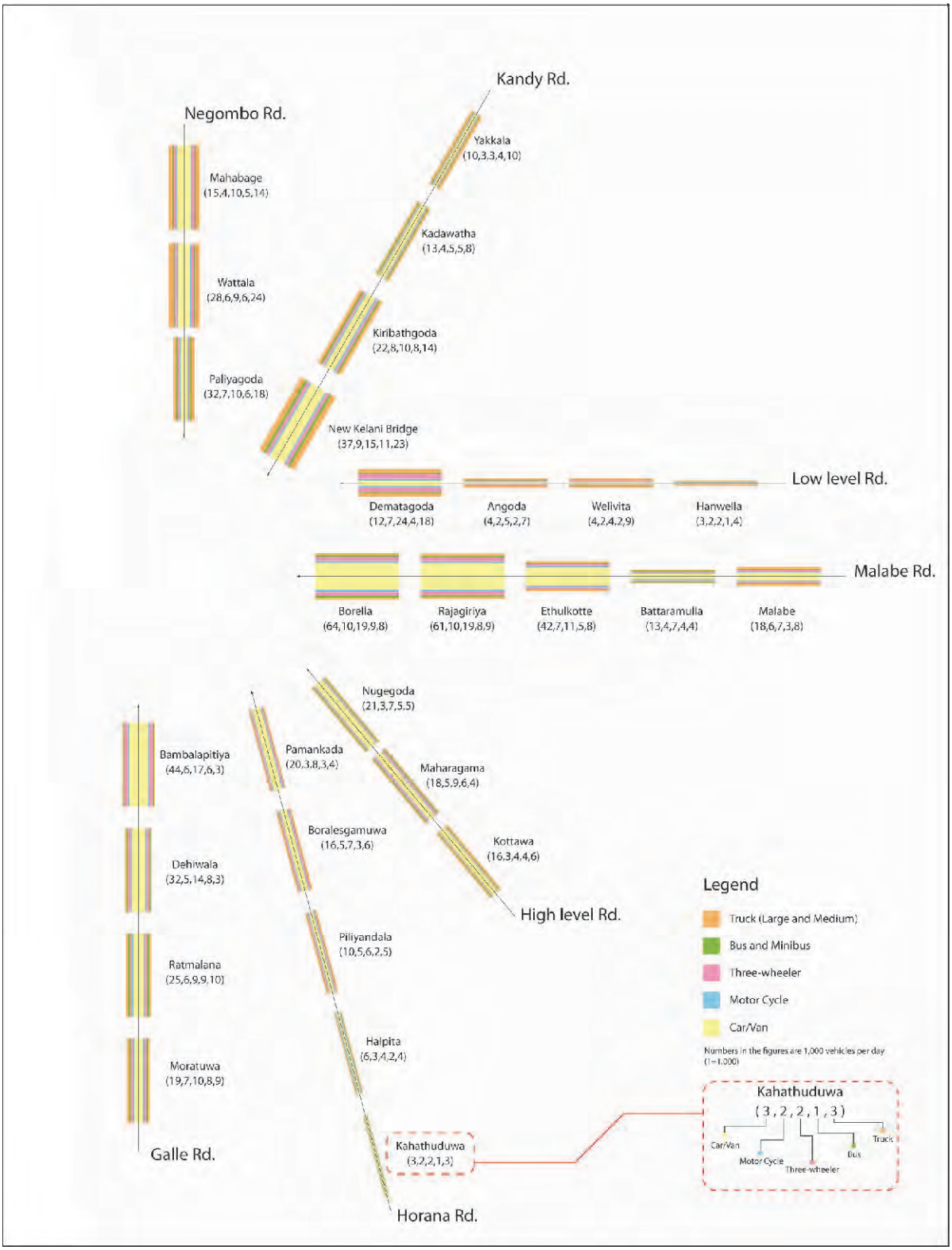
Prior to the evaluation on the urban transport system development scenarios, preliminary analysis on seven major radial transport corridors was undertaken to understand the potential transport demand in the target year 2035. Seven transport corridors have been identified as major radial corridors which 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

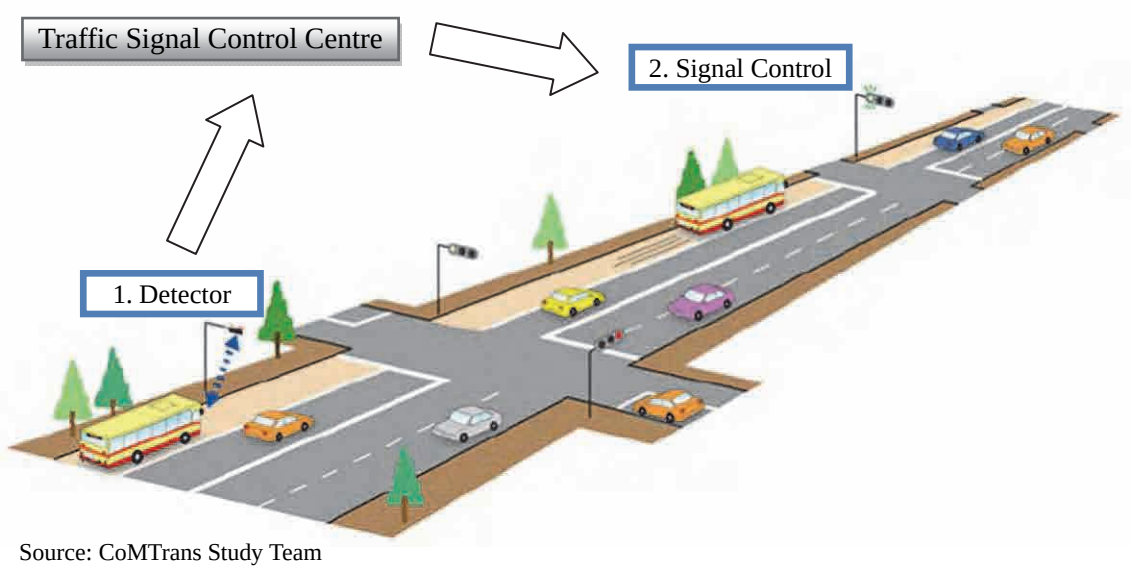


Source: CoMTrans Study Team

Figure 5.7.2 Traffic Demand on Seven Corridors

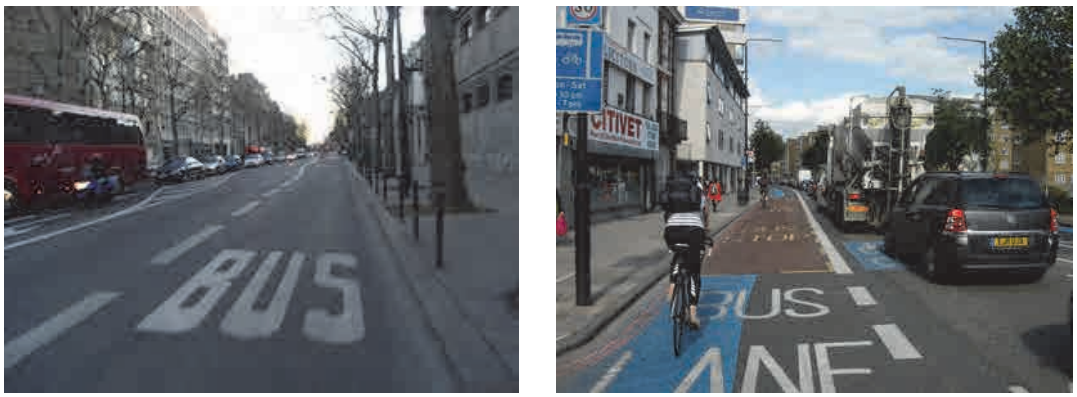
(1) Bus Priority System

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

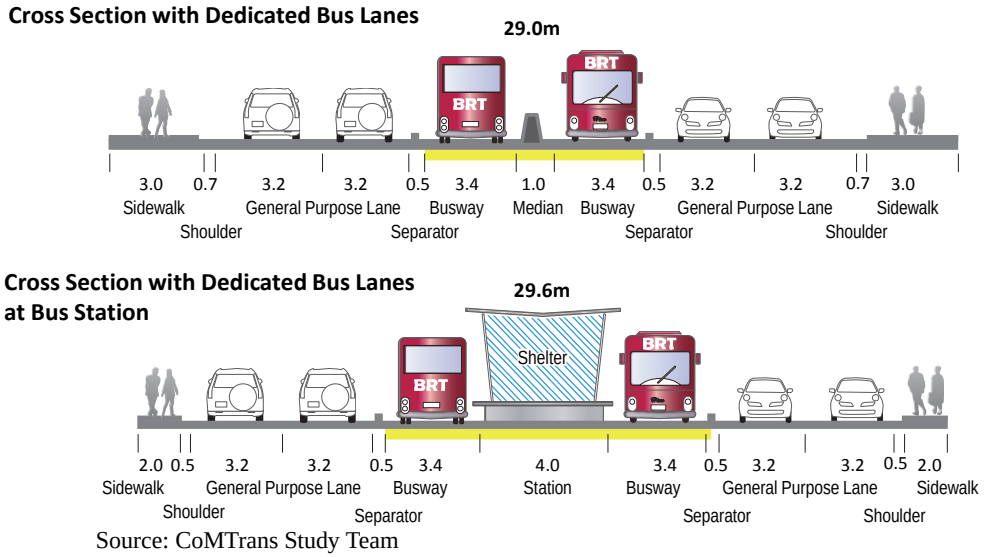
Table 5.7.4 Specifications of Bus Rapid Transit (BRT)

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

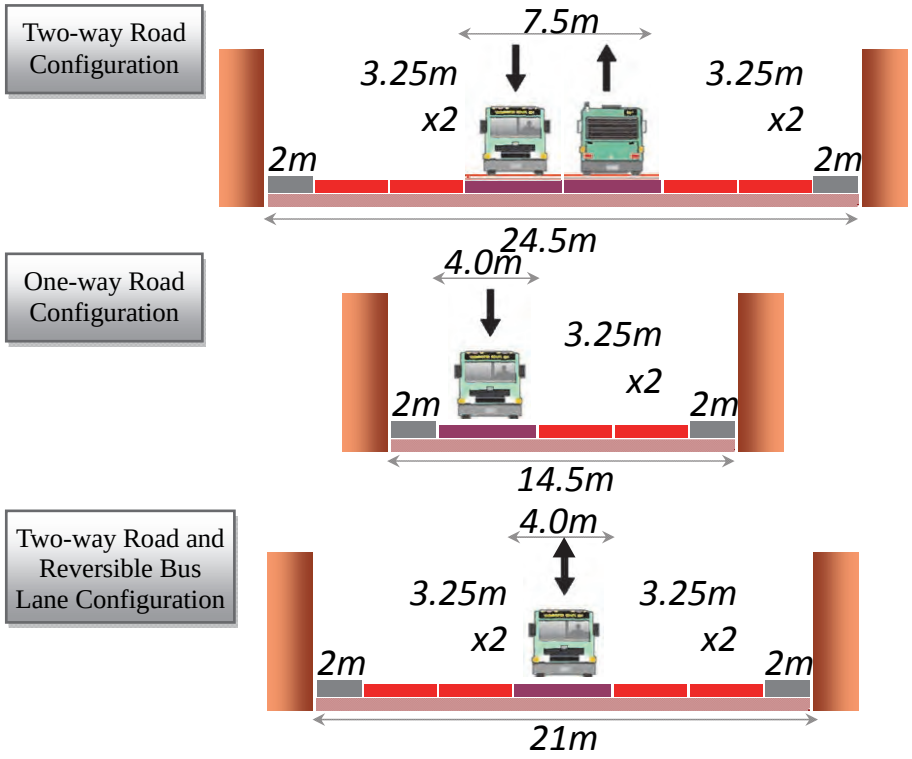
Although BRT is an inexpensive and high-capacity public mode of transport, it is essential to allocate one lane of the road for each direction. When it comes to its application in the Colombo Metropolitan Area, the limited availability of road space should be taken into account. Figure 5.7.6 shows typical 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)

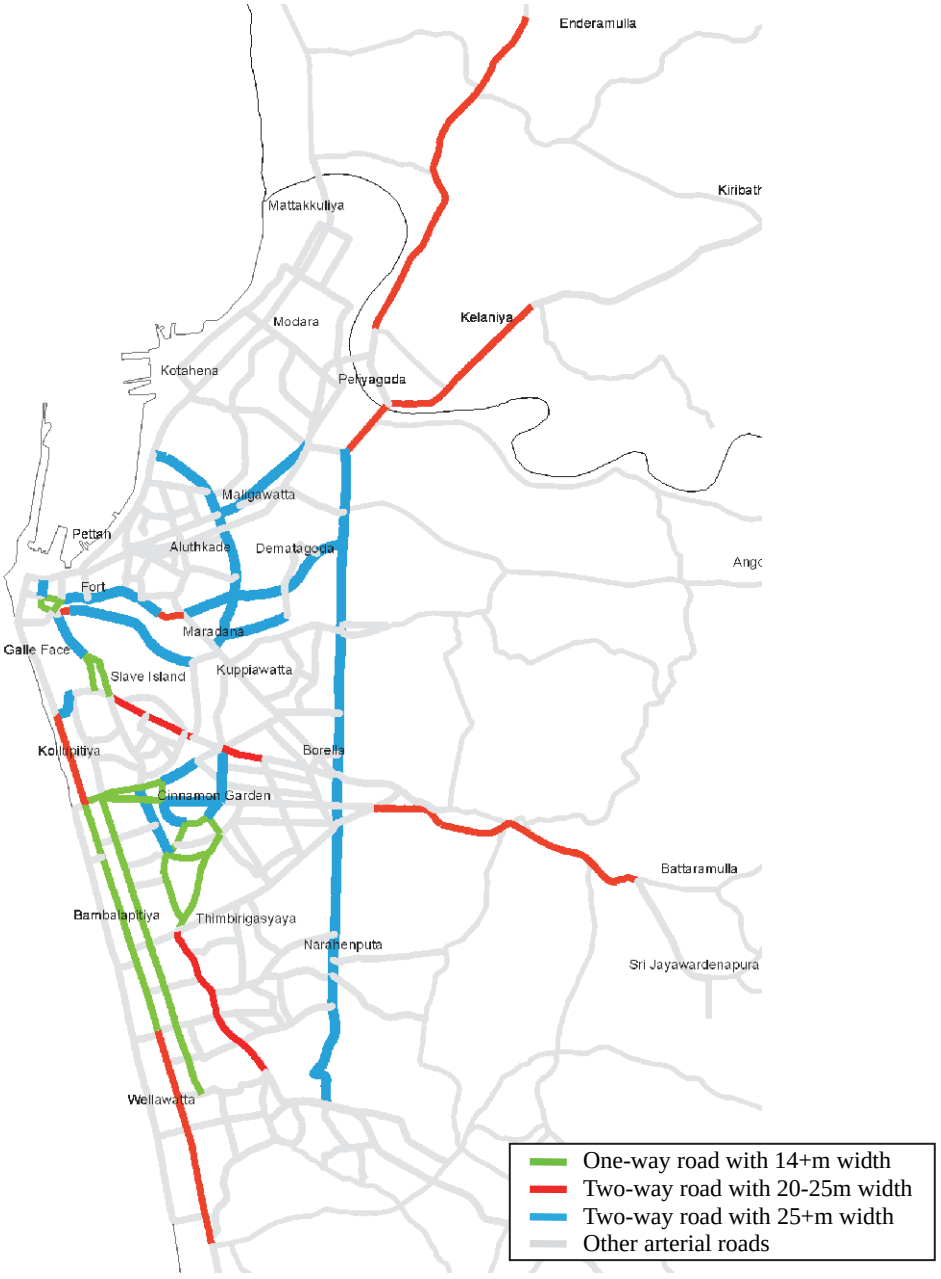
Unfortunately, only a few roads have a width of more than 29 m in the Colombo Metropolitan Area (CMA). This implies that the application of typical cross-sections might require a significant amount of land acquisition. However, compromises in the width of bus lanes and width of sidewalks can be proposed 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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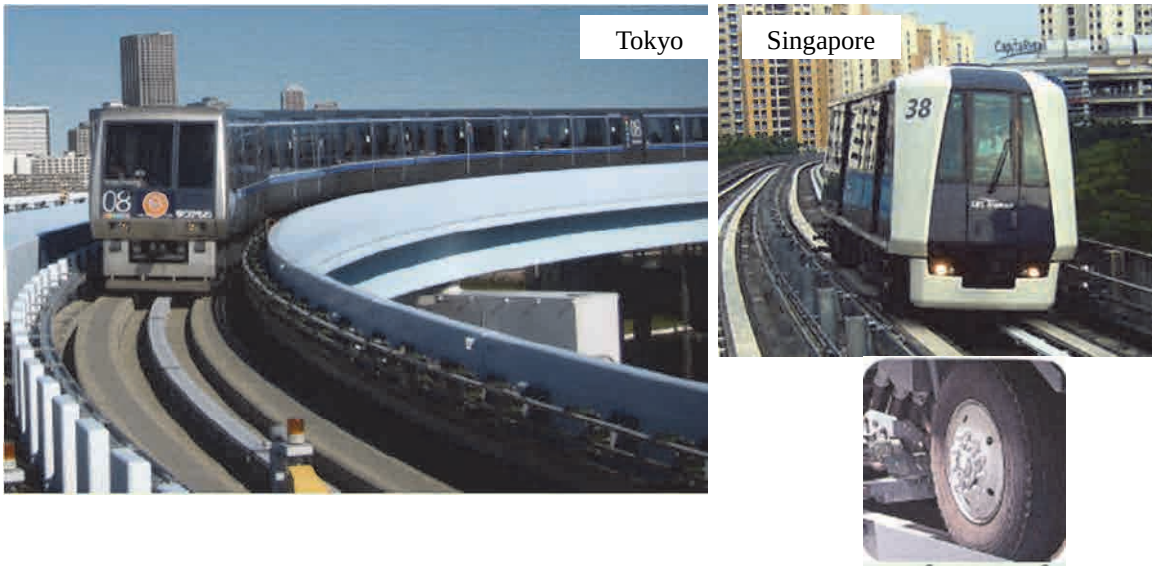


Source: Japan Transportation Planning Association (left and lower right) and Wikimedia Free License Pictures (Upper right)

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.

Hiroshima

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

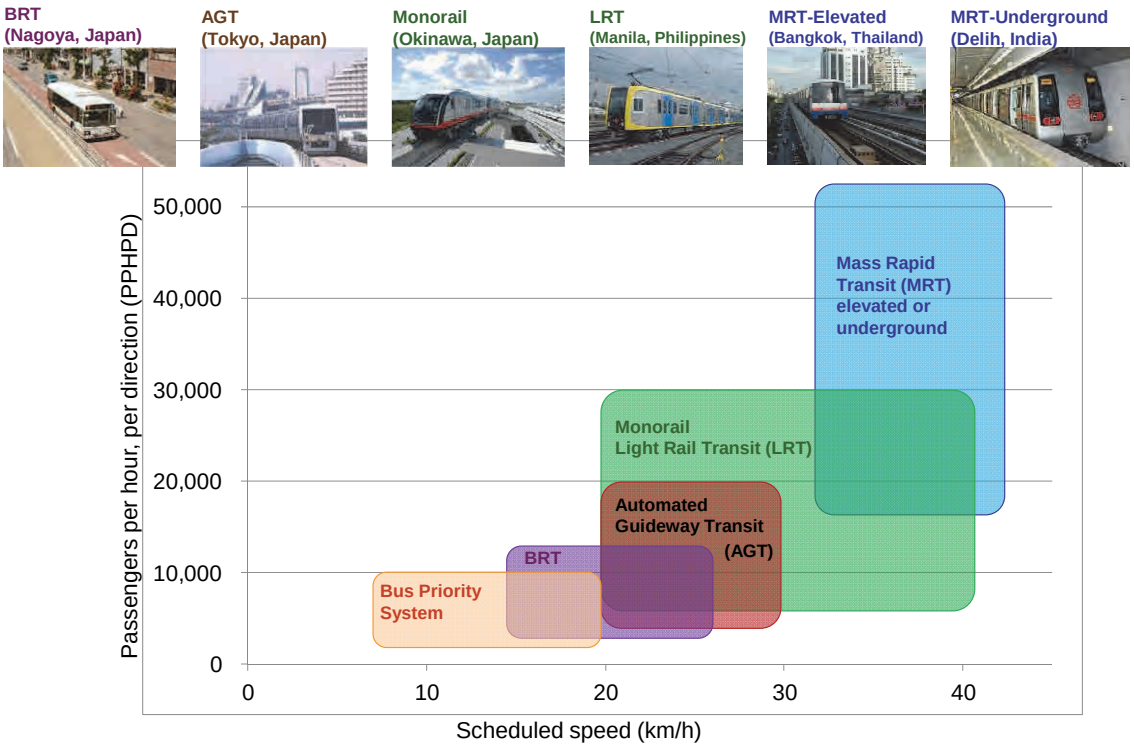
System	Bus Priority System	BRT	AGT	Monorail	LRT	MRT - Elevated	MRT - Underground
Capacity*	-10k	3-13k	4-20k	7-30k	7-30k	18-60k	18-60k
Scheduled Speed	10-20km/h	15-25m/h	20-30 km/h	20-40km/h	20-40km/h	30-40km/h	30-40km/h
Land Acquisition	no acquisition	along roads	only stations	only stations	station & 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

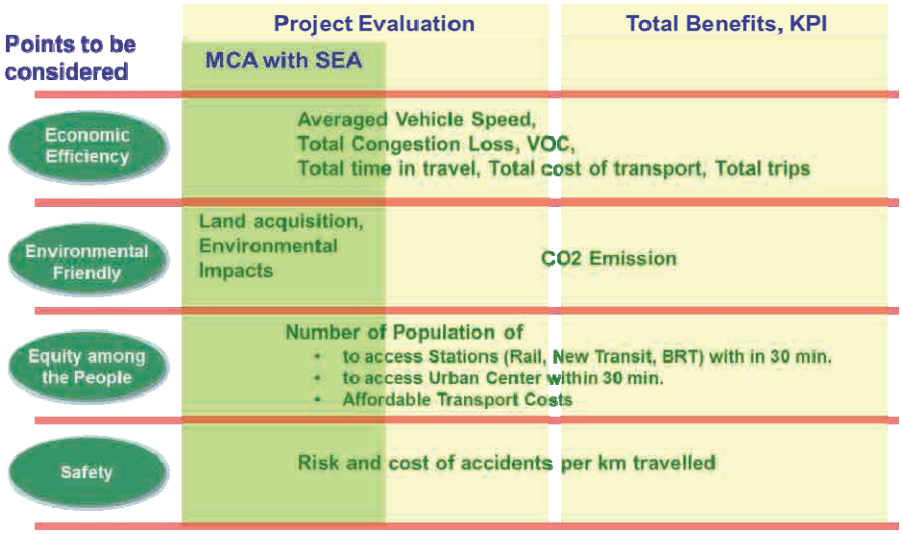
Each option is evaluated by key performance indicators for four objectives of urban transport system development as indicated in Table 5.7.15.

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	-	-	-	-	√	√	

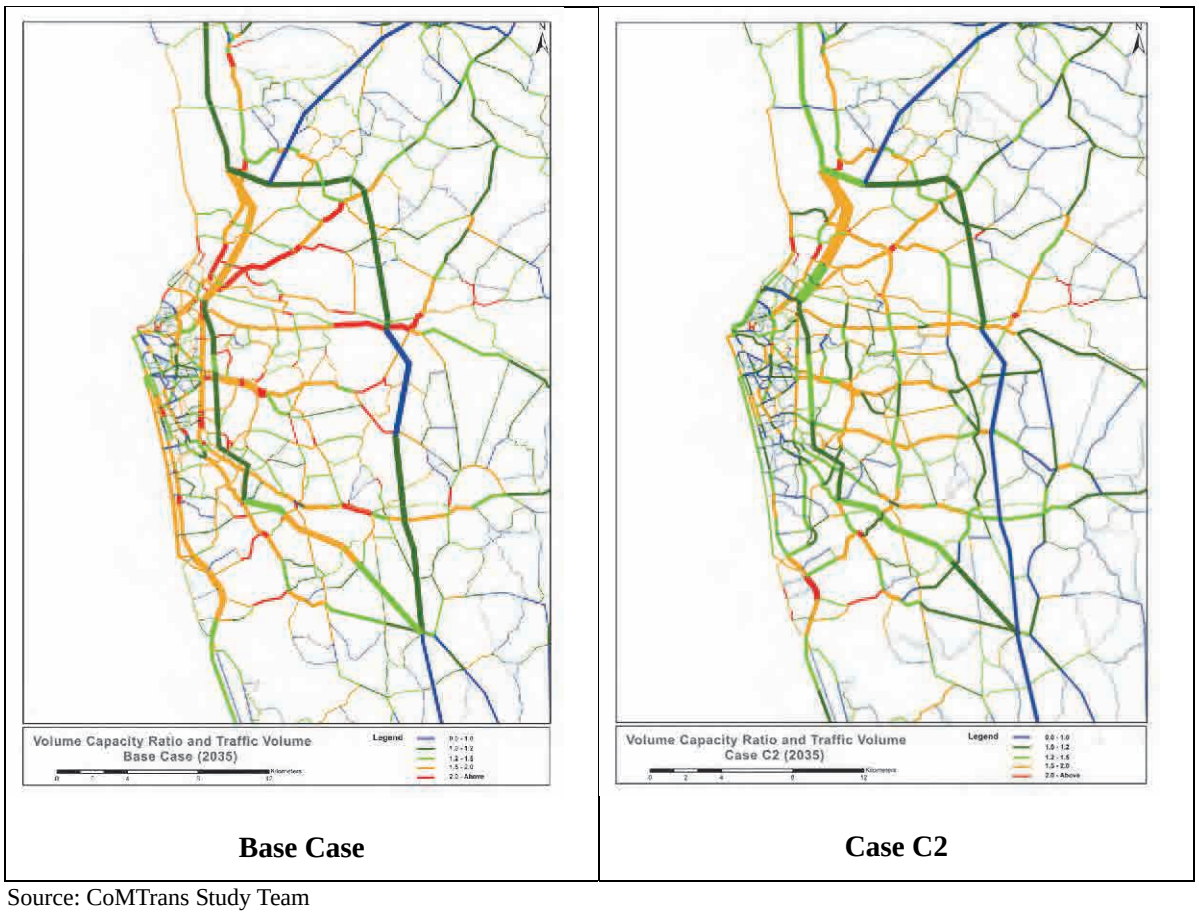
Note: √ indicates the project is included in the development scenario. – indicates that the project is not included in the scenario.

