(3) Modal Share by Corridor on CMC Boundary

Table 3.4 shows incoming and outgoing traffic at the CMC boundary in 1995. The total CMC passenger trips were around 1.7 million per day and bus passengers accounted for 57%, where as private vehicles accounted for 33%. Kandy, Galle, Negombo, High Level, and Kotte Roads are the major arterials based on passenger volume.

Table 3.4 CMC Cordon Two-way Daily Traffic Data by Mode and Corridor (1995)

Corridor/Railway line (Location)	Passengers per Day *(Percent to Total)*						
	Bus		**Private**		**Rail**		**Total**
Negombo Rd/Puttalam Line (Victoria Bridge)	146,019	*62%*	82,597	*35%*	8,000	*3%*	236,616
Kandy Rd/Main Line (New Kelani Bridge)	205,534	*55%*	77,785	*21%*	88,000	*24%*	371,319
Low Level Rd (Rail Crossing)	40,628	*64%*	23,271	*36%*			63,899
Kolonnawa Rd (Rail Crossing)	45,651	*77%*	13,845	*23%*			59,496
Kotte Rd/SJP Rd (Rajagiriya)	115,341	*46%*	133,659	*54%*			249,000
Narahenpita Rd (Canal Rd)	7,764	*22%*	27,143	*78%*			34,907
High Level Rd/KV Line (Kirullapone Bridge)	142,830	*69%*	54,981	*27%*	8,000	*4%*	205,811
Horana Rd (Pamankada Bridge)	61,826	*49%*	64,742	*51%*			126,568
Galle Rd/Coast Line (Dehiwela Bridge)	187,881	*57%*	82,154	*25%*	61,000	*18%*	331,035
Total	953,474	*57%*	560