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

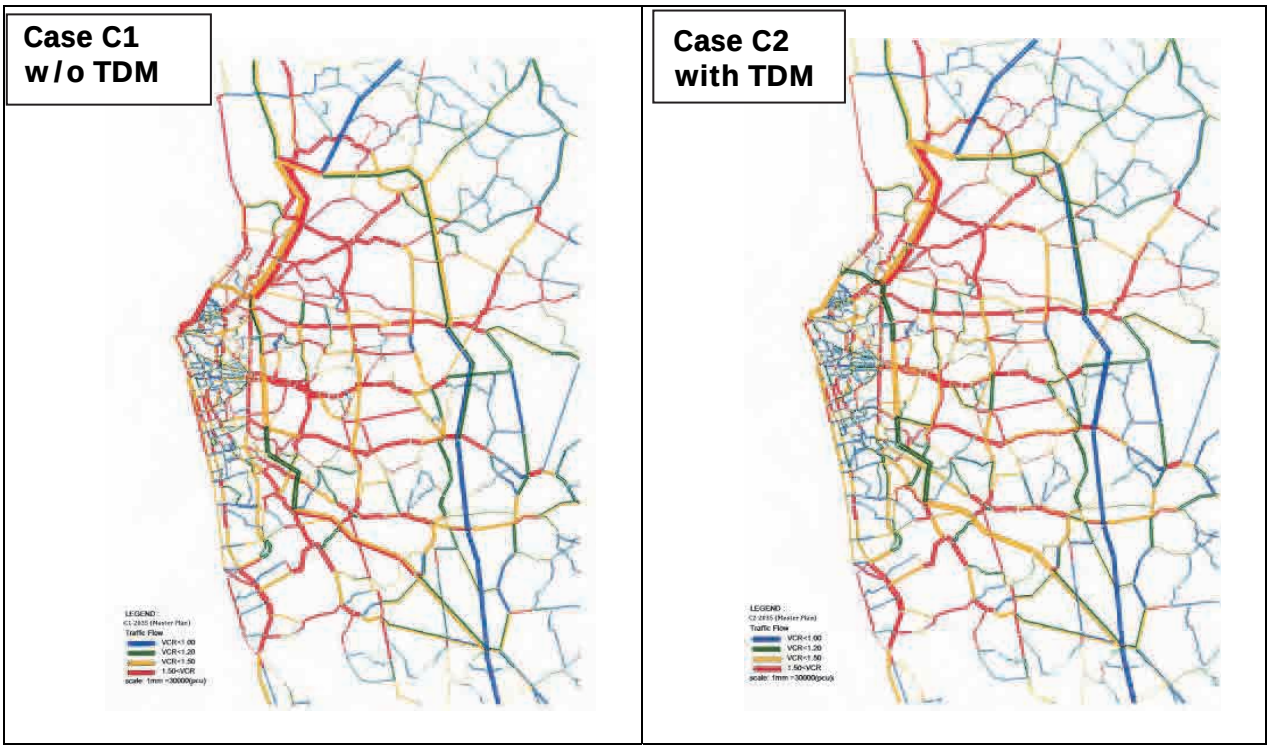
4) Traffic Safety: Economic loss due to traffic accidents

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.

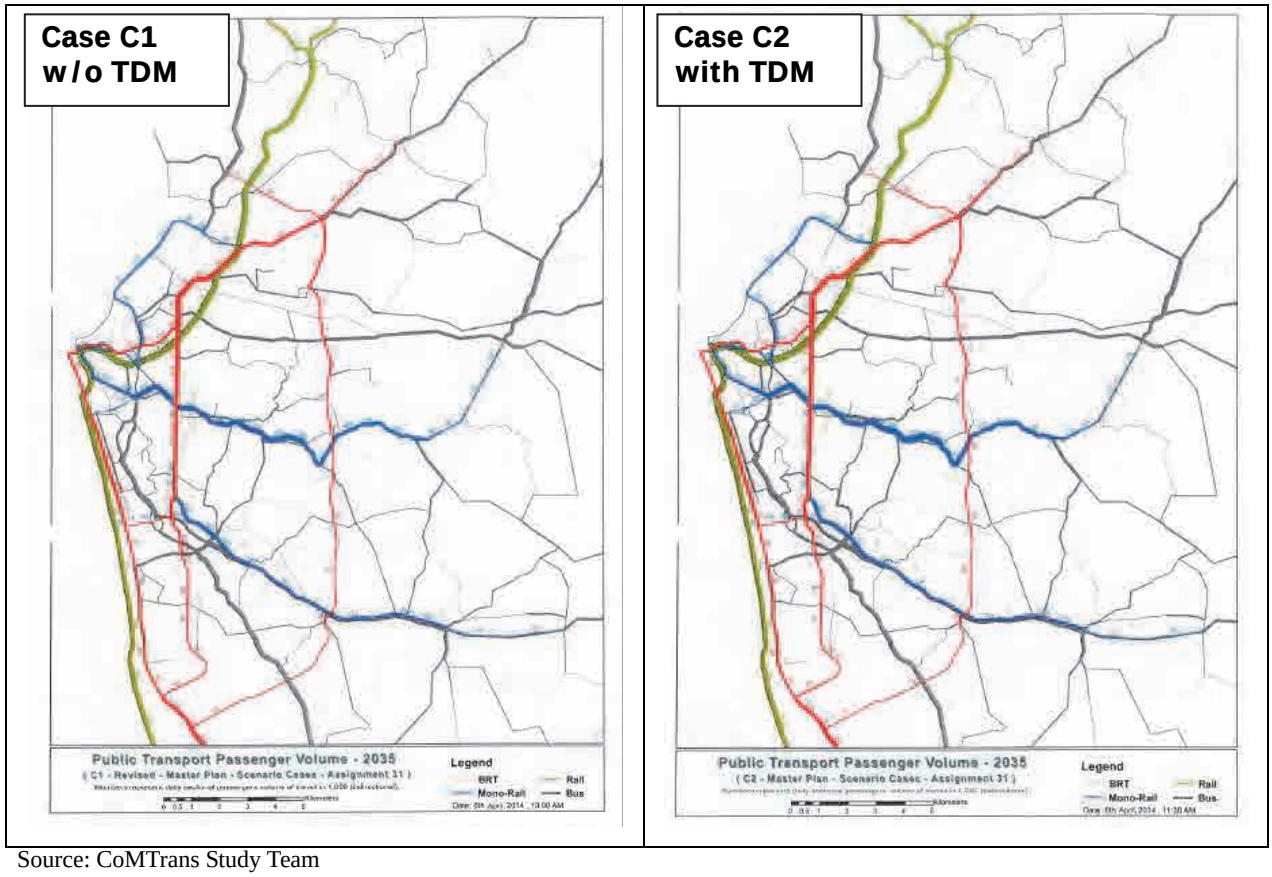
To deal with this problem, transport demand should be controlled. By employing traffic restraint schemes such as ERP, the traffic flows into the city centre could be reduced in peak hours and it this would lead to a shift to public transport. This can be observed by comparing Case C1 and Case C2. Traffic 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.

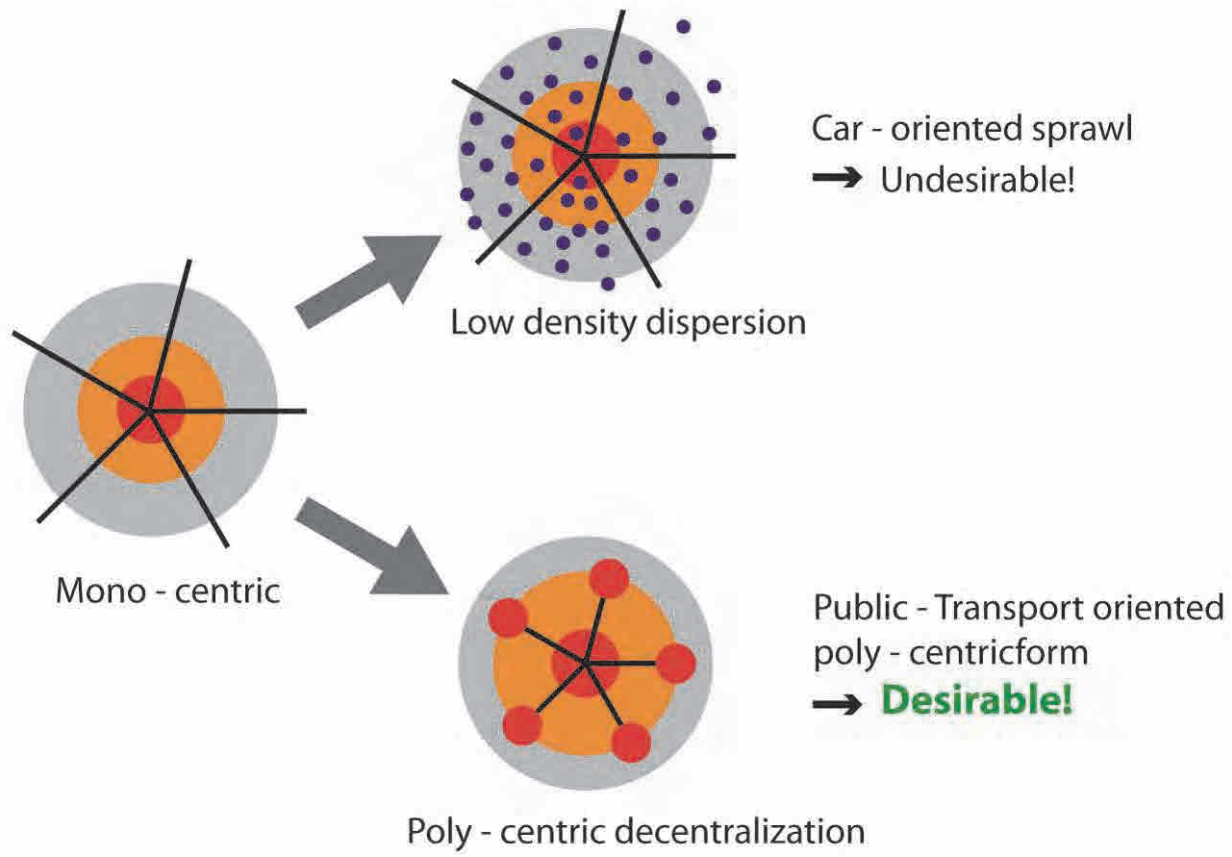
5.11.1 Strategies for Integration with Urban Planning

(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

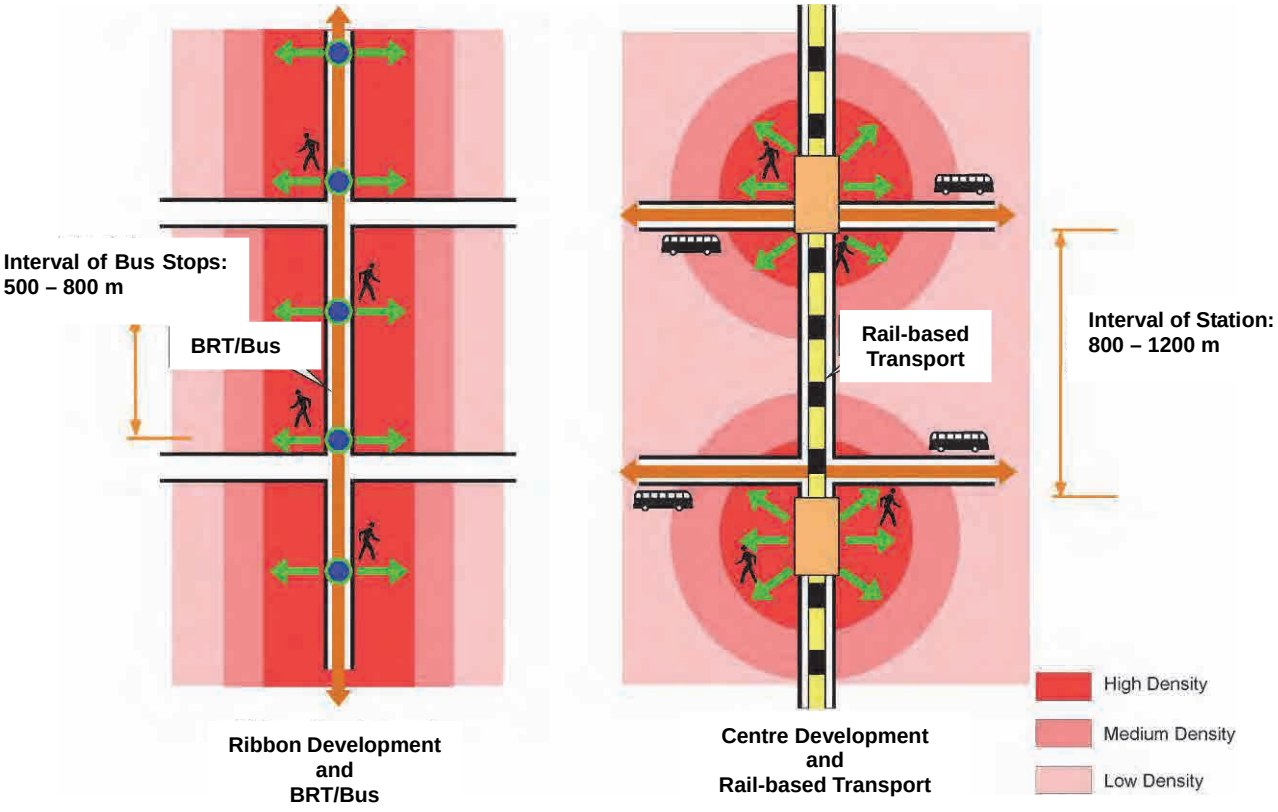
(2) Development of Public Transport Systems to be Synchronised with Urban Development

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.



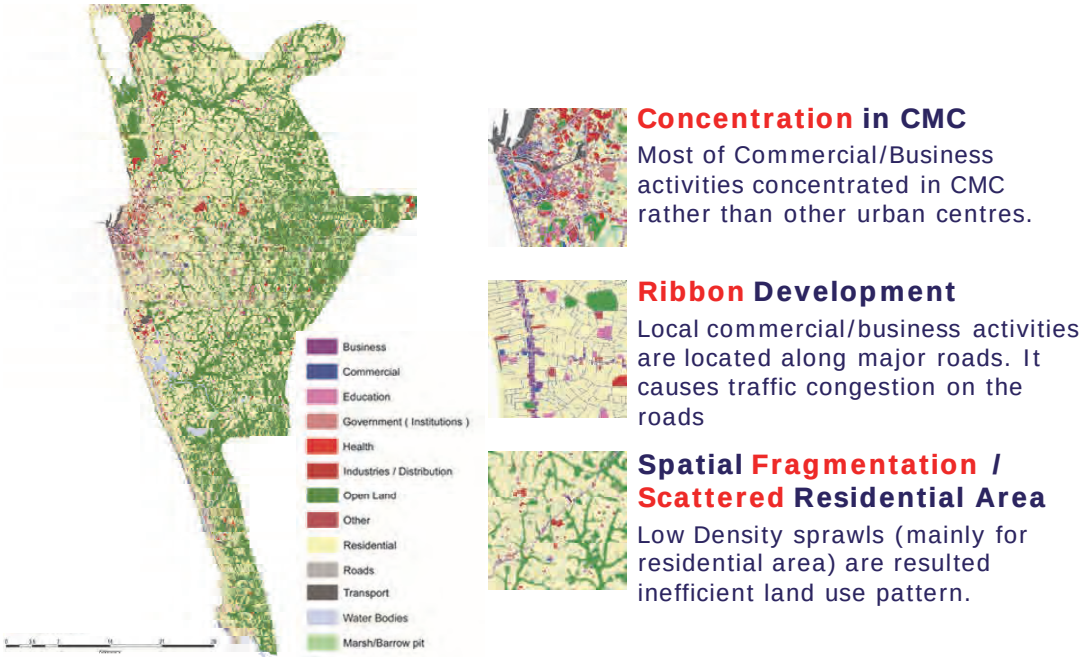
Source: CoMTrans Study Team

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.

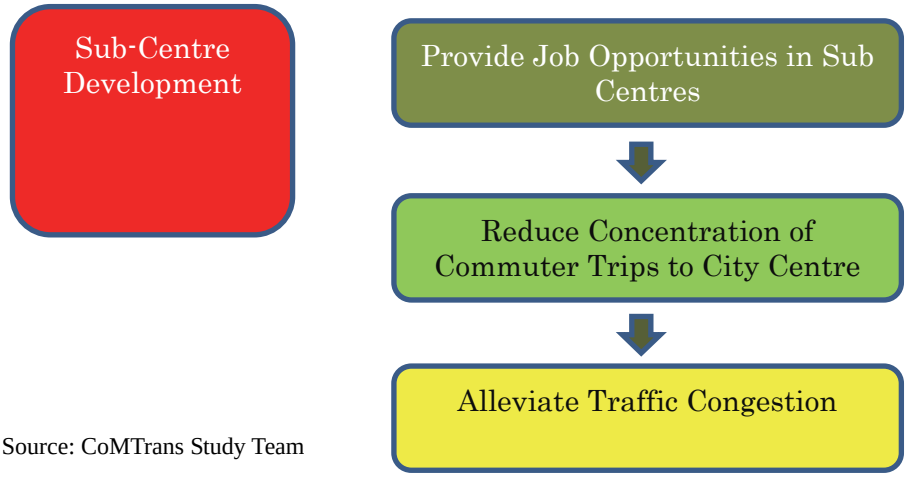
The urban transport master plan should take into consideration urban development structures.



Source: CoMTrans Land Use Survey, 2013

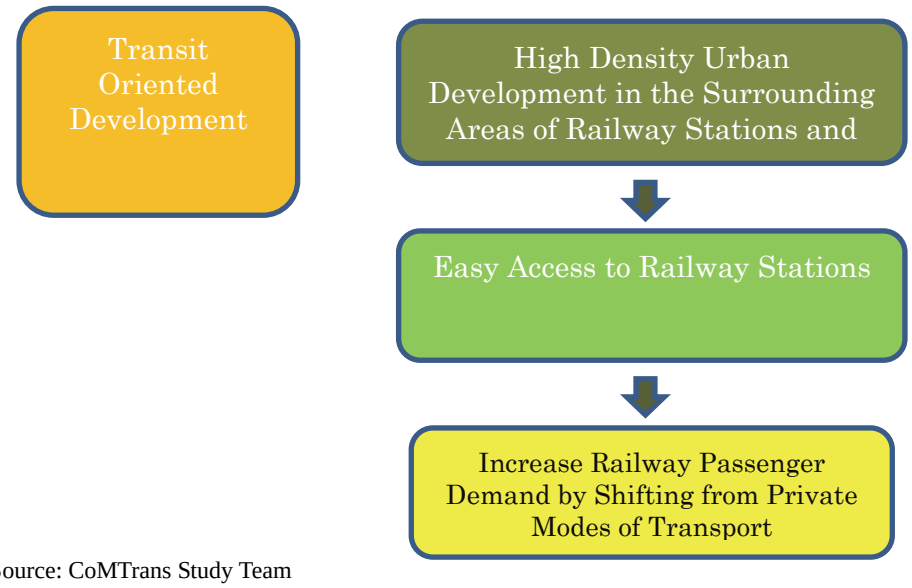
Figure 5.11.3 Present Land Use Patterns and Issues

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.

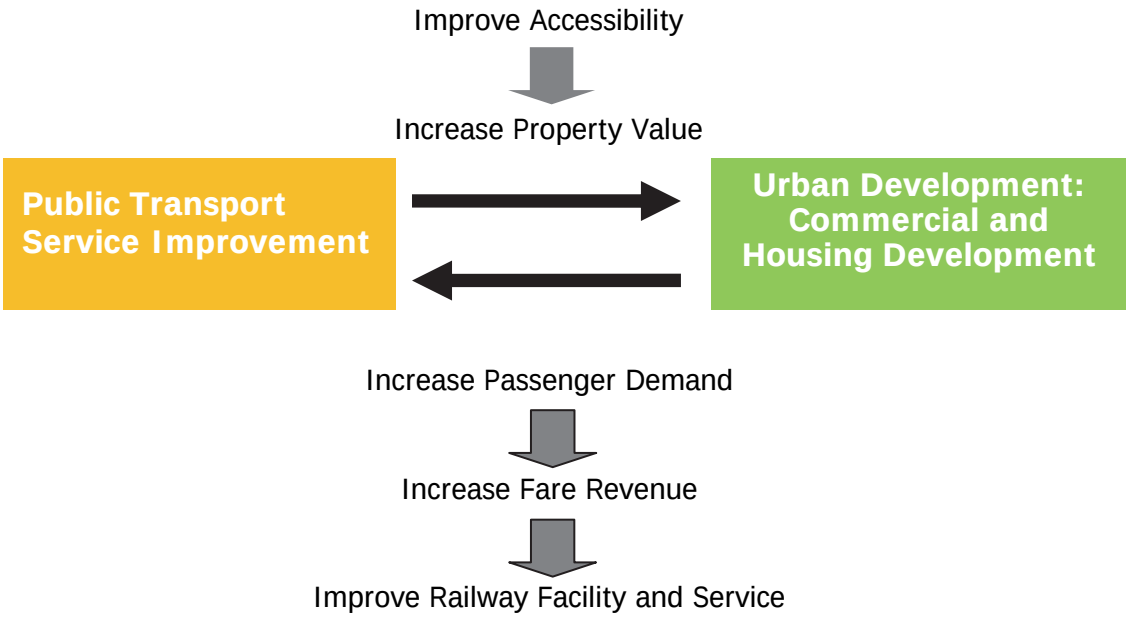
5.11.3 Strategies in Project Implementation

(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

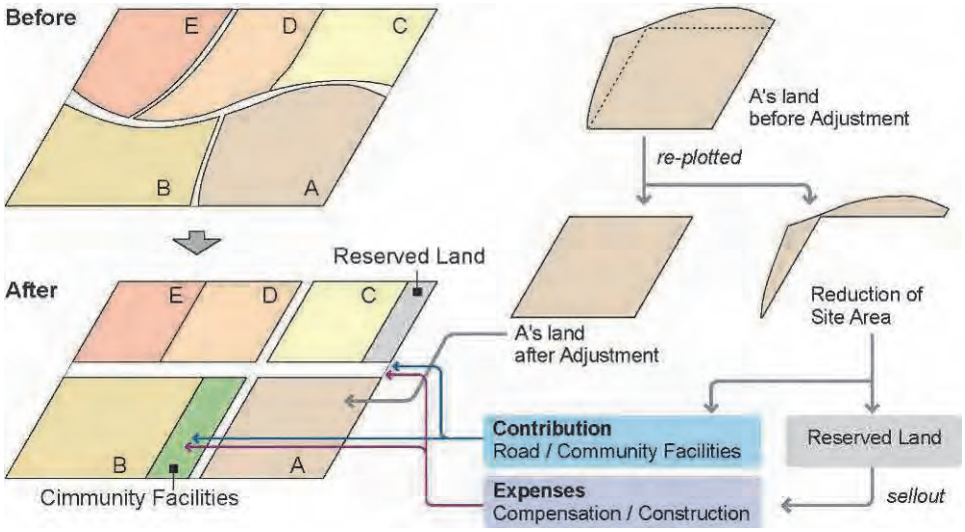
(3) Methodology of Space Preparation for Urban Development

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.



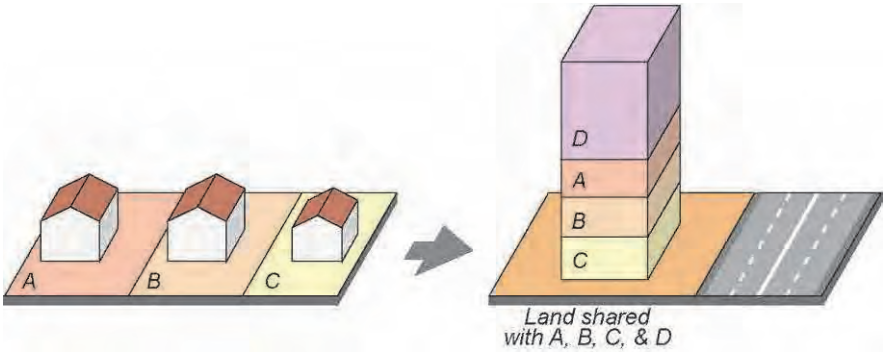
Source: CoMTrans Study Team

Figure 5.11.7 Conceptual Method of Land Re-plotting

Urban Renewal Project

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.

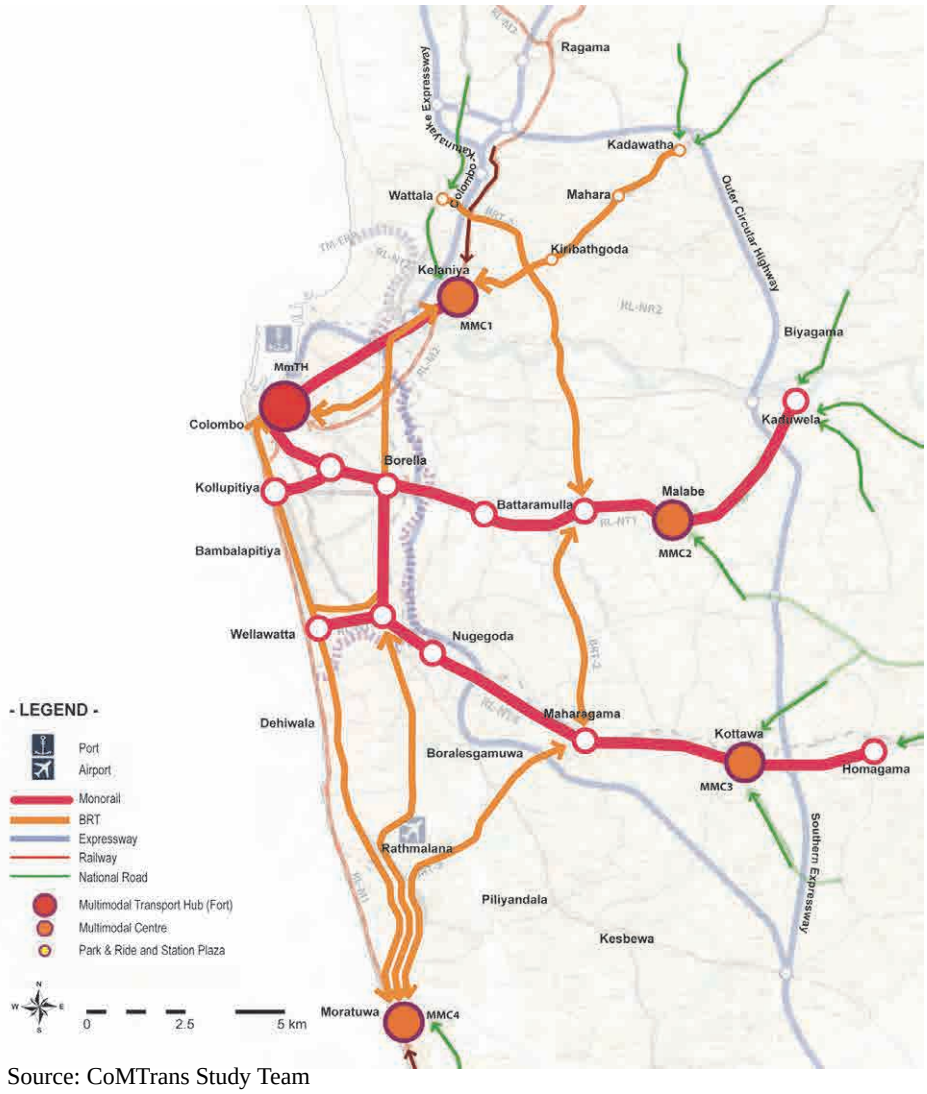
5.12.1 Inter-city Passenger Transport Systems

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

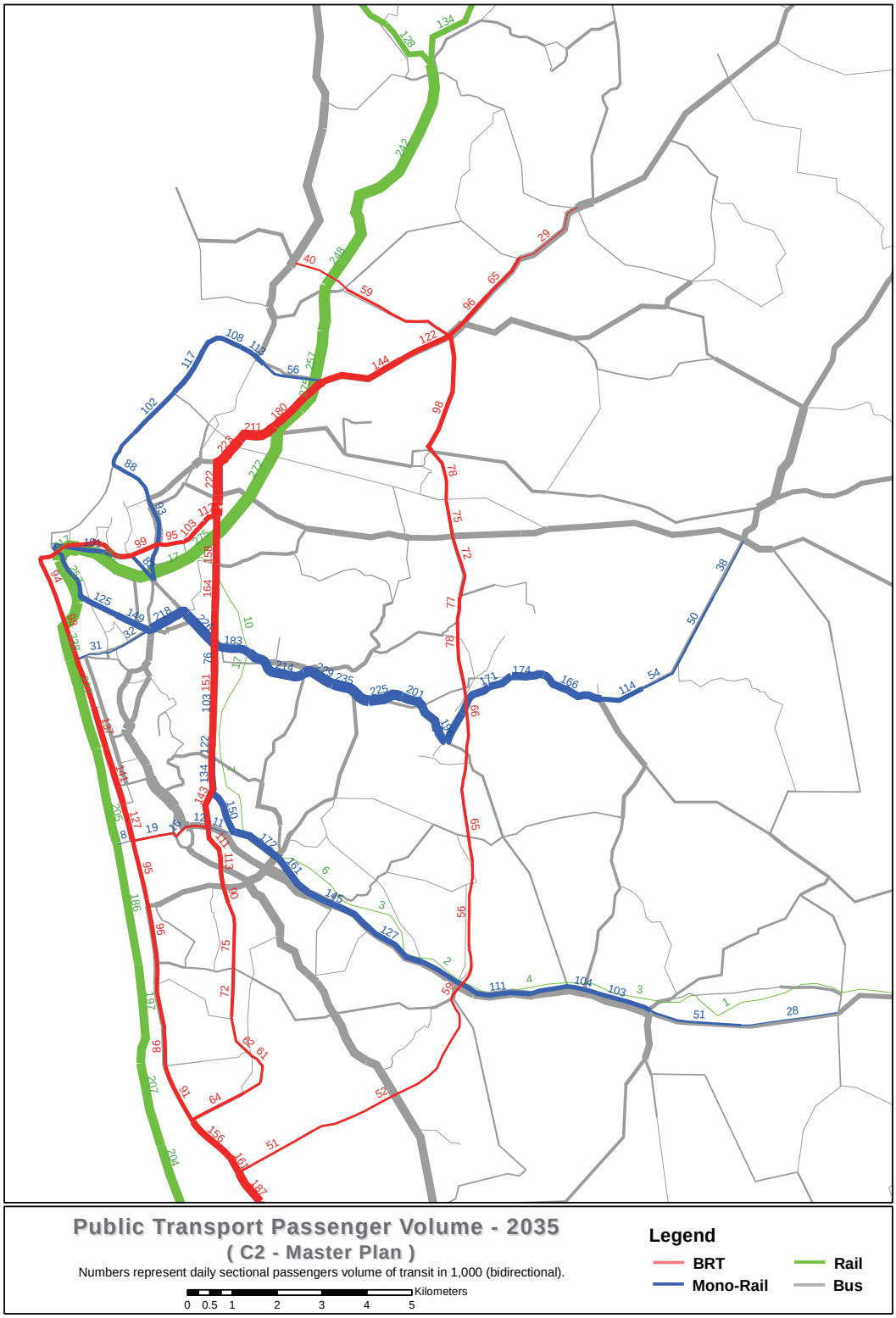
Each mode of public transport should be connected to function as a network. Public transport modes, including railways, inter-provincial buses, intra-province buses and new transit modes such as bus rapid transit (BRT) and monorail should be integrated. Railway, Monorail, and BRT as well as inter-provincial 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

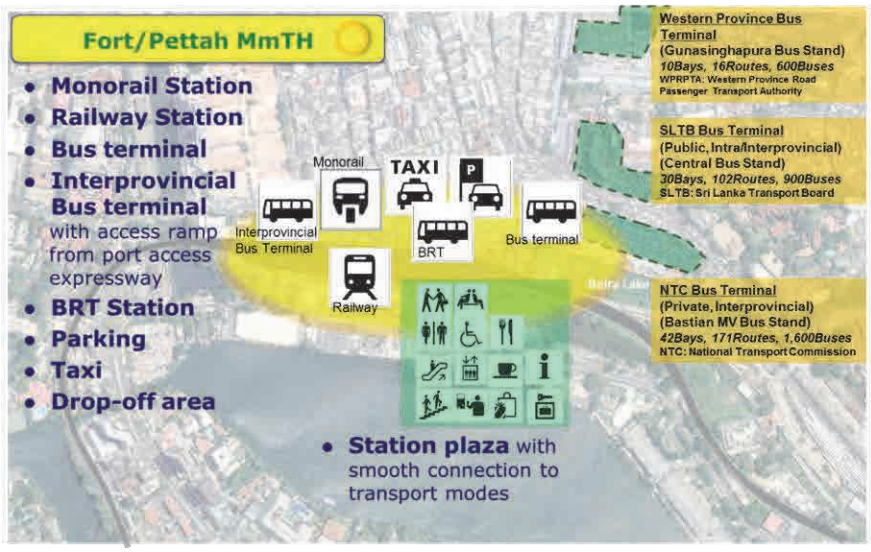
Source: CoMTrans Study Team

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)

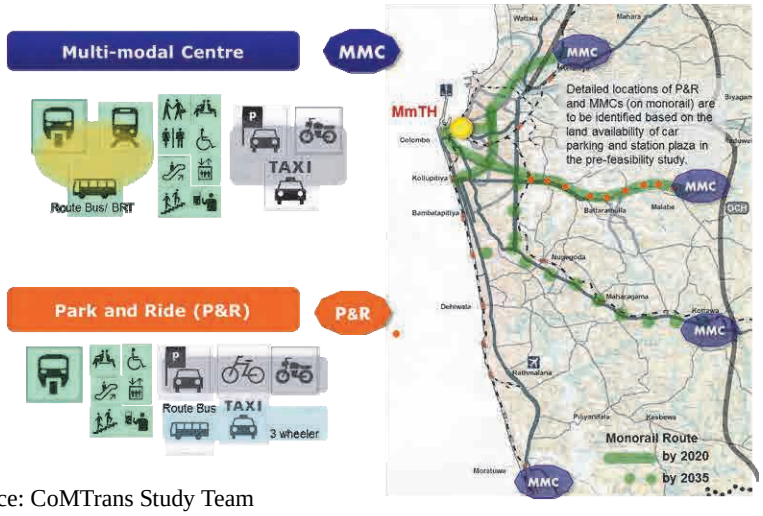
While a multi-modal transport hub will be a key component to connect all major public transport modes, concentration of all bus transport in a limited area might cause congestion in the surrounding area. Therefore, the "Multi-Modal Centre" is proposed to divert a part of the transport hub function to 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

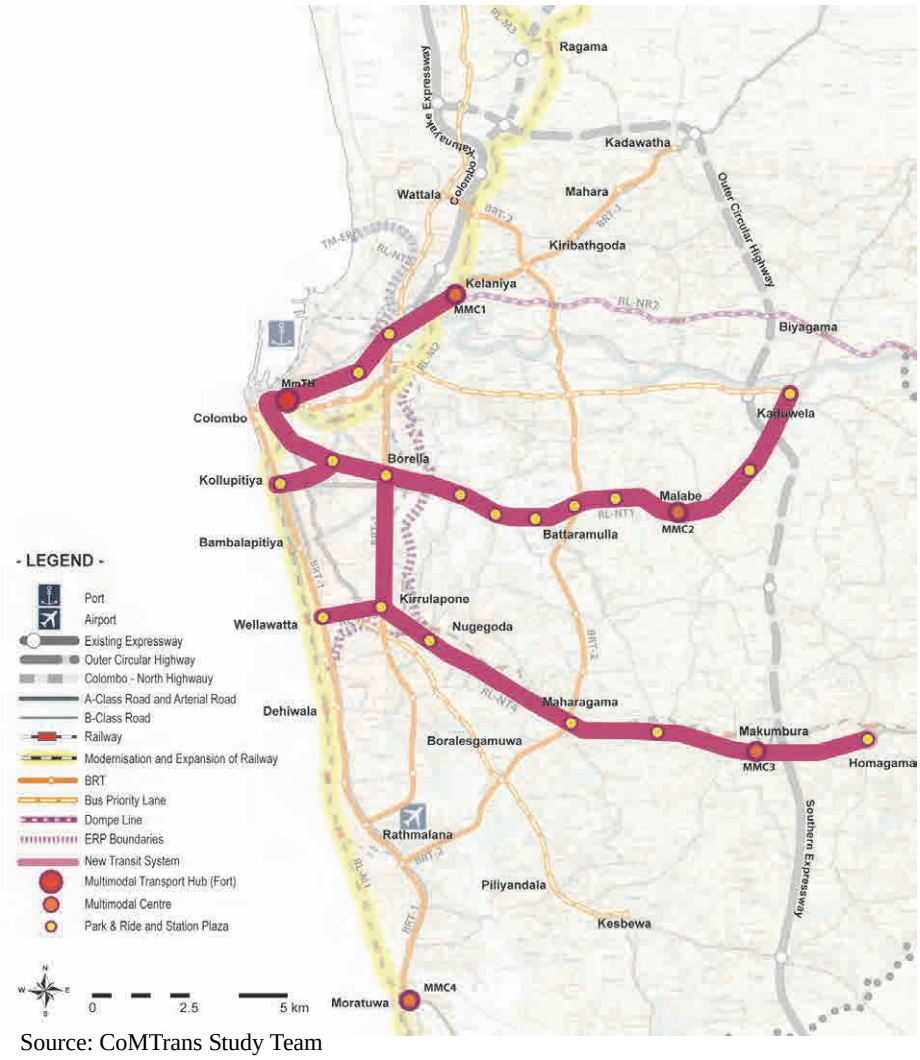
Provision of Direct Access to Multi-modal Transport Hubs for Inter-city Bus Services

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.

Park & Ride and Station Plaza Development

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

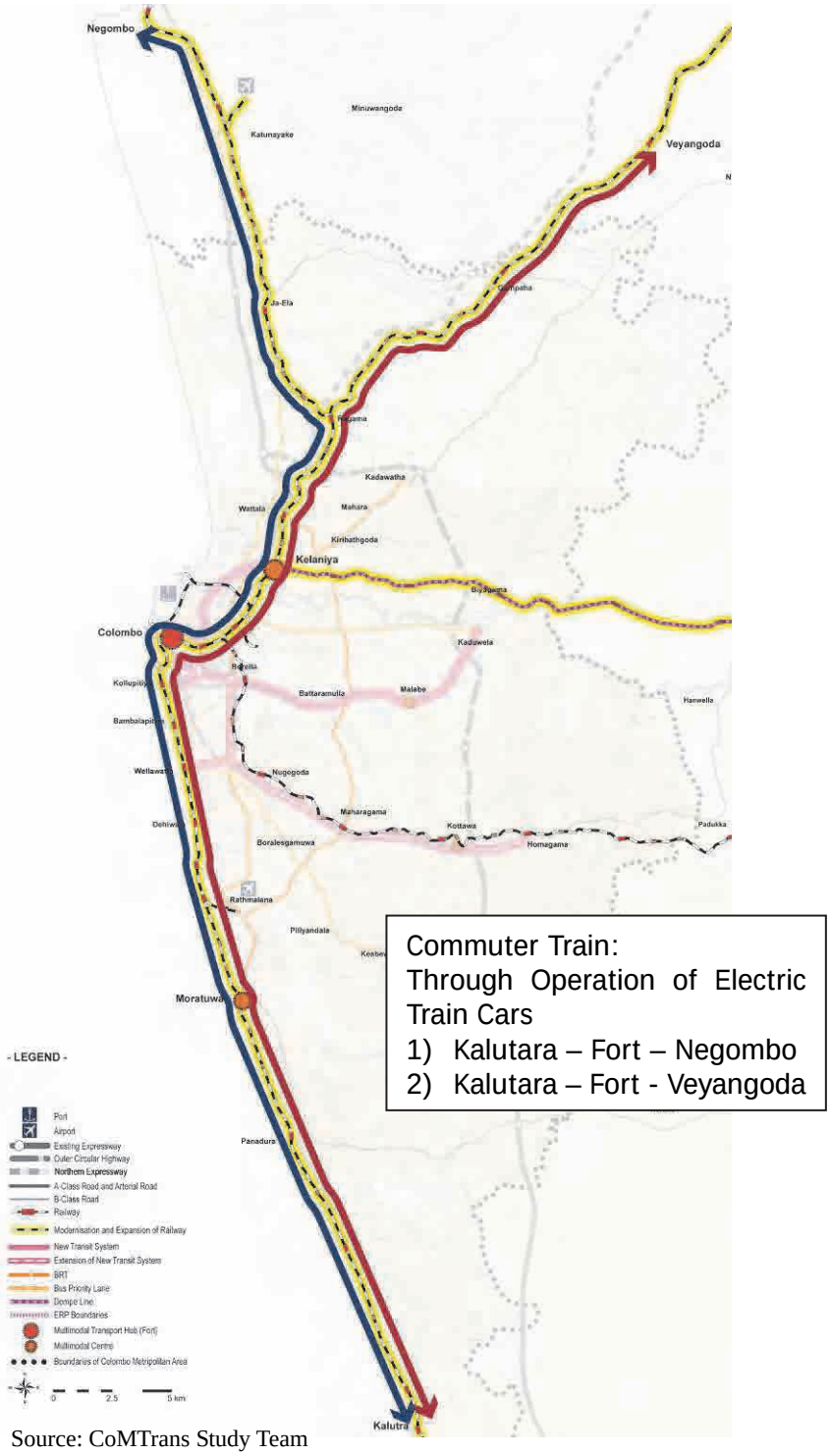
Through operation is recommended in the Fort and Maradana sections. Currently, most of the trains going north start from the Colombo Fort station and trains going south start from Maradana station. This makes the Fort and Maradana sections very congested and trains stay a long time at Fort and Maradana 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.

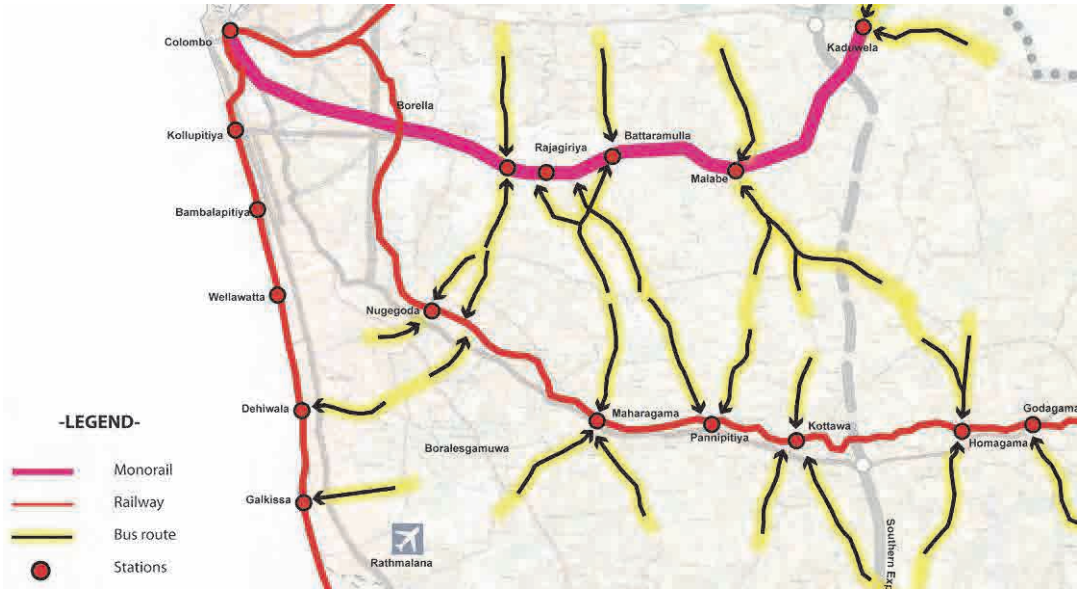


Source: CoMTrans Study Team

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.

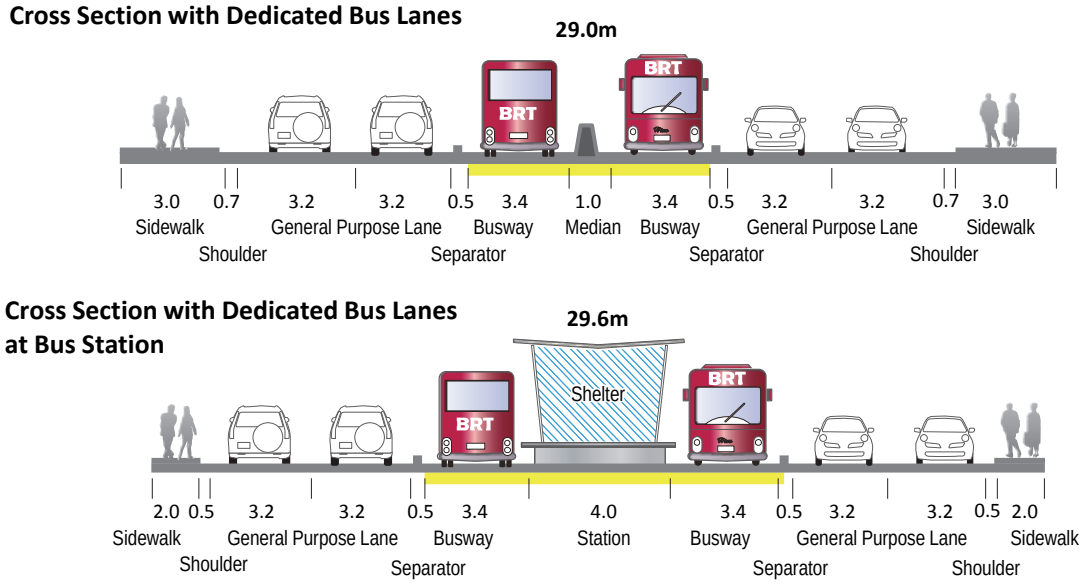
Bus rapid transit (BRT) can provide congestion-free public transport services since it has dedicated bus lanes. BRT is not expensive compared to a rail-based public transport system because usually it utilises the existing road facilities. Therefore, it can be regarded as an economical option although 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.



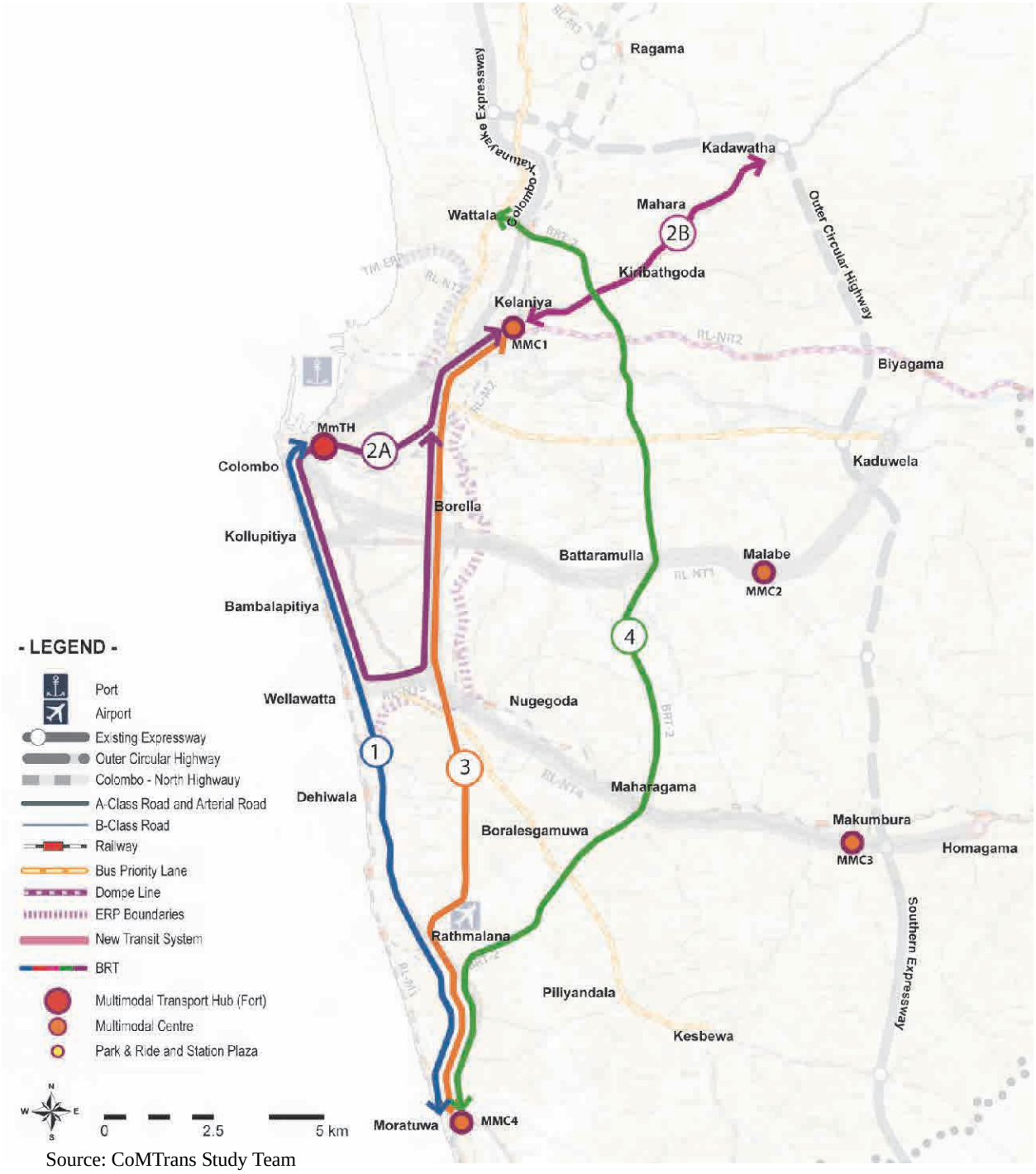
Source: CoMTrans Study Team

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

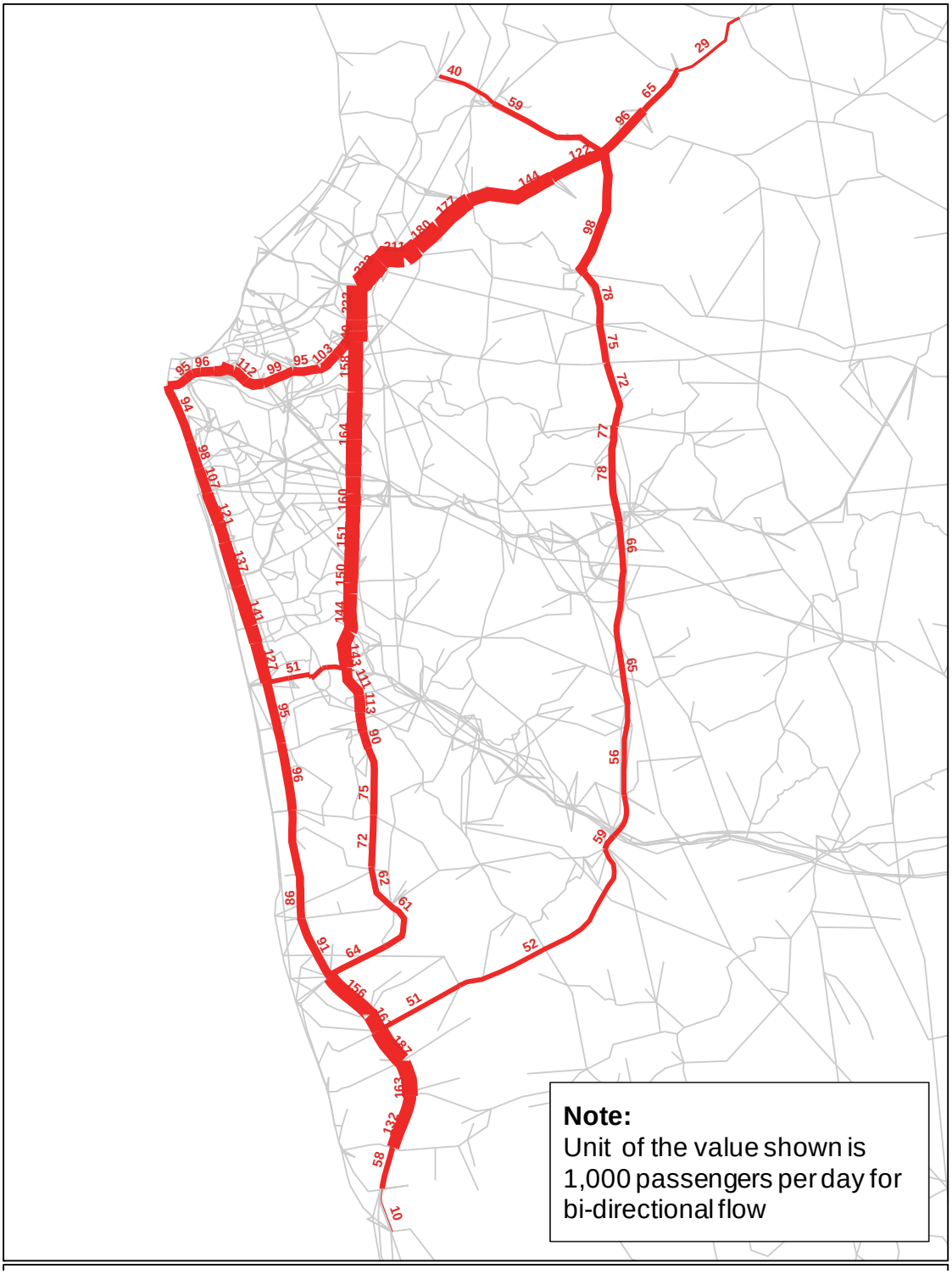
However, the existing roads which have enough space for the introduction of the exclusive bus lanes are limited in the suburbs around CMC, therefore BRT should be introduced along with the development of the road network as shown in Figure 5.13.11. Proposed BRT routes are shown in Figure 5.13.9.



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

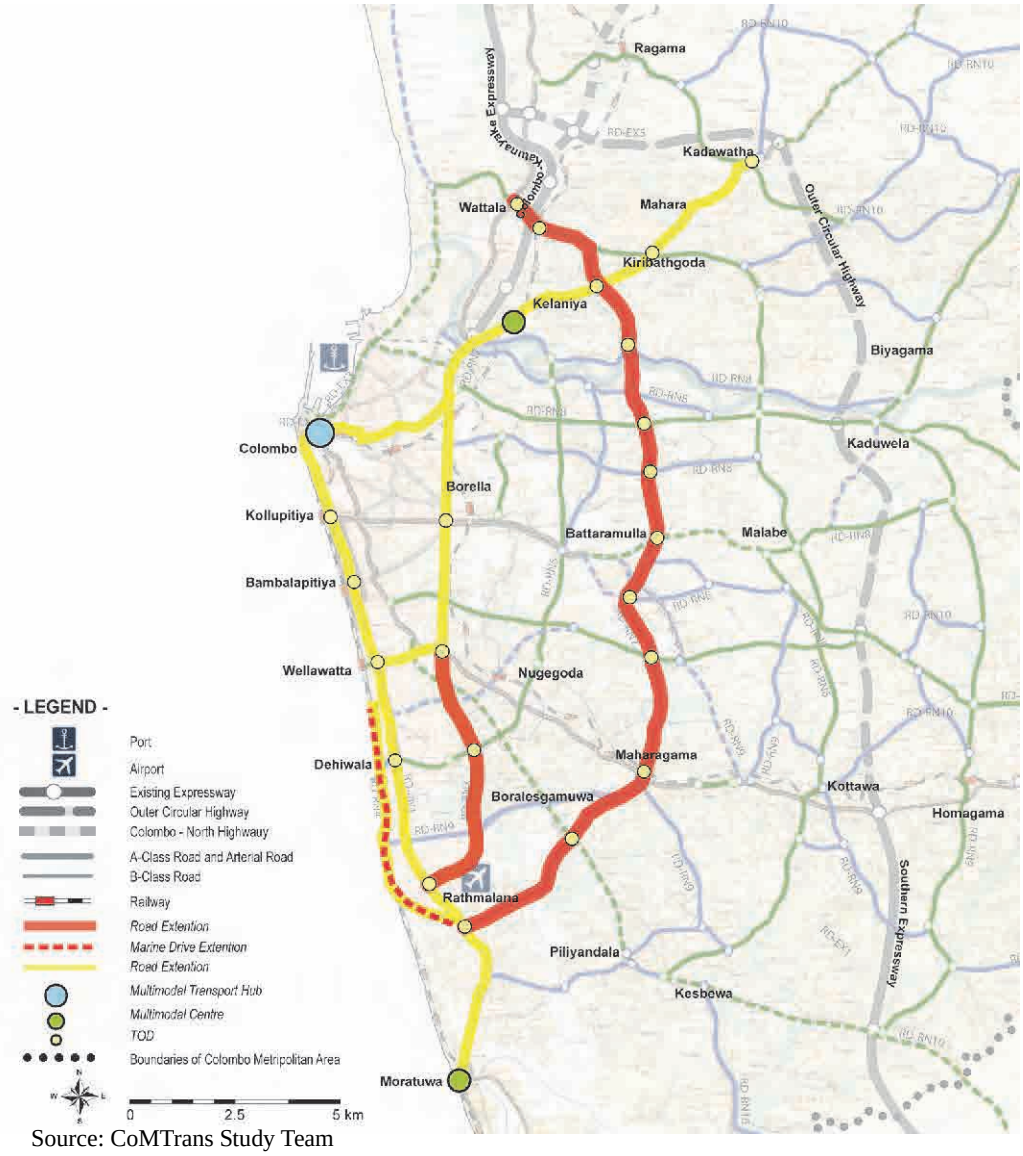
Extension of the Base Line Road as well as the extension of Marine Drive enables the introduction of dedicated bus lanes in the middle of Galle Road since these road extensions would provide additional road capacity for private modes of transport and give space for BRT.

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

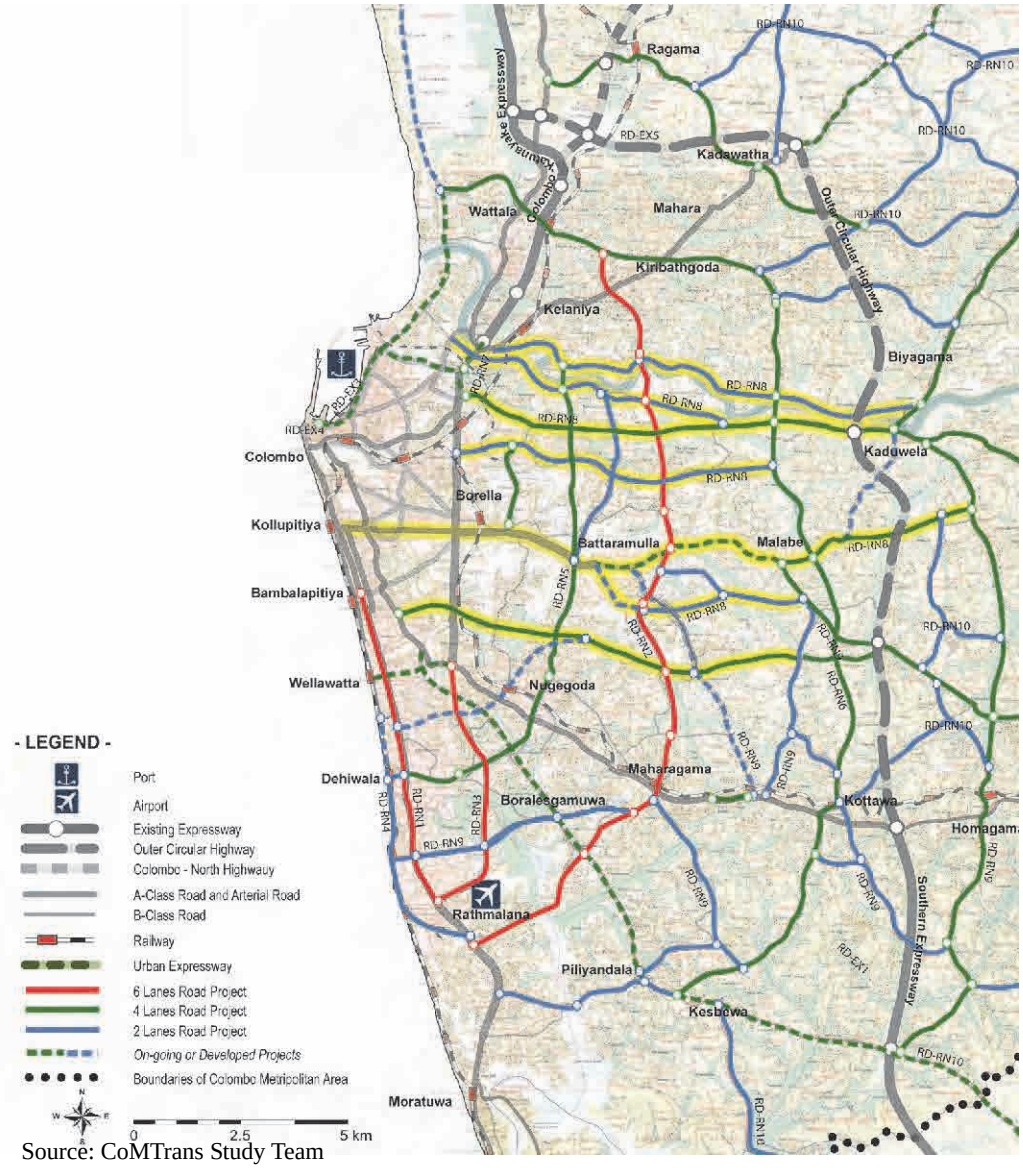
Source: CoMTrans Estimate

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

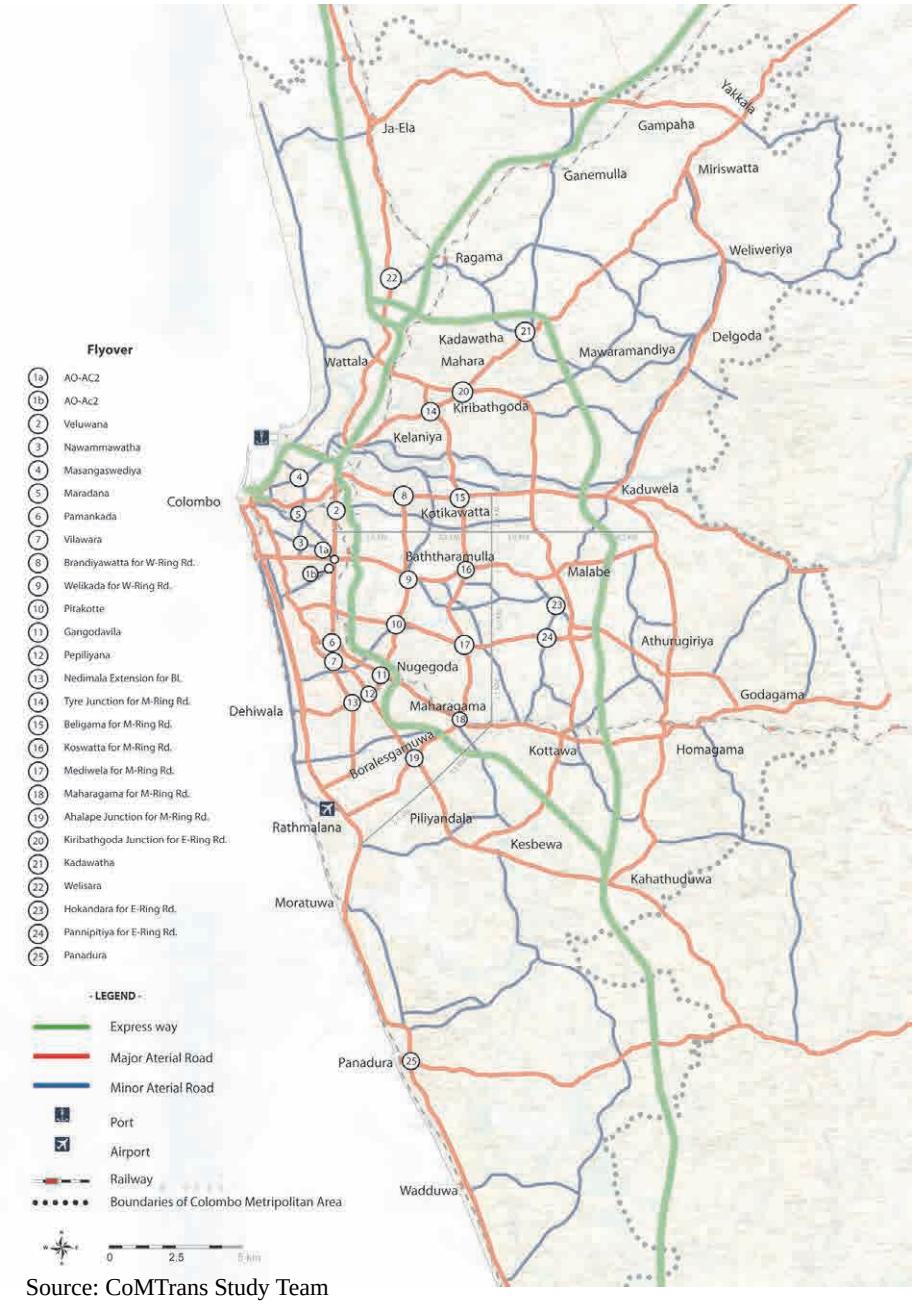
Figure 5.13.15 Expressway Network Development

(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

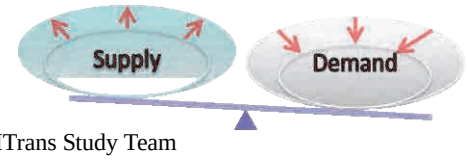
Parking Information System

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;

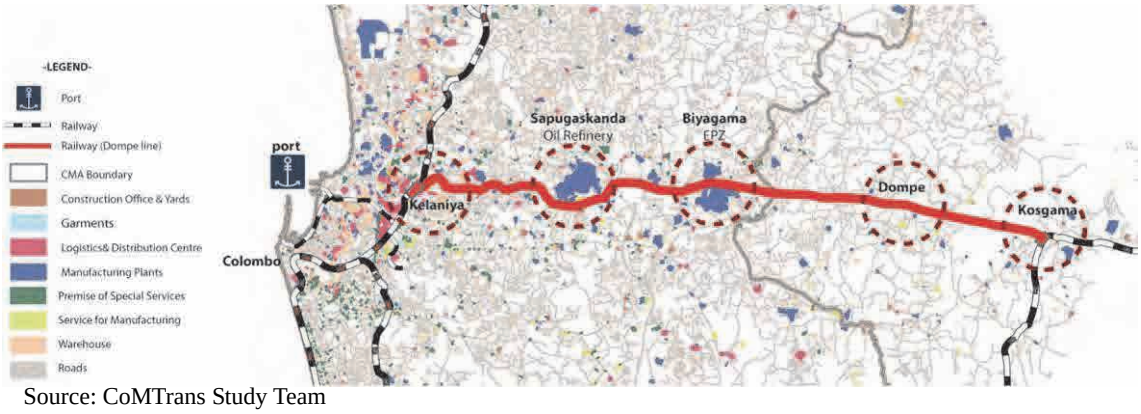
- Fuel tax increase,
- Electronic Road Pricing (ERP),
- Peak hour shift by mobility management and regulation applications,
- Park and Ride (P&R) with incentive scheme and
- Parking pricing policy,
- HOV (High Occupancy Vehicle) lane etc.

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			Outline of the Project	Length (km)	Phase		
	ID	Name				Short	Intermediate	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.***

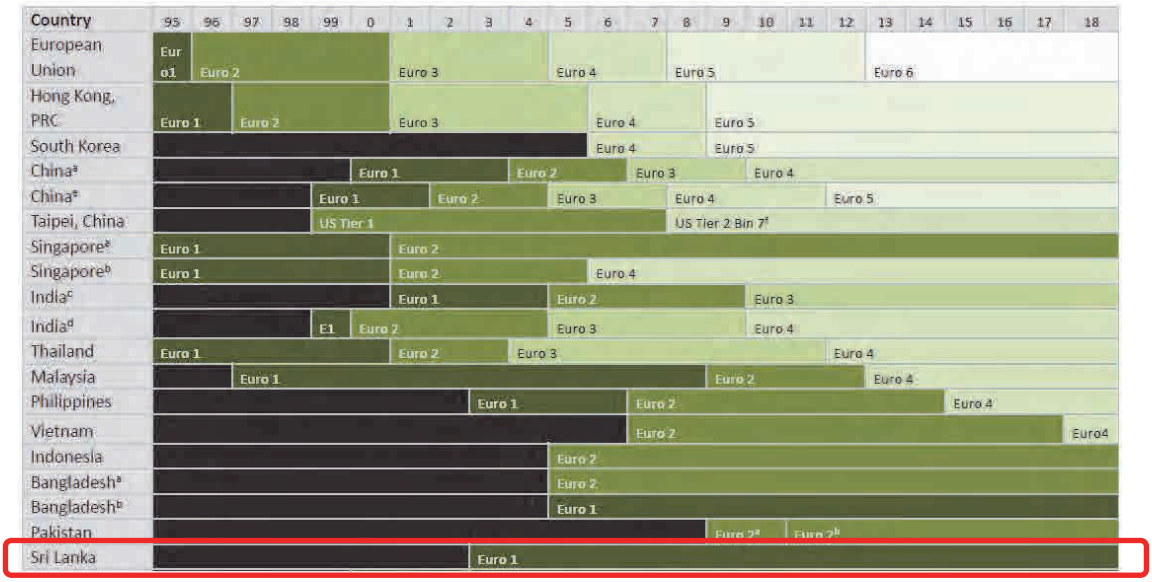
(1) Establishment of Environmental Management Scheme

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.

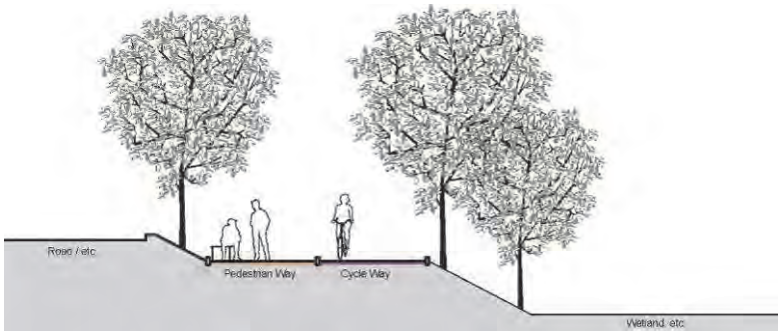
(7) Promotion of Walking and Bicycle Use for Energy Saving and to Promote Health

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.

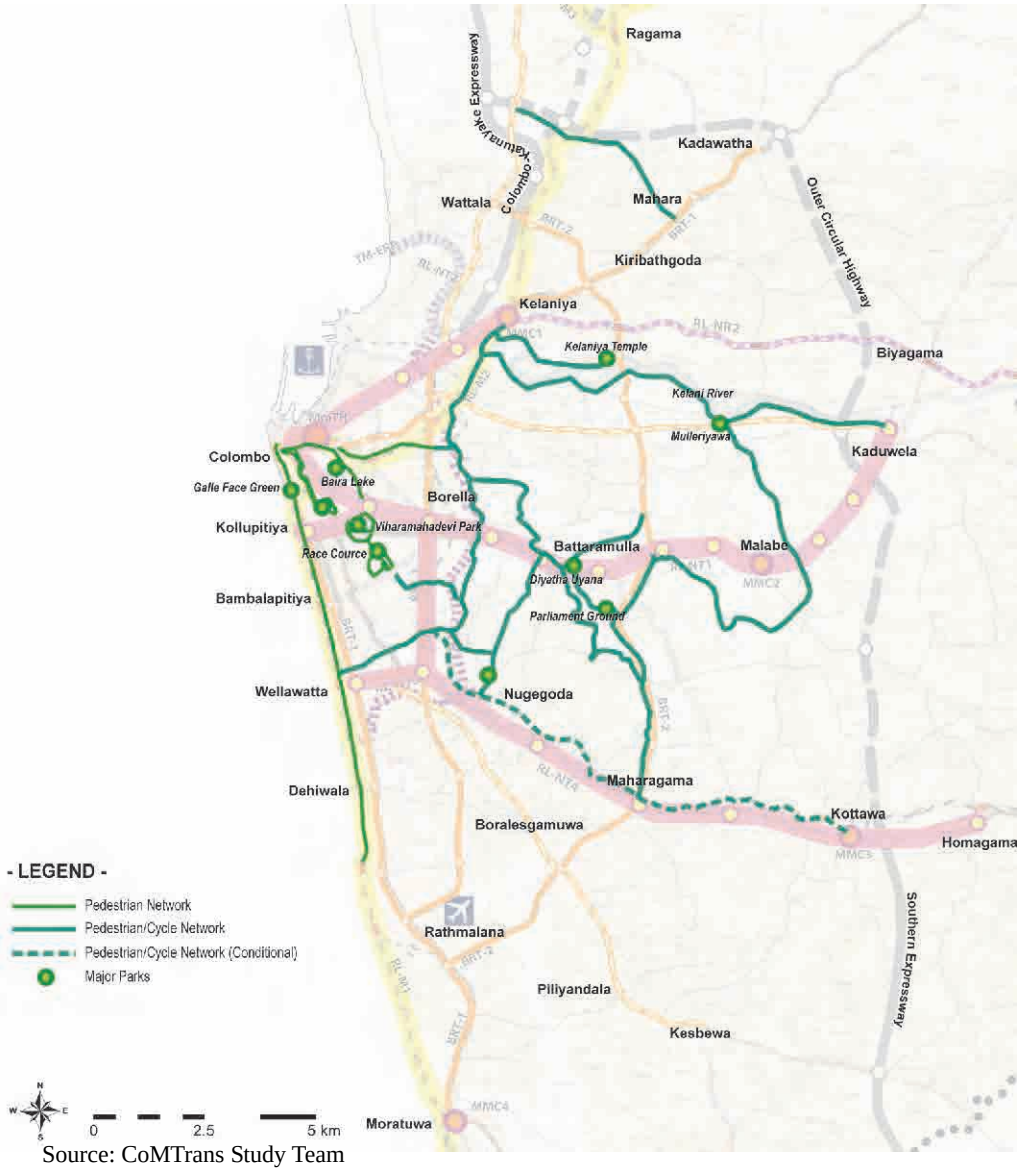
Source: CoMTrans Study Team

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		✔		

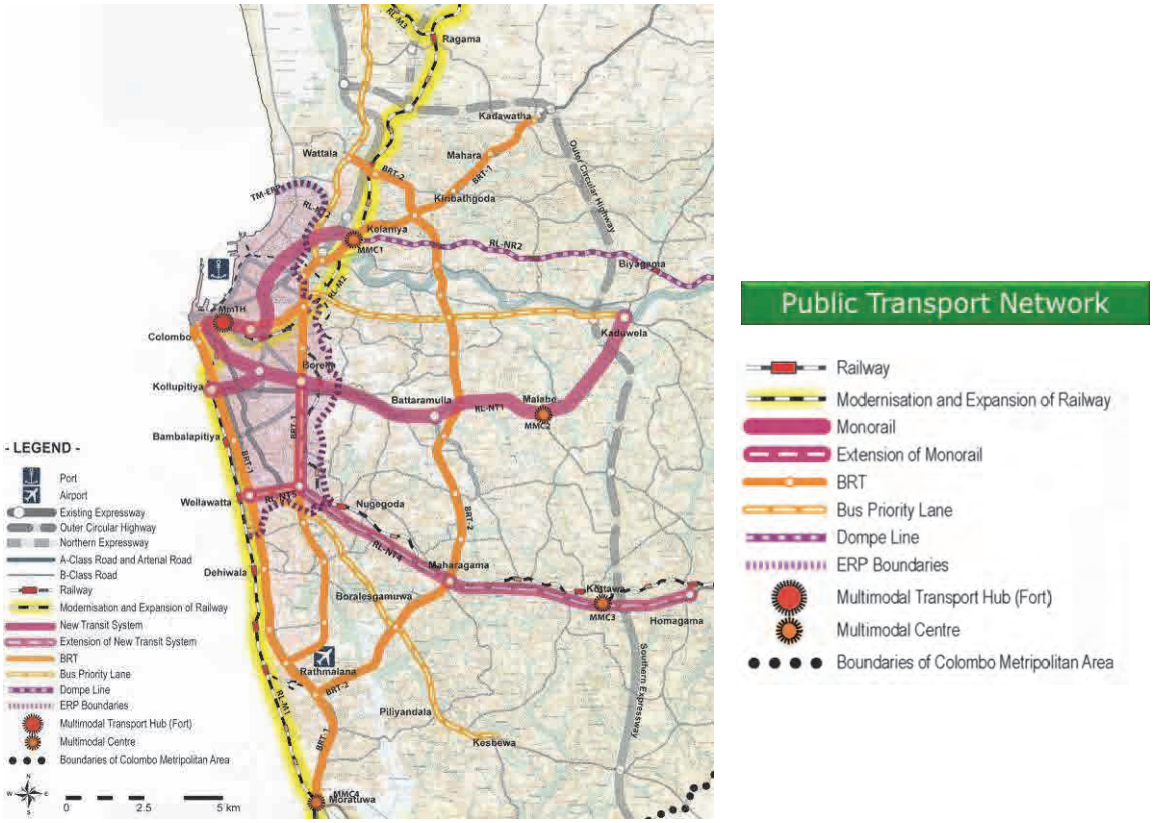
Source: CoMTrans Study Team

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.

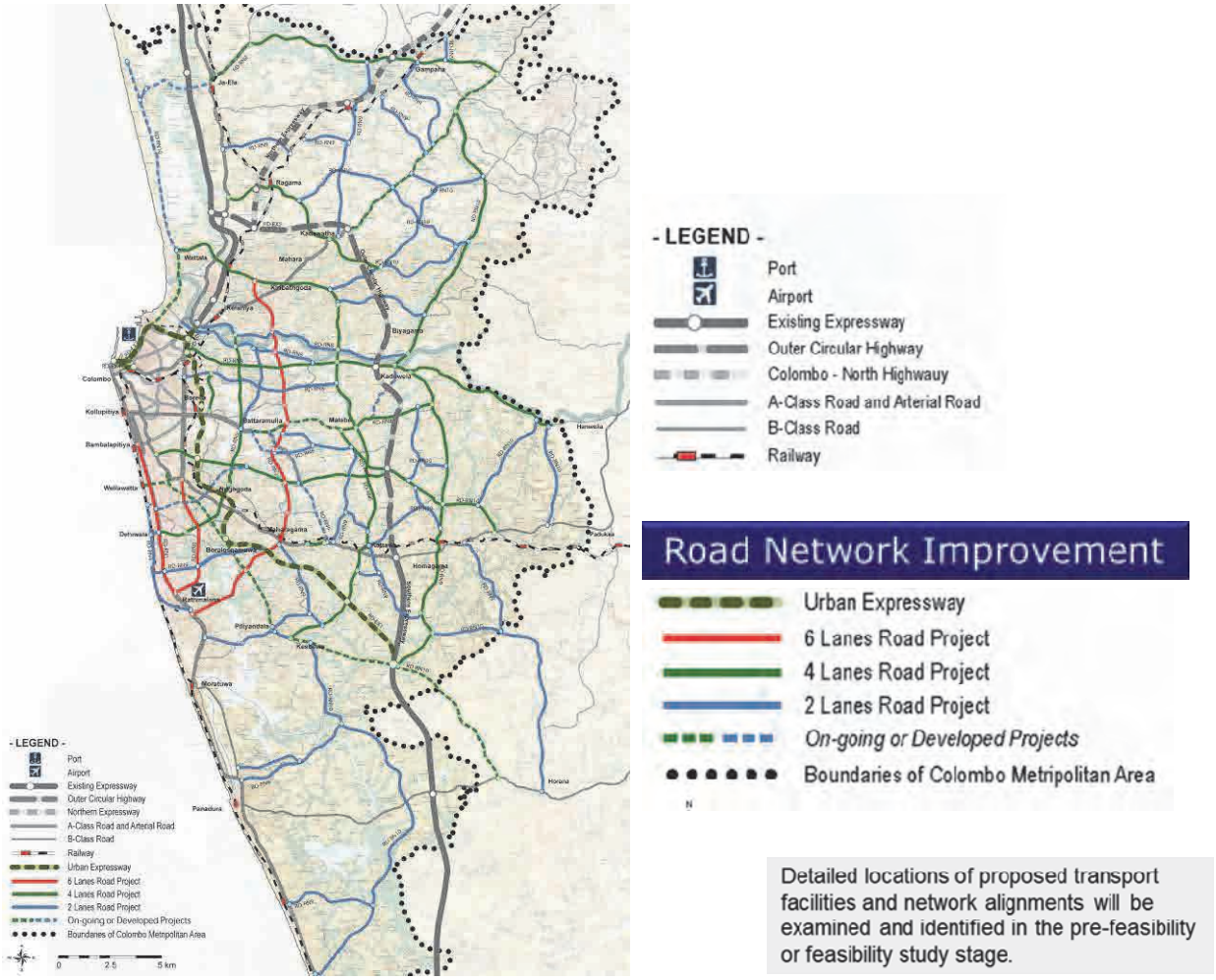


Source: CoMTrans Study Team

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.



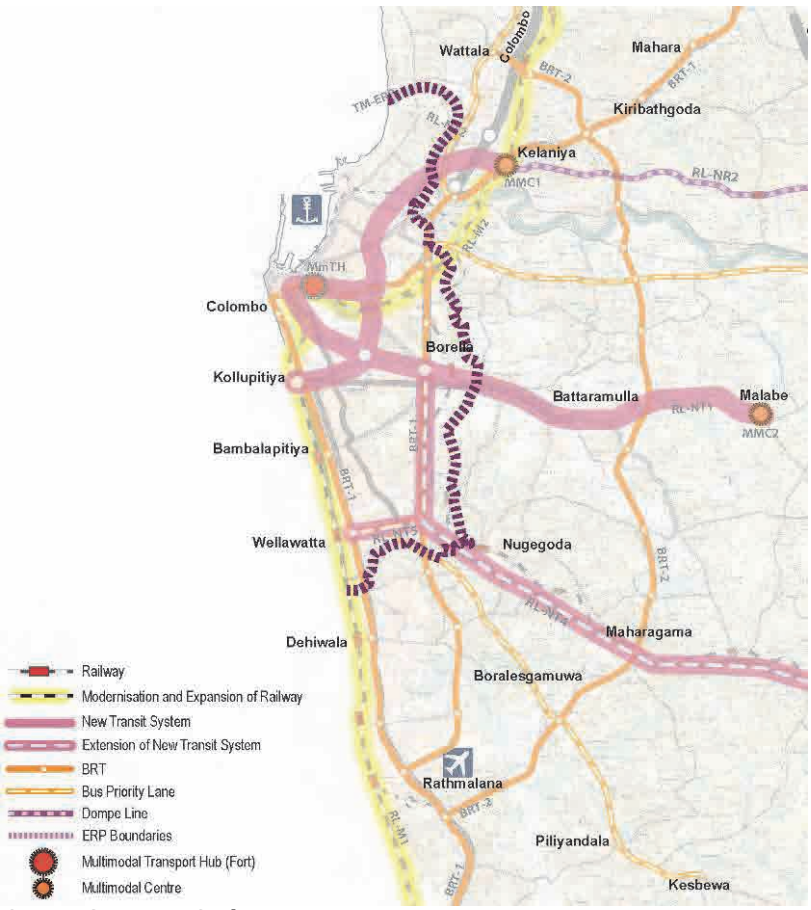
Source: CoMTrans Study Team

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;

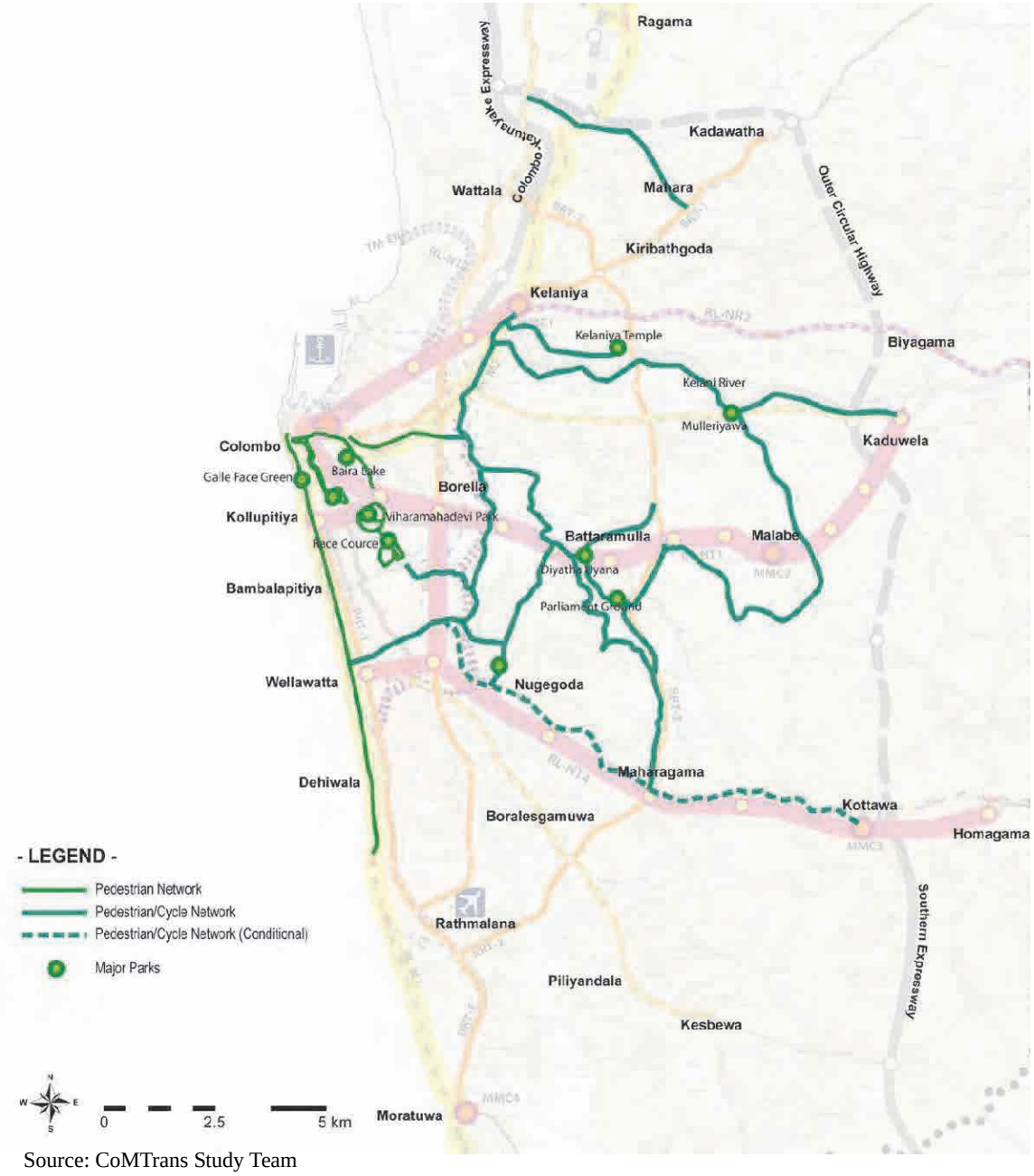
- Reduce the flow of traffic within the city of Colombo and the promotion of change to public transport by the installation of a system to charge the vehicles which travel across the CMC boundary

(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.

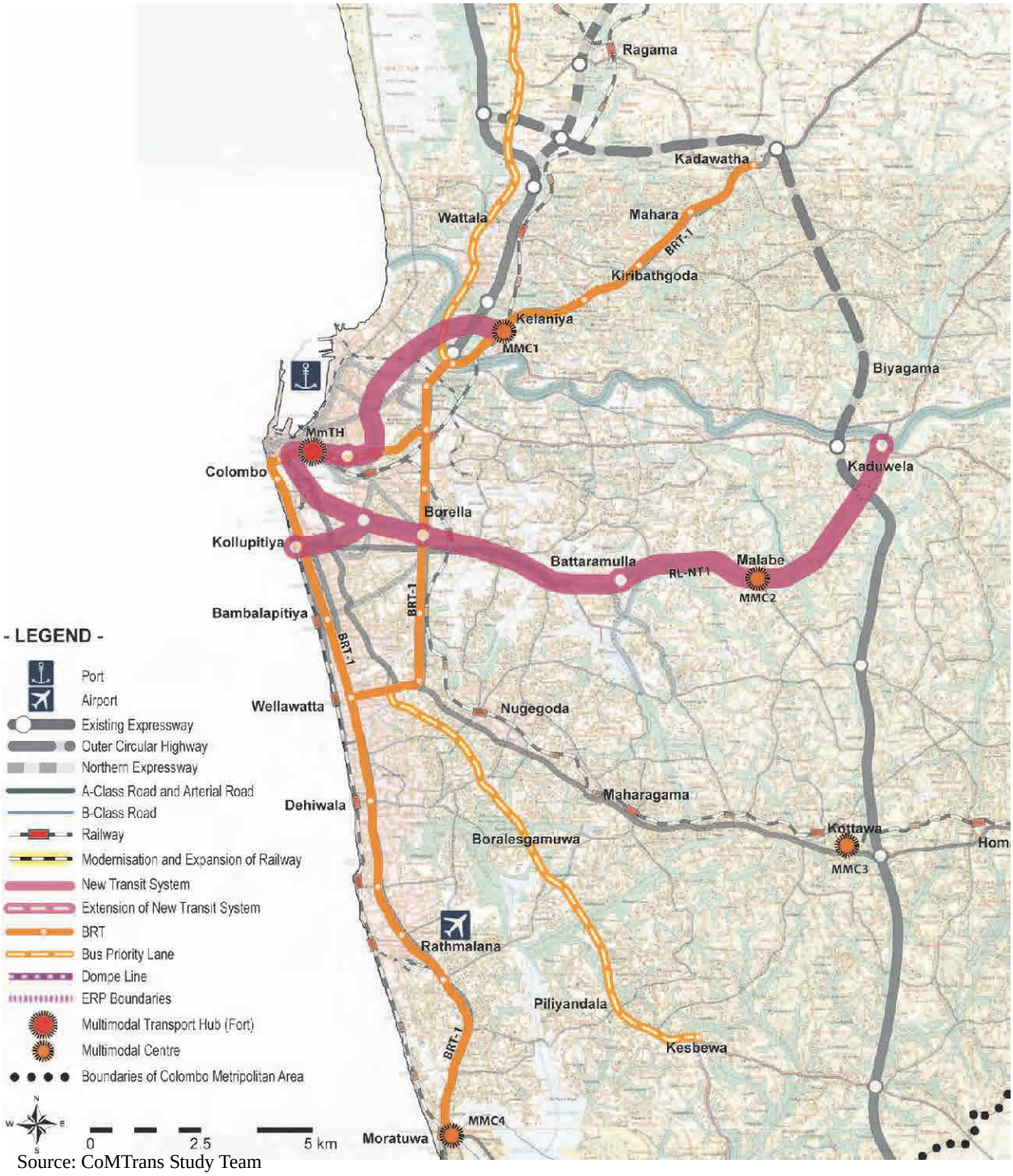
The long-term development programme for the public transport system by the year 2035 is illustrated in Figure 5.14.9 and that for the road network is shown in Figure 5.14.10.

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.

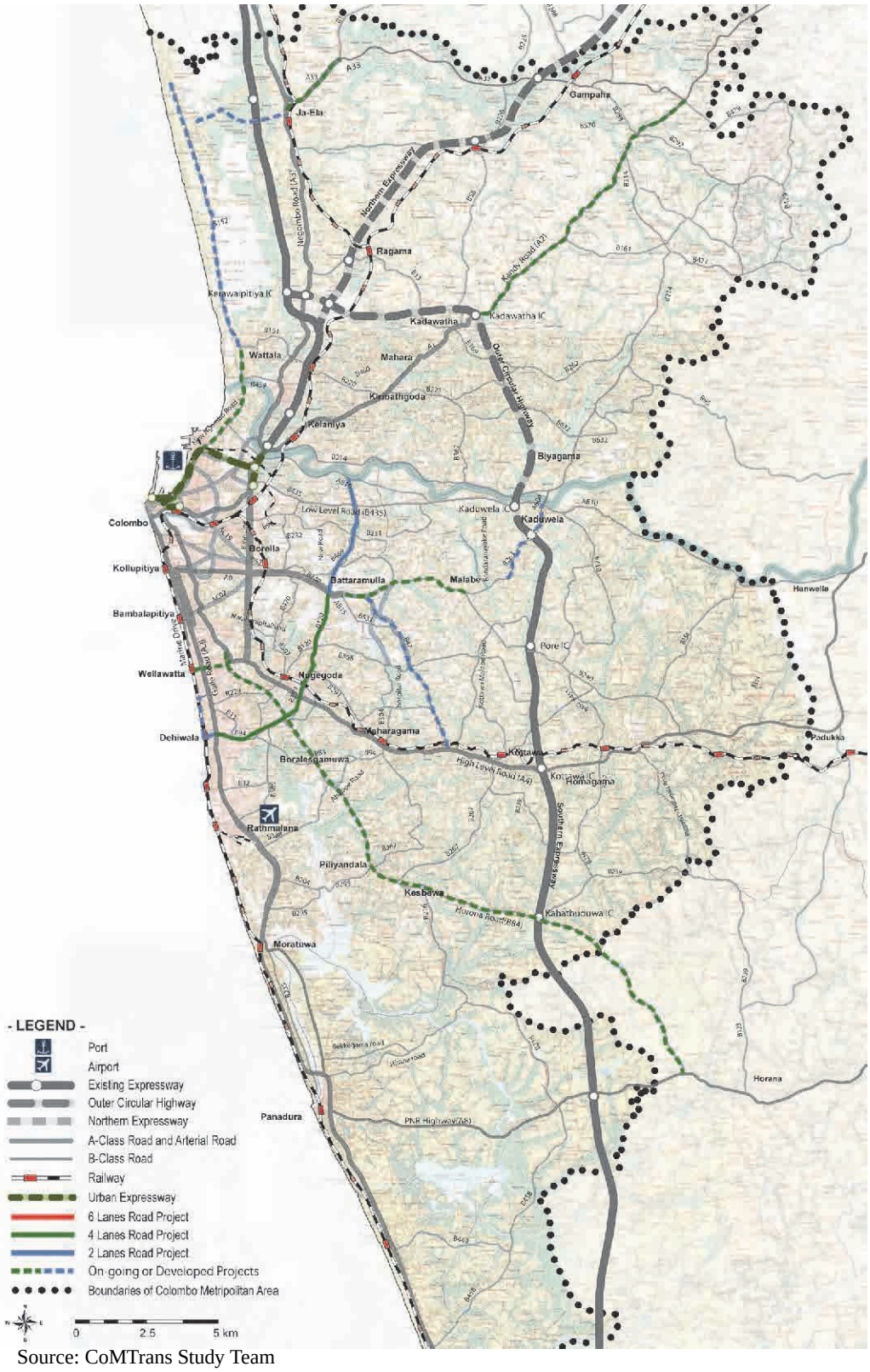
Figure 5.14.11 illustrates the CoMTrans projects on the map in CMA. Figure 5.14.12 depicts the relationship between urban structure and urban transport system.

Short term development Programme (~2020)



Source: CoMTrans Study Team

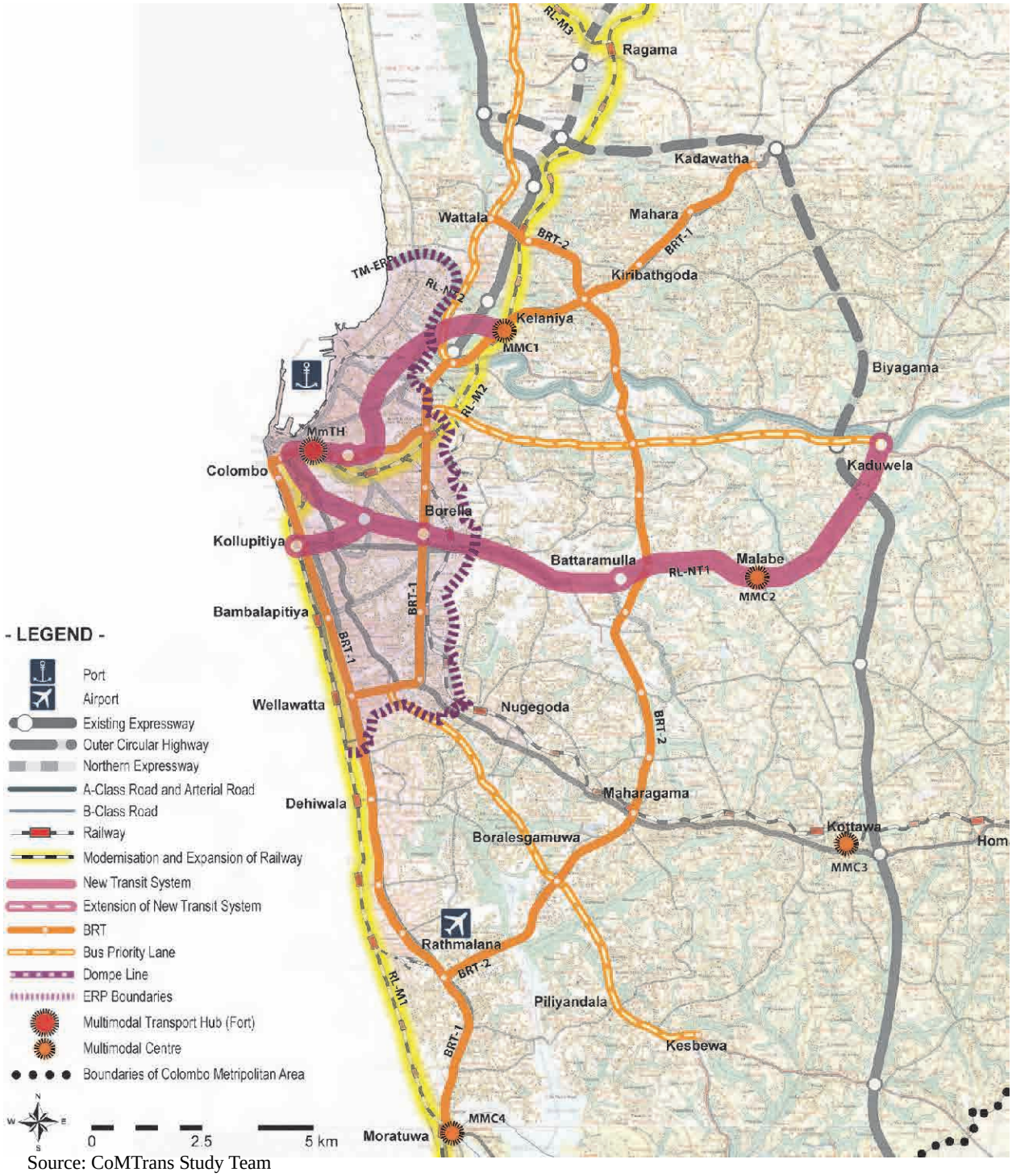
Figure 5.14.5 Short-Term Public Transport Development Plan (~2020)



Source: CoMTrans Study Team

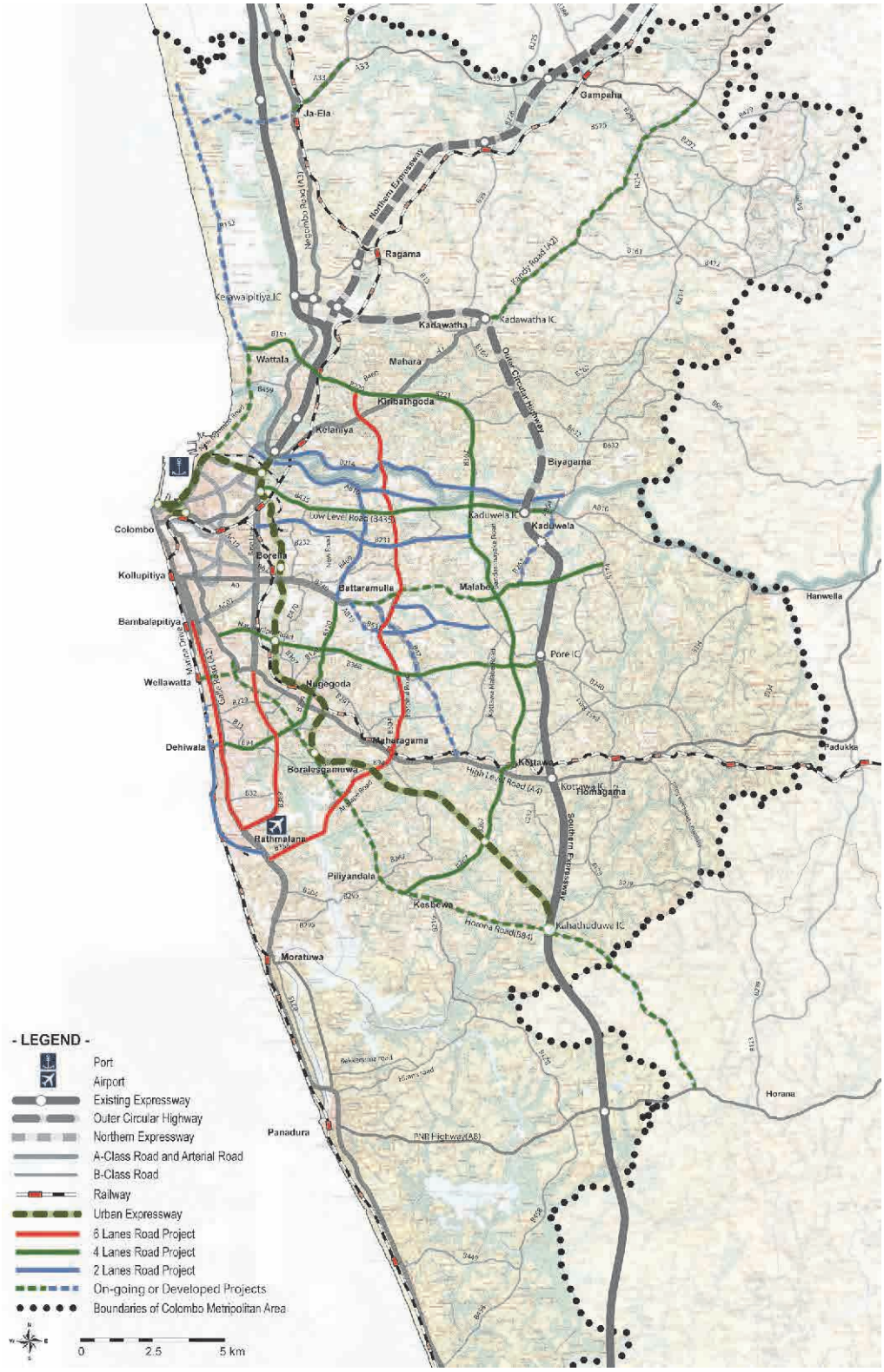
Figure 5.14.6 Short-Term Road Network Development Programme (~2020)

Intermediate term development Programme (~2025)



Source: CoMTrans Study Team

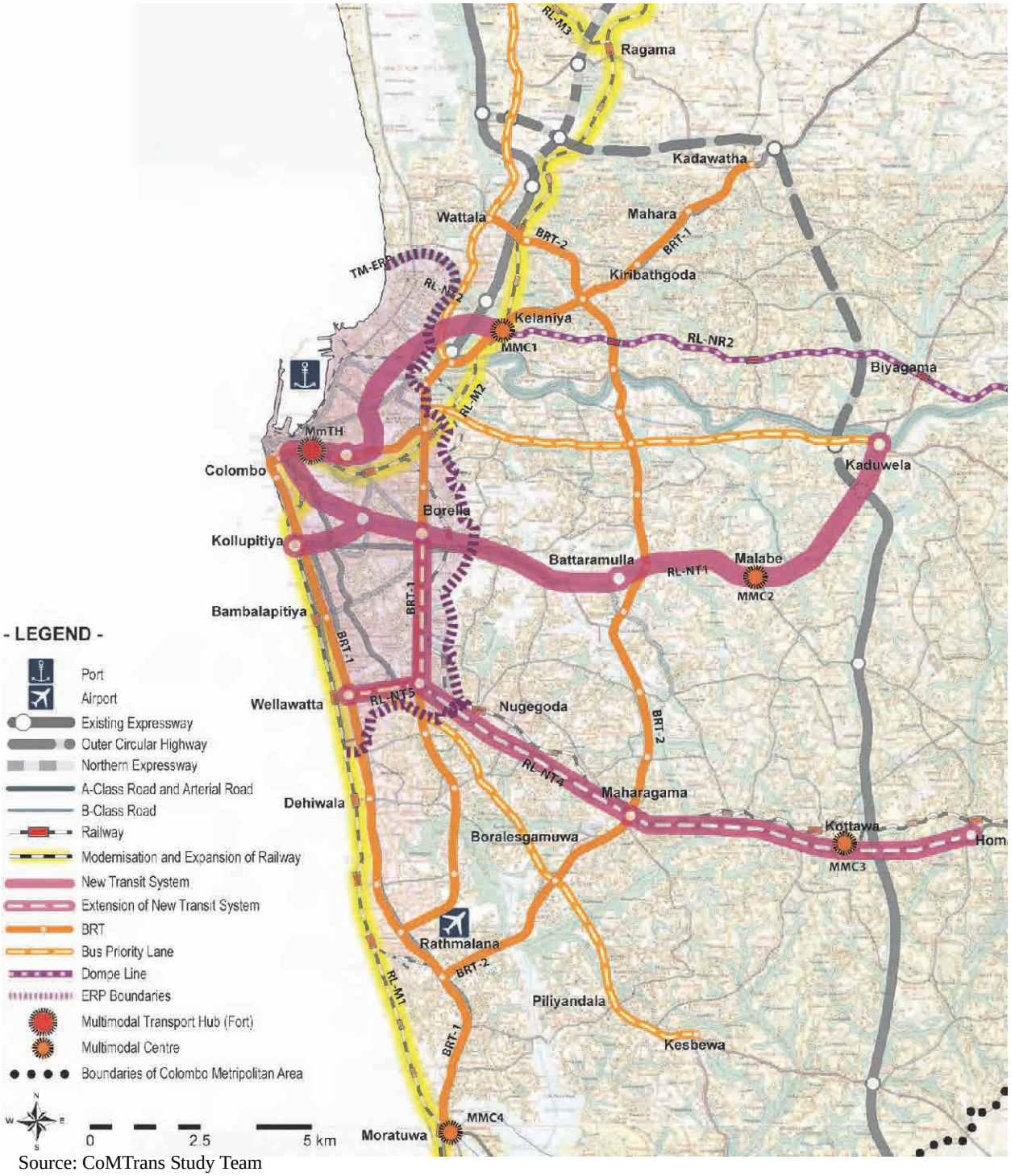
Figure 5.14.7 Intermediate-Term Public Transport System Development Plan (~2025)



Source: CoMTrans Study Team

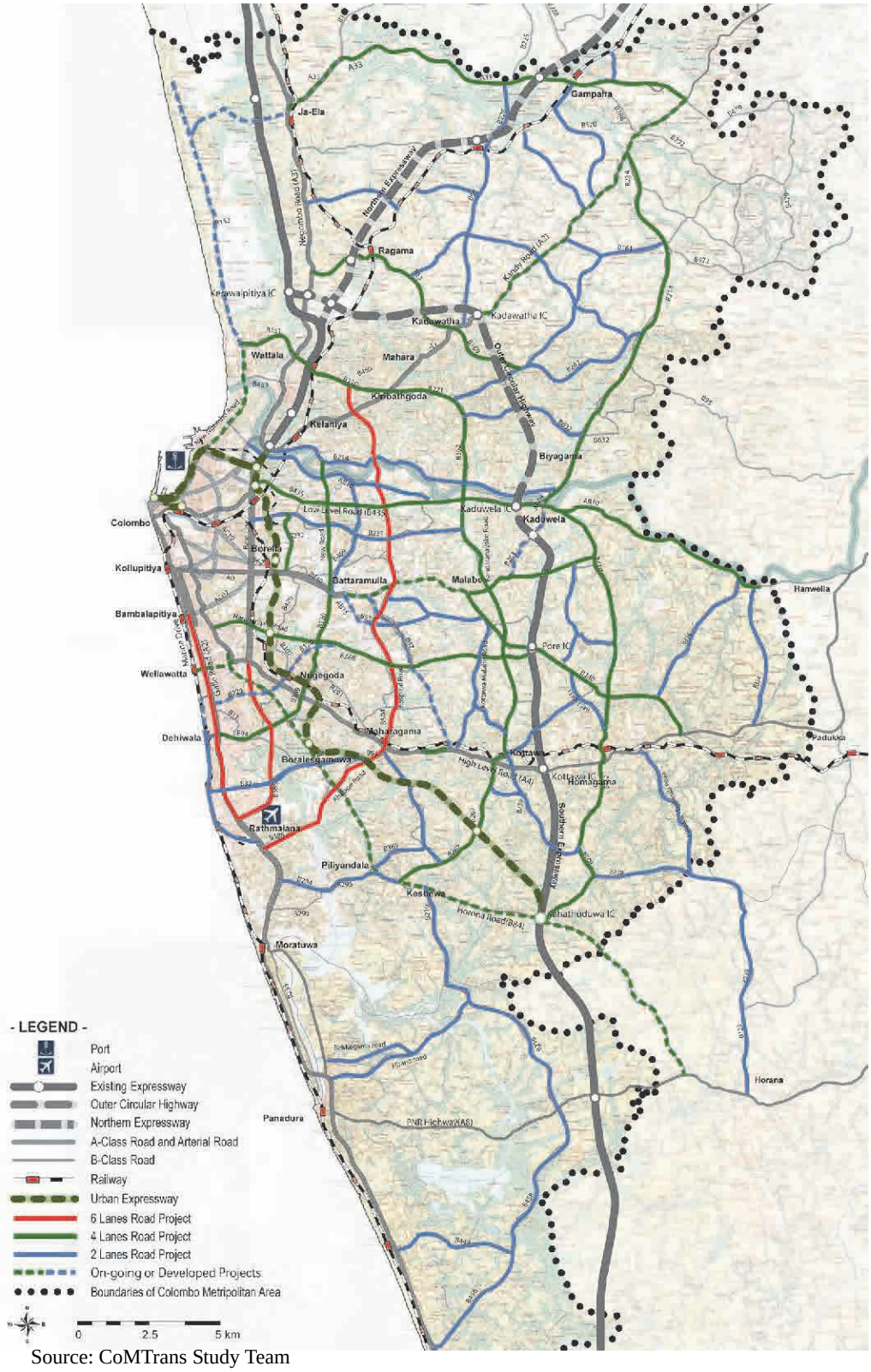
Figure 5.14.8 Intermediate-Term Road Network Development Plan (~2025)

Long term development Programme (~2035)



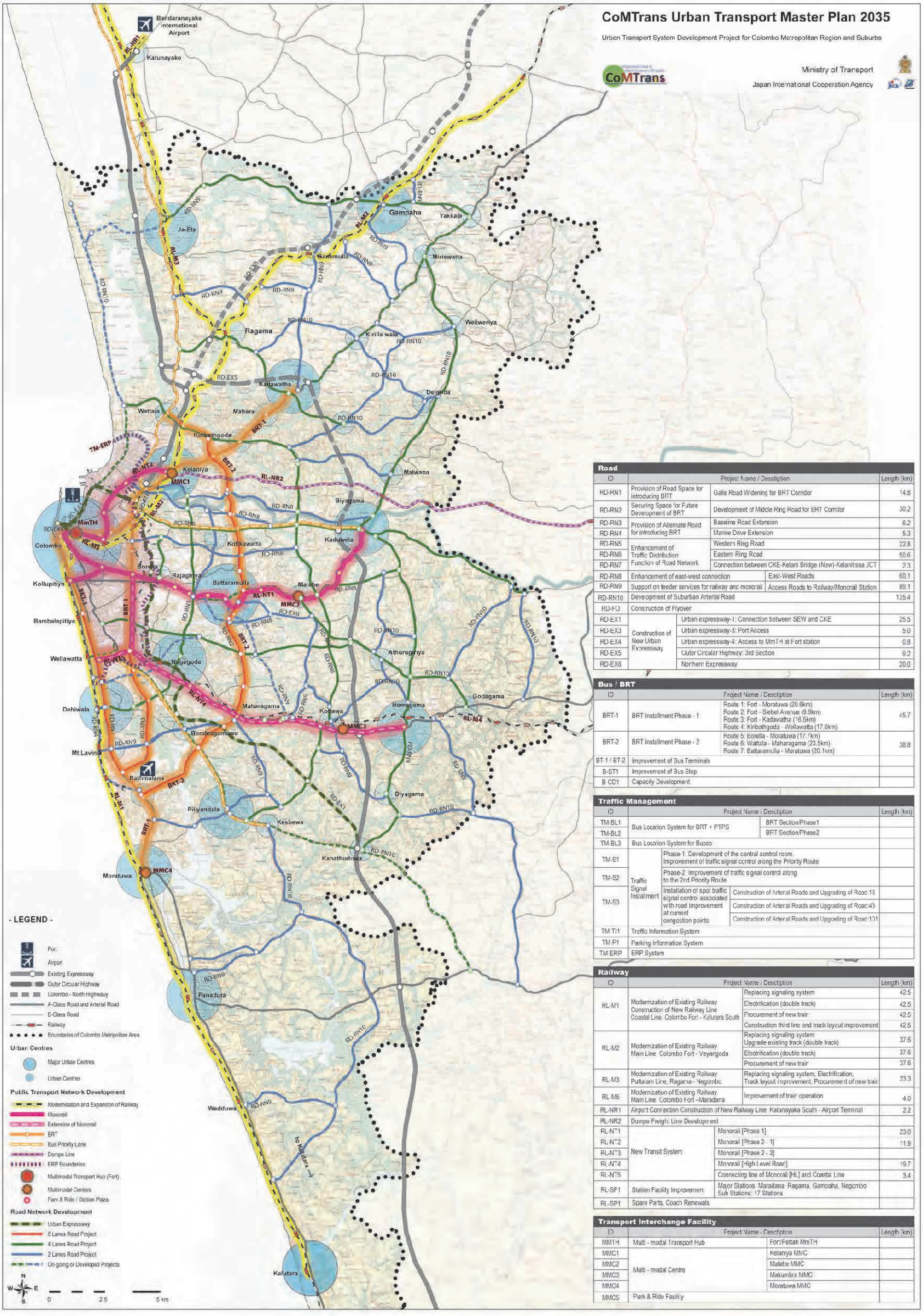
Source: CoMTrans Study Team

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 / Description		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)-Kelaniitssa 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 / Description		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 / Description		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-PI1	Parking Information System		
TM-ERP	ERP System		

Railway

ID	Project Name / Description		Length (km)
RL-M1	Modernization of Existing Railway Construction of New Railway Line Coastal Line: Colombo Fort - Kelutara South	Replacing signalling 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 signalling 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 / Description		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

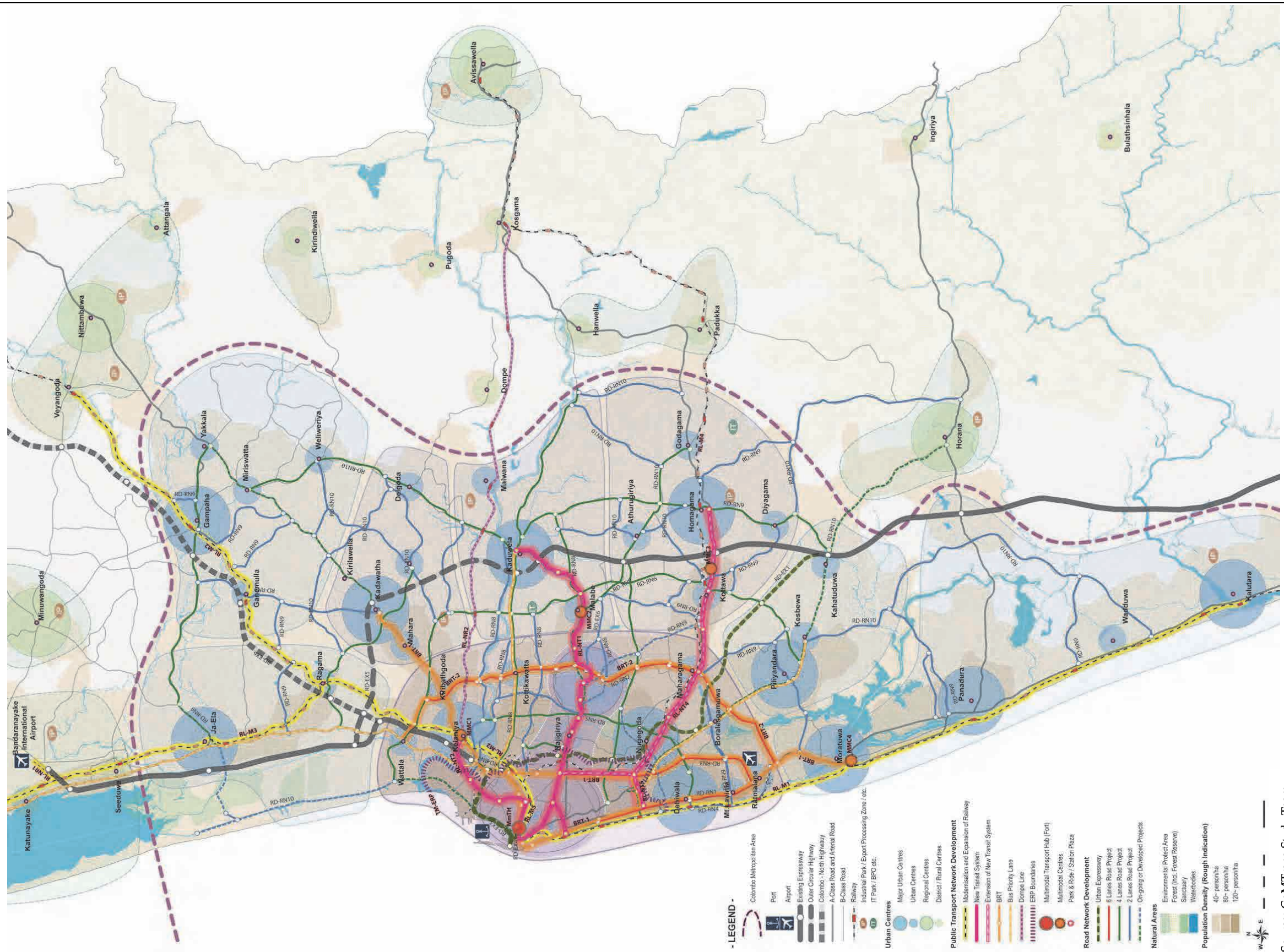


Figure 5.14.12 CoMTrans Urban Transport Master Plan and Urban Structure in CMA

Source: CoMTrans Study Team

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.

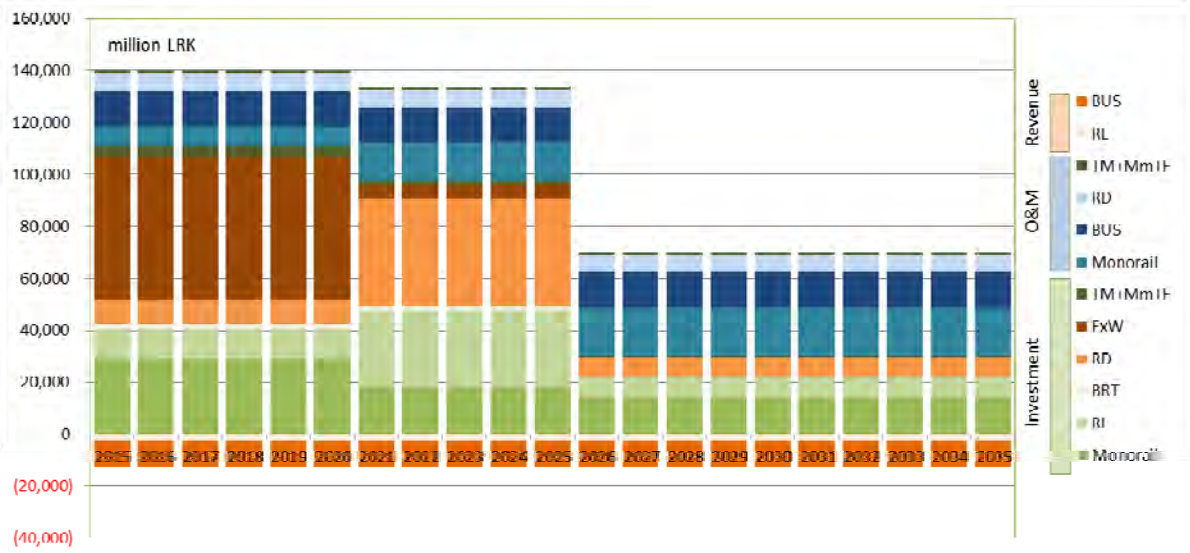
Figure 6.1.1 depicts the estimated annual requirement flow for investment and O&M cost by each transport mode. If there are larger portion of costs of investment in the short-term, then the share of O&M costs becomes larger in the intermediate and long-term.

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**	
	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*

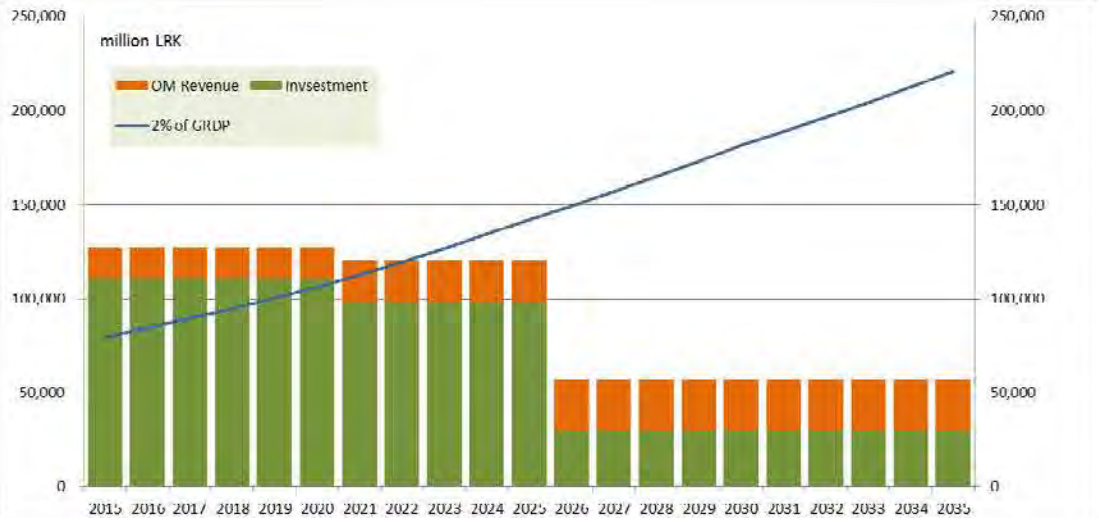
Source: CoMTrans Estimate

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

	Policy Making	Planning	Regulation	Infrastructure Provision	Service Provision
Motor vehicles (all)	Ministry of Transport assisted by NTC and other stakeholders	NTC (in concurrence with province for national plans and to get concurrence from centre to provincial plans).	DMT	RDA/PRDA/ LA & Private	Private
Railways			SLR		
Inland Waterways				Provincial Councils	Private
Road Passenger Transport Services			NTC (Inter) RPTA (Intra)	SLTB/NTC/ RPTA/LA/ Private	SLTB/Private
Para-transit (carriage of passengers)			DMT/NTC RPTA (Intra) LA	LA	Private
Rental vehicles			DMT	Private	Private
Freight vehicles (carriage of goods)			NTC (Inter) RPTA (Intra)	Private	Private
Non-motorised			LA	RDA/PRDA/ LA	Private
Traffic Management			LA	RDA/PRDA/ LA	RDA/PRDA/ LA

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 Developmen (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

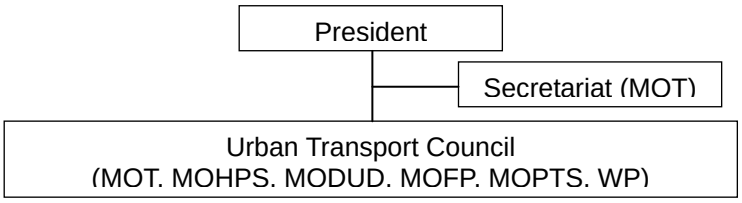
In line with the National Transport Policy, the CoMTrans suggests the establishment of an Urban Transport Council under the President. The council is expected to be a central high-level body that represents all main political decision makers in urban transport, including the Western Provincial Council. 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	Project Name	Transport Sub Sector
RL-M1	Modernisation of Coast 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
Colombo Fort - Kalutara South (42.5km)	☑ Short-term ☑ Medium-term ☑ Long-term	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.

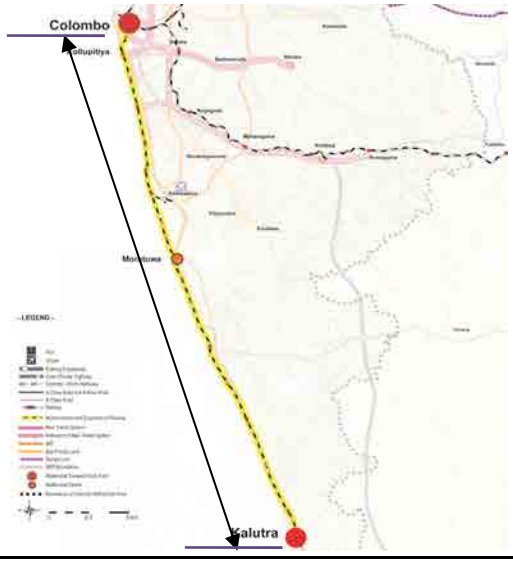
11. Environmental Impact

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	Project Name	Transport Sub Sector
RL-M2	Modernisation of Main 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
Colombo Fort – Veyangoda (37.6km)	☑ Short-term ☑ Medium-term ☐ Long-term	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.

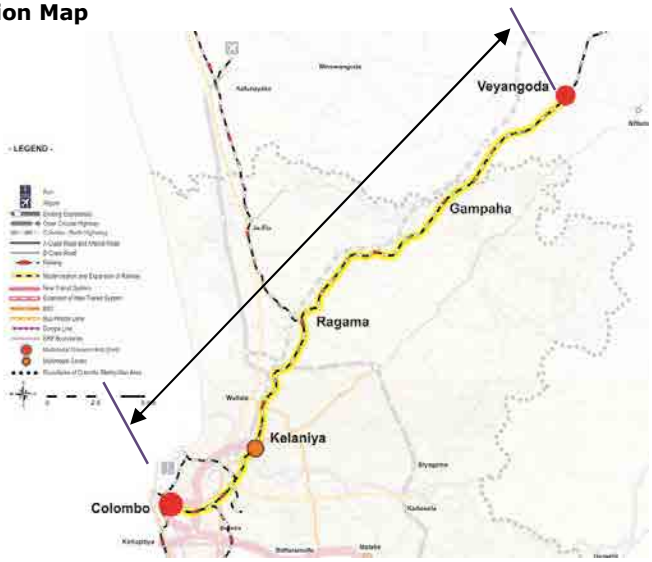
11. Environmental Impact

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

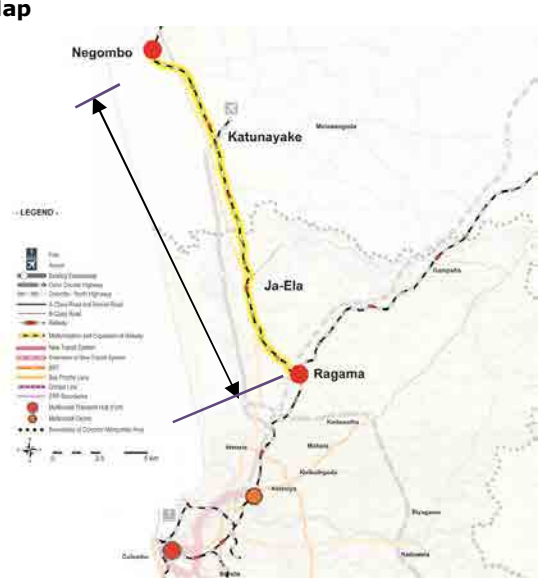
10. Special Considerations
Since the CTC with Relay Interlocking and Bi-directional Automatic Block Signalling on double lines was installed in 1962, replacing of the signalling system is an emergency issue.

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	Project Name	Transport Sub Sector
RL-M5	Modernisation of Main Line (Track Layout Improvement)	☑ 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 Fort – Maradana (4.0km)	☑ Short-term ☐ Medium-term ☐ Long-term	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	Project Name	Transport Sub Sector
RL-NR1	Airport Connection	☑ 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
Katunayaka South - Airport Terminal (2.2km)	☐ Short-term ☑ Medium-term ☐ Long-term	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
☑ Reduction of Pollution
☐ Promotion of Health
☐ Alleviation of Traffic Congestion
☐ Reduction of Traffic Accident

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

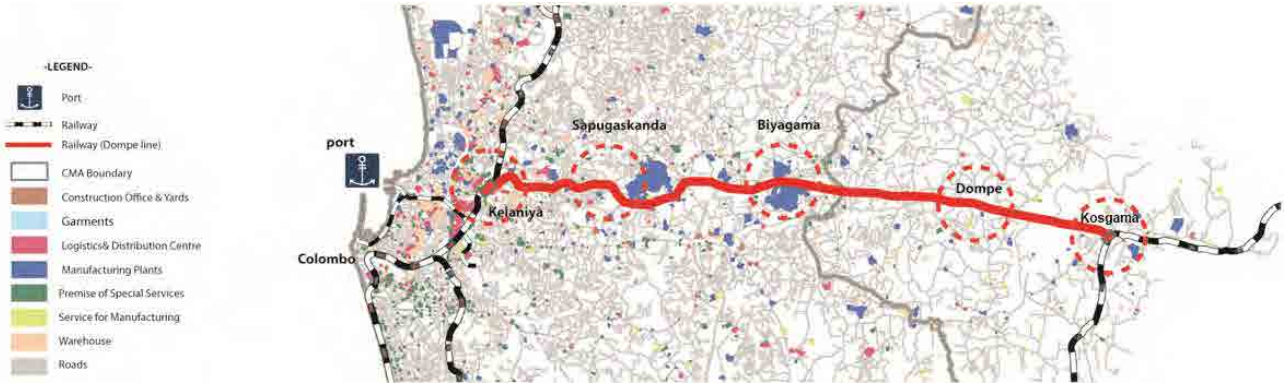
- Land Acquisition: Further investigation is required.
- Resettlement :B or C
- Other Social Impact: B or C

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
☑ Reduction of Pollution
☐ Promotion of Health
☑ Alleviation of Traffic Congestion
☐ Reduction of Traffic Accident

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

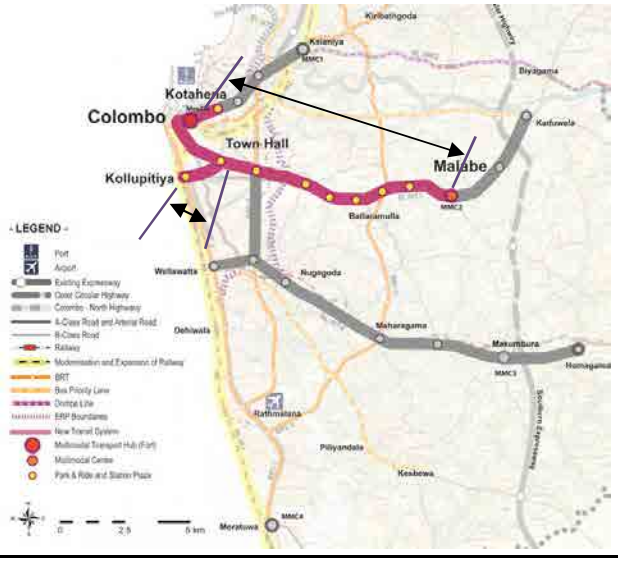
- Land Acquisition: Minimum land acquisition required at some stations (Further study will be conducted under CoMTrans)
- Resettlement :B
- Other Social Impact: B

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	Transport Sub Sector
RL-NT2,3	Monorail [Phase 2]	☑ 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
Mattakkuliya - Kelaniya Malabe-Kaduwela (Total Length: 11.9 km)	☐ Short-term ☑ Medium-term ☑ Long-term	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

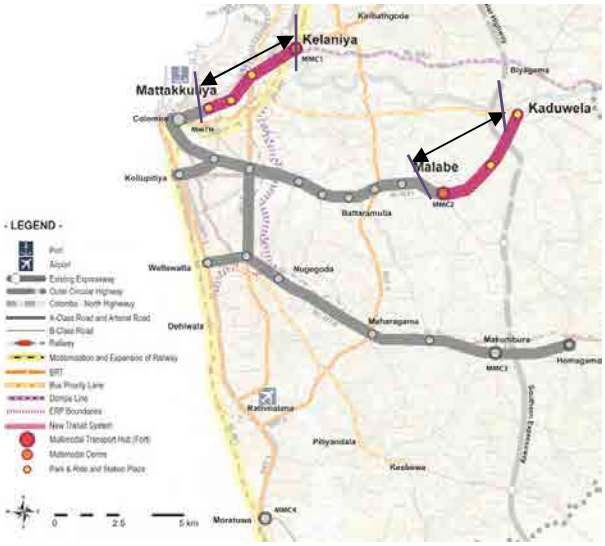
- Land Acquisition: Further investigation is required.
- Resettlement :B
- Other Social Impact: B

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
☑ Reduction of Pollution
☐ Promotion of Health
☑ Alleviation of Traffic Congestion
☐ Reduction of Traffic Accident

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

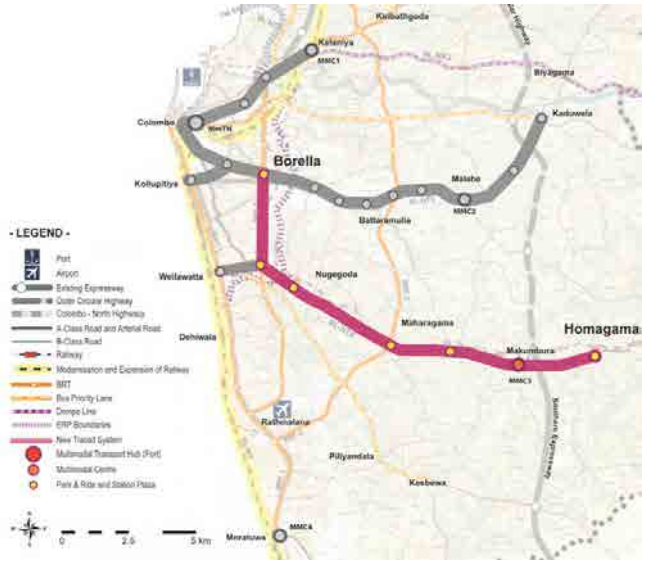
- Land Acquisition: Further investigation is required. Basically minimum land acquisition is required if monorail is constructed on existing road, only required around several station area
- Resettlement :B
- Other Social Impact: B

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	Project Name	Transport Sub Sector
RL-NT5	Monorail [Connection with Monorail (High Level Road Line) and Railway (Coast 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
Siebel - Wellawatta (Total Length: 3.4 km)	☐ Short-term ☐ Medium-term ☑ Long-term	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.

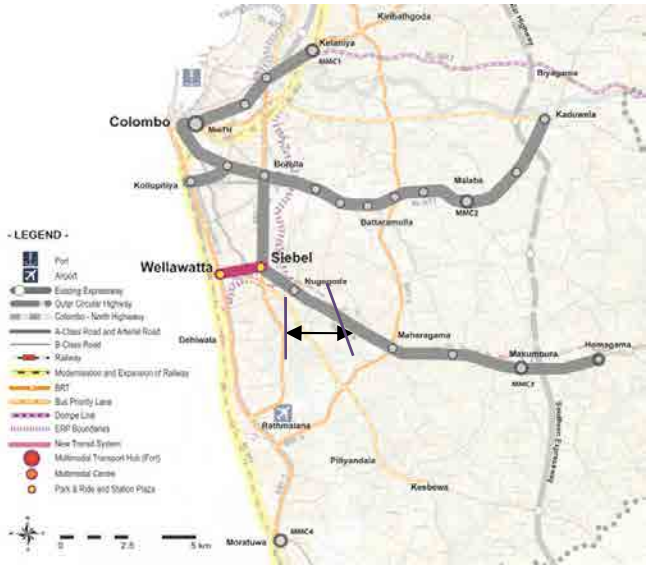
11. Environmental Impact

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

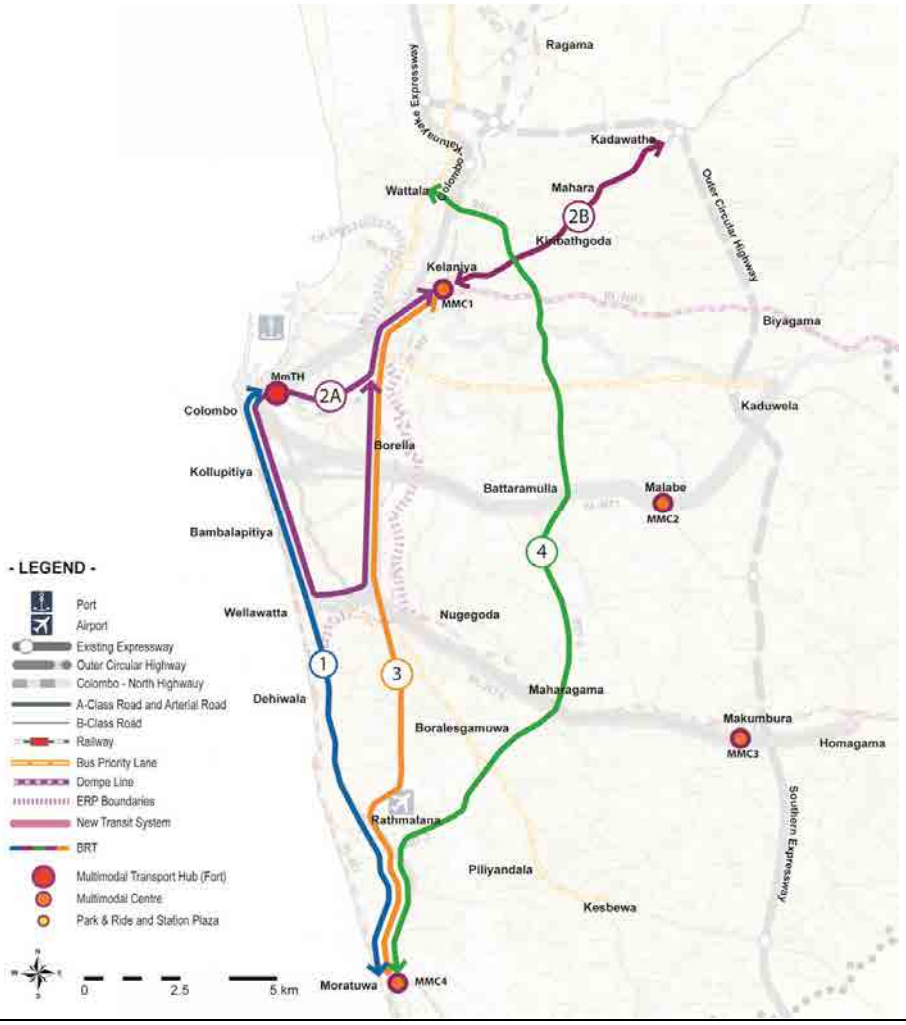
11. Environmental Impact

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

- To promote the utilisation of public transport by improving the function of transport nodes

2. Expected Benefits

- 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

- 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

4. Linkages with Other Projects/Sectors

- 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)

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.

6. Implementing Agency

- 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

☑ Public Sector

☑ Public Private Partnership

☐ Private Sector Initiative

8. Expected Operator (if any)

To be determined (for bus terminal operation, terminal facility operation and commercial area operation)

9. Project Cost (in 2013 Constant Price)

Initial Investment Cost: US$ 195.7 Million
Recurrent O & M: US$ 5.8 M/year

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.
- 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

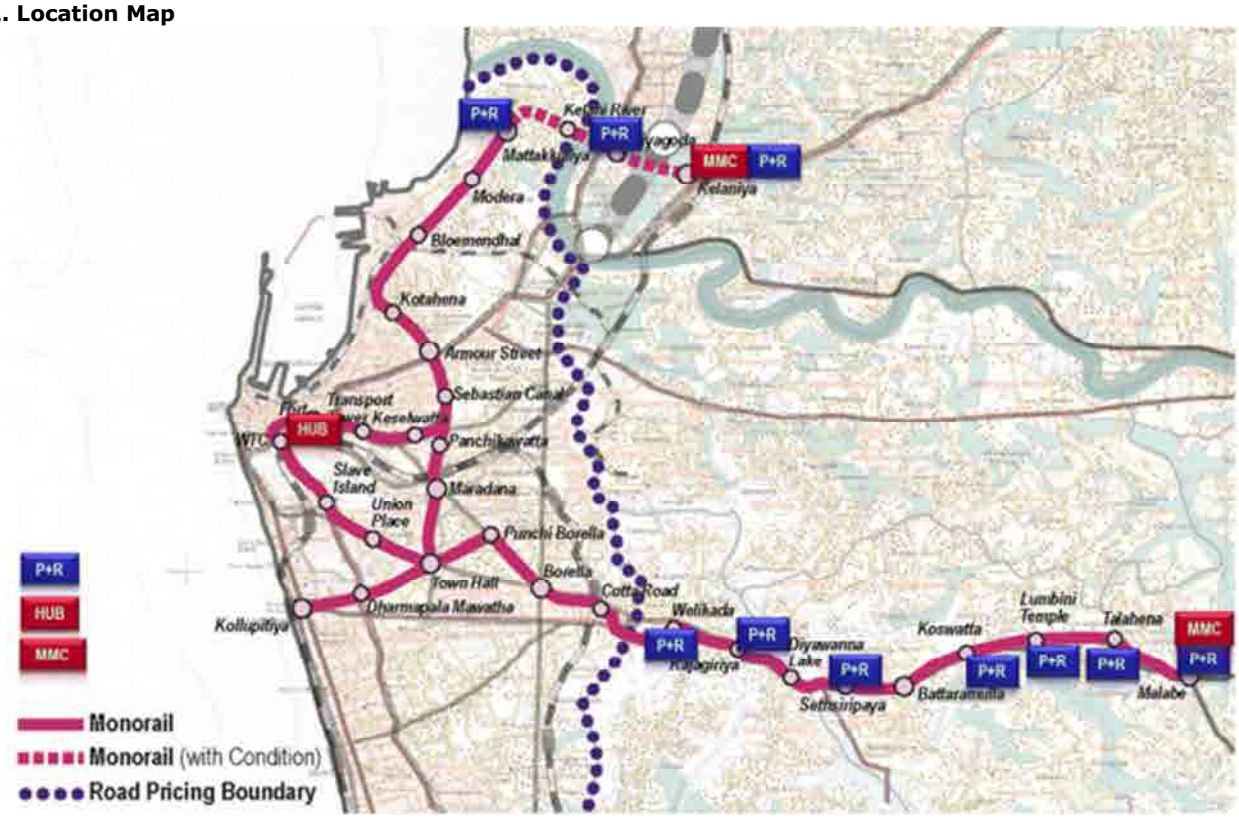
2) Natural Environment

- 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

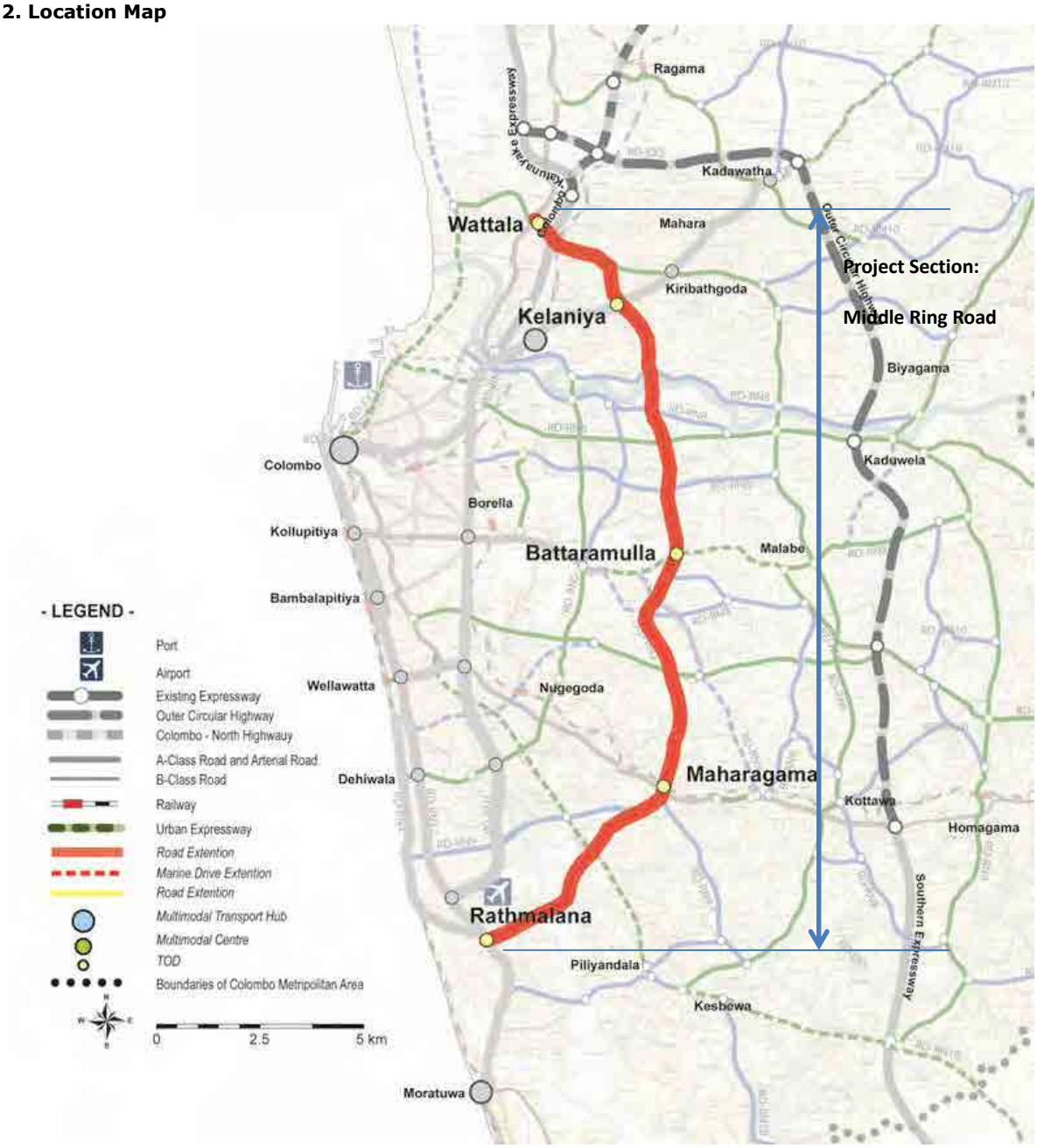
2) Natural Environment

- 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	Project Name	Transport Sub Sector
RD-RN4	Provision of Alternative Road for introducing BRT / Extension of Marine Drive	☐ 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
Proposed extended section of Marine Drive Road between Dehiwala to Rathmalana	☐ Short-term ☑ Medium-term ☐ Long-term	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

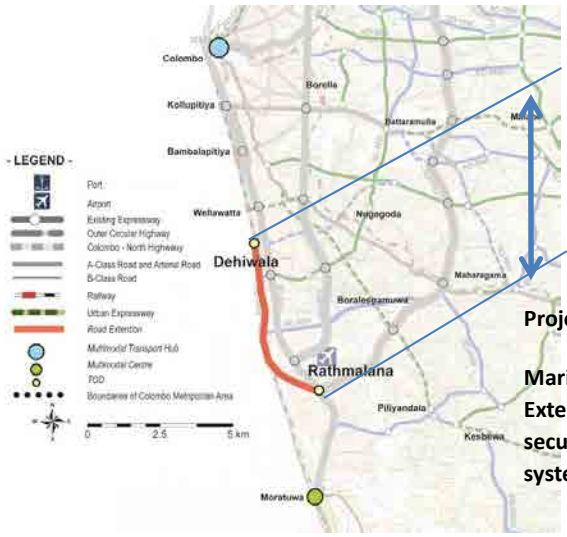
10. Special Considerations
Traffic volumes of existing arterial roads are almost at their capacities, the shortage of alternative routes for through traffic between the southern area of CMC and the Port area is an emergency issue, the extension of Marine Drive is required as an alternative route.

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	Transport Sub Sector
RD-RN5	Enhancement of Traffic Distribution Function of Road Network / Development of Western 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
Piliyagoda – Rajagiriya - Dehiwala	☑ Short-term ☐ Medium-term ☐ Long-term	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

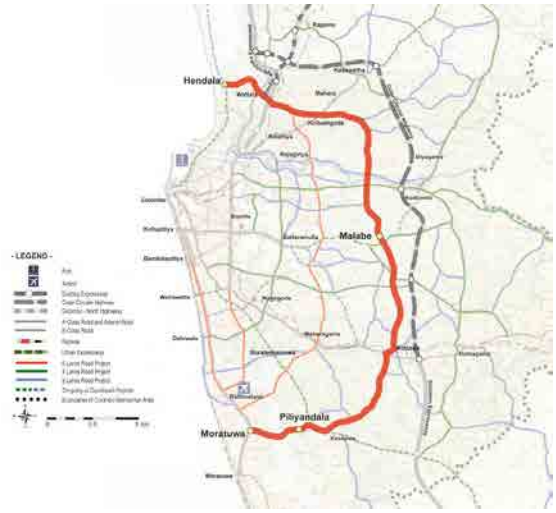
- Land Acquisition: Approx. 254,000 m^2 of land acquisition is estimated.
- Resettlement: B or C, further detailed investigation is required.
- Other Social Impact: B

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	Project Name	Transport Sub Sector
RD-EX1	Construction of New Urban Expressway / Connection Between the SEW and the CKE	☐ 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
Orugodawatta – Borella – Nugegoda – Boralesgamuwa - Kathathuduwa	☐ Short-term ☑ Medium-term ☐ Long-term	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

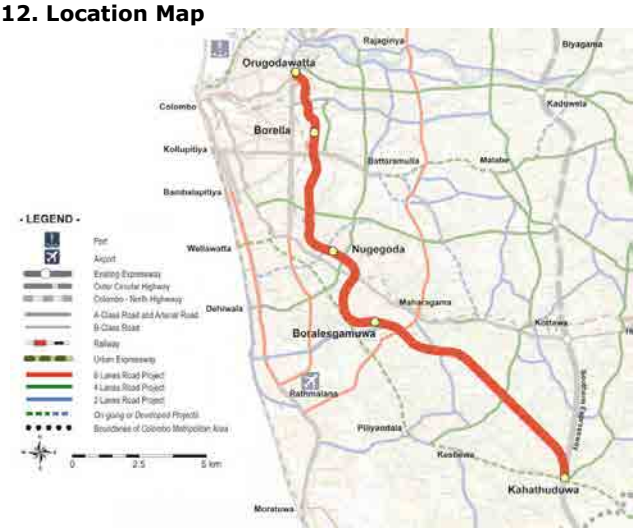
10. Special Considerations
- In order to improve the low accessibility between the northern and southern areas of CMC and expressways, additional lines are required as urban expressways to use the existing expressways effectively.

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

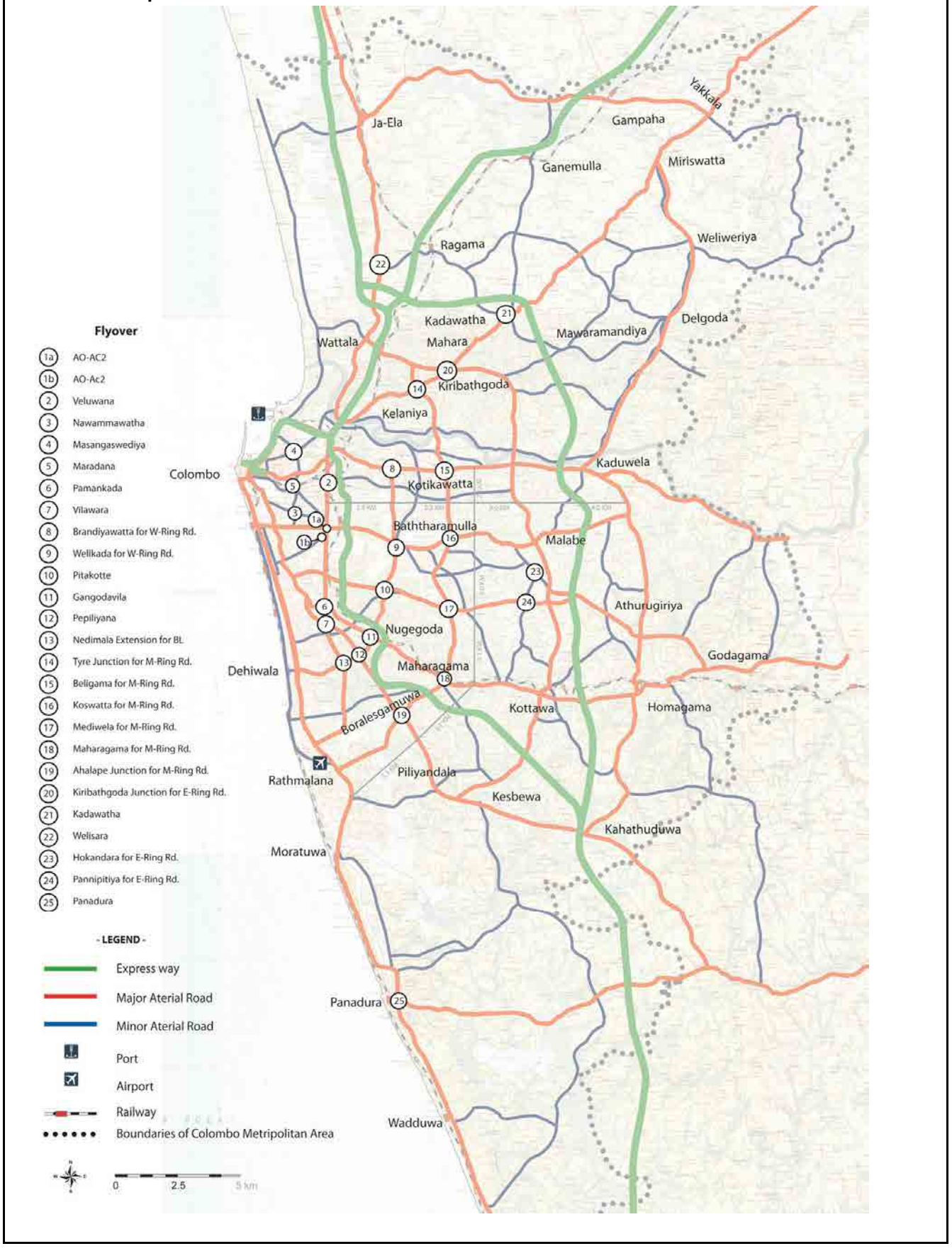
1) Social Environment
- Land Acquisition:
  1,400 ~ 4,200 m^2/point
- Resettlement: B or C, further investigation is required.
- Other Social Impact: B

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

<table>
<tr><td>Project ID Code

TM-S1~S3</td><td colspan="3">Project Name

Traffic Signal Control Improvement</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
☐ Reduction of Traffic Accident
☑ Promotion of Health</td></tr>
<tr><td colspan="2">Project Location
Congestion points in Colombo Metropolitan Area</td><td>Project Priority
☑ Short-term
☑ Medium-term
☑ Long-term</td><td>Implementation Period</td></tr>
<tr><td colspan="2">1. Objectives of Project
- To alleviate traffic congestion by optimised traffic signal control with an area-wide signal control system</td><td colspan="3">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</td></tr>
<tr><td colspan="2">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)</td><td colspan="3">4. Linkages with Other Projects/Sectors
- Road improvement (Widening, New Construction)</td></tr>
<tr><td colspan="2">5. Important Assumptions (Conditions for the Project)</td><td colspan="3">6. Implementing Agency
- Road Development Authority
- Colombo Municipal Council</td></tr>
<tr><td colspan="2">7. Financing Scheme
☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative</td><td colspan="3">8. Expected Operator (if any)
- Road Development Authority
- Colombo Municipal Council</td></tr>
<tr><td colspan="2">9. Project Cost (in 2013 Constant Price)
Initial Investment Cost: US$ 75.0 Million
Recurrent O & M: US$ M/year</td><td colspan="3">10. Special Considerations</td></tr>
</table>

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.

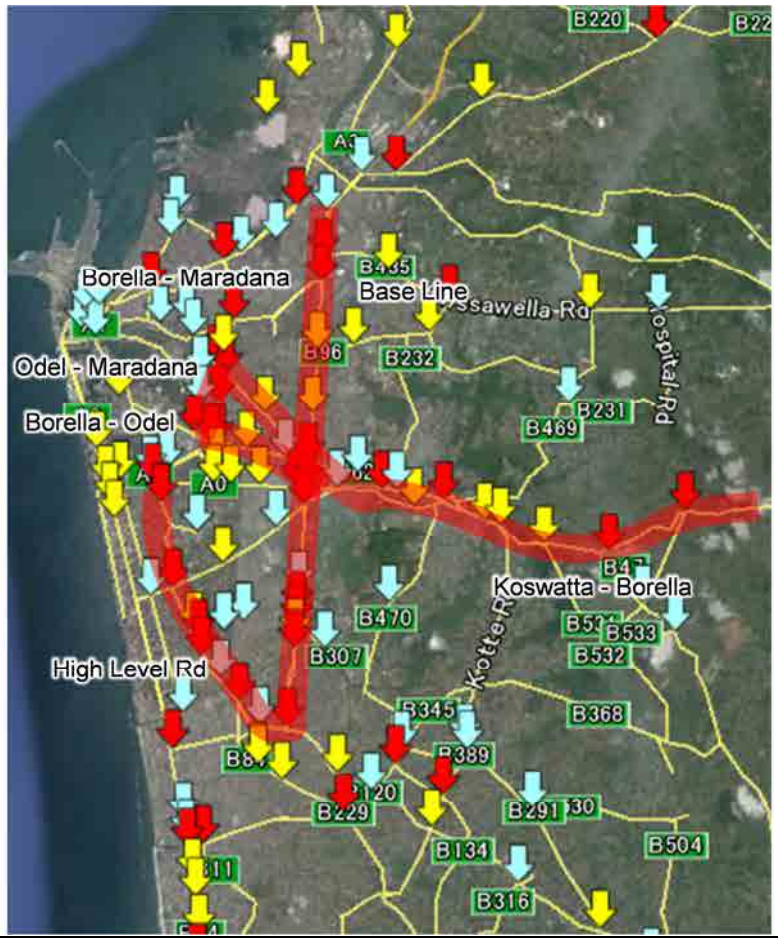
2) Natural Environment

- 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

Project ID Code	**Project Name**	**Transport Sub Sector**
TM-TI1	Traffic Information System	☐ 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

- 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

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.

3. Project Description

Collecting Information

- Installation of CCTV cameras to detect the traffic situation, especially for sudden events (congestion, accidents) with image processing program at approx. 200 location

Development of data analysis and equipment to accumulate the data

- Development of system for detecting sudden events
- Development of collection system on accumulated accurate congestion information, road closure information and Traffic regulation information.

Provision of information

- Development of dissemination system through internet/SMS/information board on road for reporting traffic congestion information and guiding the alternative route

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

5. Important Assumptions (Conditions for the Project)

The current CCTV's optical cable spread by Traffic Police would be utilised for this system.

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$ 33.0 Million
Recurrent O & M: US$ M/year

10. Special Considerations

CoMTrans PROPOSED PROJECT PROFILE

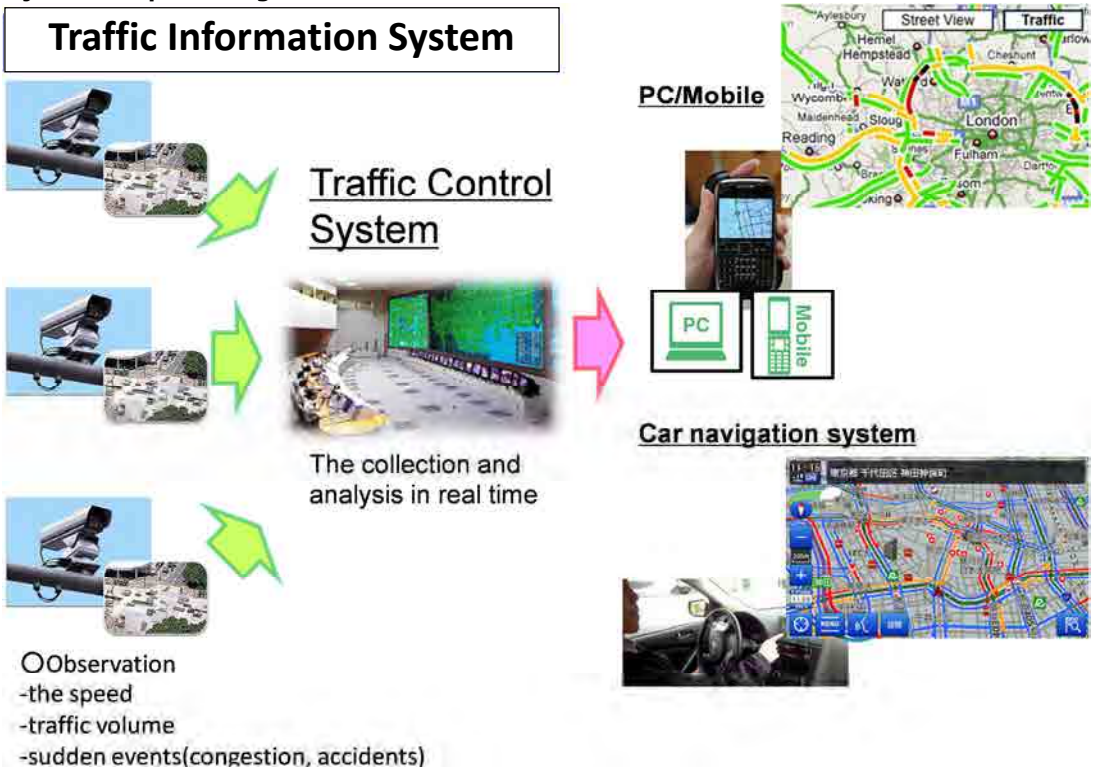
11. Environmental Impact

1) Social Environment
- Land Acquisition: Not major 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="2">Project Name
Bus Priority System + Bus Location System for BRT</td><td rowspan="2">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 ☐ Reduction of Traffic Accident
☑ Promotion of Health</td></tr>
<tr><td>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><td></td></tr>
<tr><td colspan="2">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="2">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="2">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

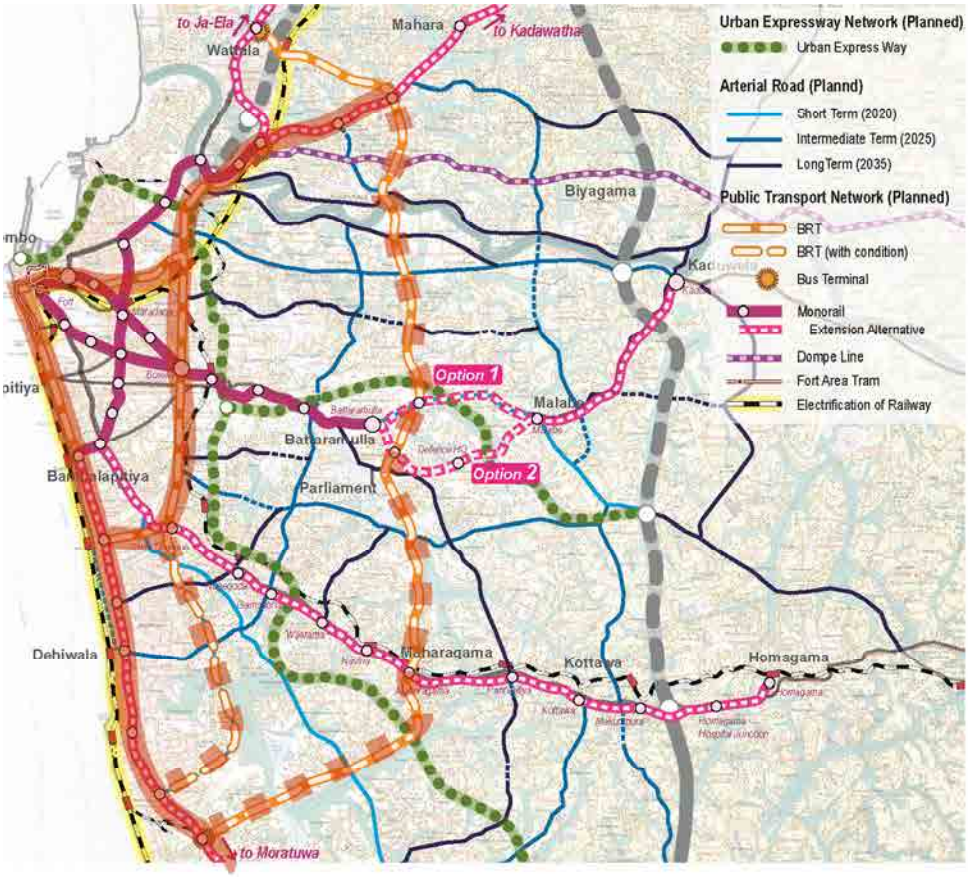
- Land Acquisition: Not major required
- Resettlement :B
- Other Social Impact: B

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

<table>
<tr><td>Project ID Code
TM-BL3</td><td colspan="2">Project Name
Bus Location System for Public/Private Buses</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 ☐ Reduction of Traffic Accident
☑ Promotion of Health</td></tr>
<tr><td>Project Location
Colombo Metropolitan Area</td><td>Project Priority
☐ Short-term
☑ Medium-term
☐ Long-term</td><td>Implementation Period</td></tr>
<tr><td colspan="2">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</td><td colspan="2">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</td></tr>
<tr><td colspan="2">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)</td><td colspan="2">4. Linkages with Other Projects/Sectors
- BRT Installation
- Traffic information system
- Common transport card (IC card) system</td></tr>
<tr><td colspan="2">5. Important Assumptions (Conditions for the Project)</td><td colspan="2">6. Implementing Agency
- Ministry of Transport
- CMC
- Traffic police</td></tr>
<tr><td colspan="2">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="2">9. Project Cost (in 2013 Constant Price)
Initial Investment Cost: US$ 1.0 Million
Recurrent O & M: US$ M/year</td><td colspan="2">10. Special Considerations
Institutional arrangement should be carefully designed.</td></tr>
</table>

CoMTrans PROPOSED PROJECT PROFILE

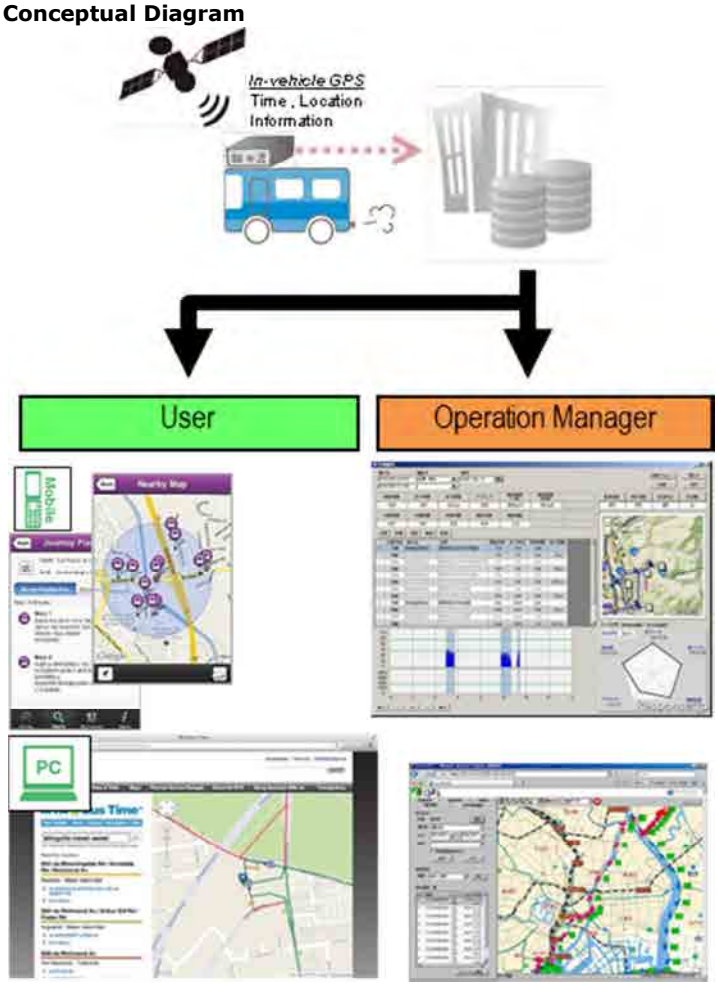
11. Environmental Impact

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

12. Project Conceptual Diagram



CoMTrans PROPOSED PROJECT PROFILE

Project ID Code	**Project Name**	**Transport Sub Sector**
TM-P1	Parking Information System	☐ 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**
Public parking and P&R station, possibility to link to private car parking	☐ Short-term ☐ Medium-term Long-term	

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

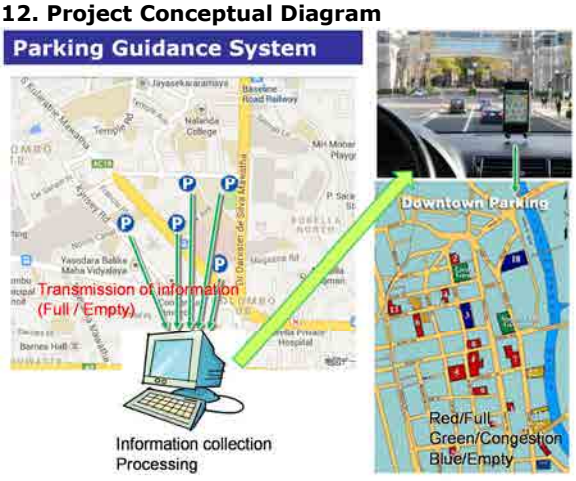
10. Special Considerations
Institutional arrangement should be carefully designed

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="2">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="3">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>Project Location
CMC Boundary</td><td>Project Priority
☐ Short-term
☑ Medium-term
☐ Long-term</td><td>Implementation Period</td></tr>
<tr><td colspan="2">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="2">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="2">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="2">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="2">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

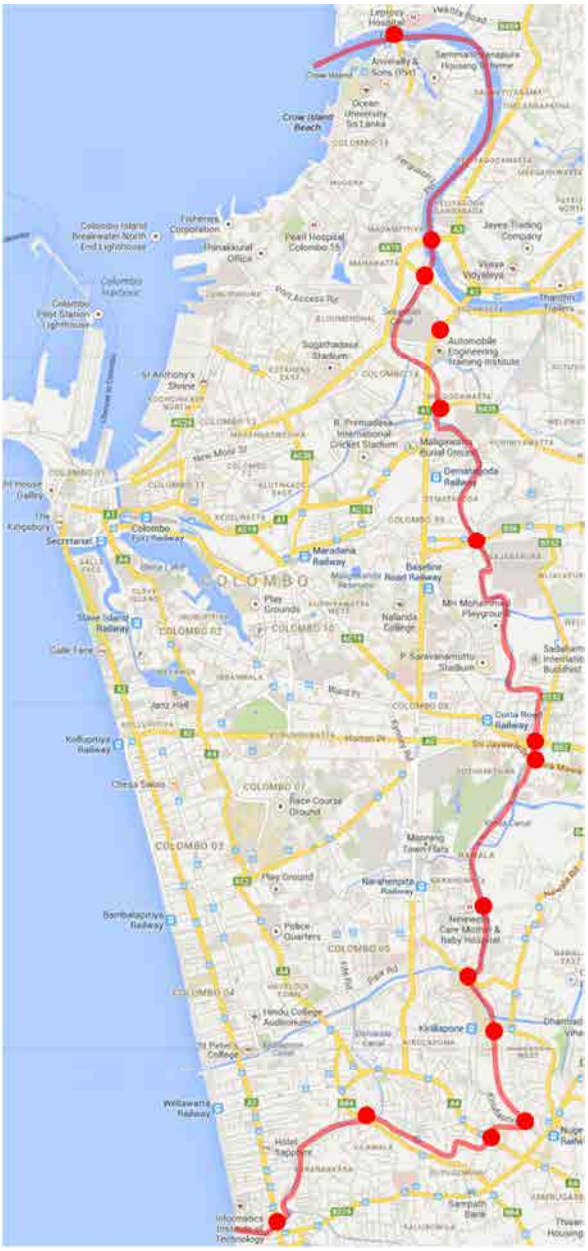
- Land Acquisition: Not major required
- Resettlement :B
- Other Social Impact: B

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

<table>
<tr><td>Project ID Code

RS-3</td><td colspan="2">Project Name

Enforcement of Safety Measures on 7 Corridors to Reduce Traffic Accidents</td><td rowspan="2">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
☑ Reduction of Traffic Accident
☐ Promotion of Health</td></tr>
<tr><td>Project Location
Location where the frequent traffic accident happens.
(e.g. 7 Corridors)</td><td>Project Priority
☑ Short-term
☑ Medium-term
☐ Long-term</td><td>Implementation Period
Total 5 years</td><td></td></tr>
<tr><td colspan="2">1. Objectives of Project
- To decrease head on accidents
- To decrease accidents during overtaking
- To decrease accidents during night time</td><td colspan="2">2. Expected Benefits
- Reduction of fatalities in vehicle traffic accidents</td></tr>
<tr><td colspan="2">3. Project Description
- Installation of Centre Median
- Installation of Ramble Strip
- Introducing Fast lane
- Introducing No-passing zone
- Increase and improve roadside lights</td><td colspan="2">4. Linkages with Other Projects/Sectors
- Development/improvement of roads</td></tr>
<tr><td colspan="2">5. Important Assumptions (Conditions for the Project)</td><td colspan="2">6. Implementing Agency
- Traffic Police
- Road Development Authority</td></tr>
<tr><td colspan="2">7. Financing Scheme
☑ Public Sector
☐ Public Private Partnership
☐ Private Sector Initiative</td><td colspan="2">8. Expected Operator (if any)</td></tr>
<tr><td colspan="2">9. Project Cost (in 2013 Constant Price)
Initial Investment Cost: US$_____Million_
Recurrent O & M: US$_____M/year</td><td colspan="2">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.</td></tr>
<tr><td colspan="2">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</td><td colspan="2">12. Location Map

n.a.</td></tr>
</table>

CoMTrans PROPOSED PROJECT PROFILE

Project ID Code EN-01	**Project Name** Air Emission Standard for Vehicles	**Transport Sub Sector**
Urban Transport Policy: ☐ Promotion of Public Transport ☒ Reduction of Pollution/ Promotion of Health ☐ Alleviation of Traffic Congestion ☐ Reduction of Traffic Accident		☐ Railway and New Transit ☐ Bus Transport ☐ Road ☐ Traffic Management ☐ Traffic Safety ☒ Environment ☐ Urban Planning ☒ Institution/Funding
Project Location n.a.	**Project Priority** ☑ Short-term ☐ Medium-term ☐ Long-term	**Implementation Period** 3 years

1. Objectives of Project - To establish and enhance of emission standard for vehicles. - To reduce air emission generated from transport sector.	**2. Expected Benefits** - Contributing to improvement of air quality in Colombo area
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.	**4. Linkages with Other Projects/Sectors** Vehicles inspection and maintenance programmes (EN-02)
5. Important Assumptions (Conditions for the Project) None	**6. Implementing Agency** Air Resource Management Centre (AirMAC)
7. Financing Scheme ☐ Public Sector	**8. Expected Operator (if any)** n.a.
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-02	**Project Name** Vehicles Inspection and Maintenance Programmes	**Transport Sub Sector**
Urban Transport Policy: ☐ Promotion of Public Transport ☒ Reduction of Pollution/ Promotion of Health ☐ Alleviation of Traffic Congestion ☐ Reduction of Traffic Accident		☐ Railway and New Transit ☐ Bus Transport ☐ Road ☐ Traffic Management ☐ Traffic Safety ☒ Environment ☐ Urban Planning ☒ Institution/Funding
Project Location n.a.	**Project Priority** ☒ Short-term ☐ Medium-term ☐ Long-term	**Implementation Period** 3 years

1. Objectives of Project - To improve a vehicle inspection and maintenance programme for the checking of air emissions.	**2. Expected Benefits** - Air emissions from vehicles shall be within the vehicle emission standards resulting in improvement of air quality.
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	**4. Linkages with Other Projects/Sectors** Air emission standard for vehicles (EN-01)
5. Important Assumptions (Conditions for the Project) None	**6. Implementing Agency** - Department of Motor Traffic - Air Resource Management Centre (AirMAC)
7. Financing Scheme ☐ Public Private Partnership	**8. Expected Operator (if any)** Private Sector Participation

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.

CoMTrans PROPOSED PROJECT PROFILE

- 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 ☒ 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 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.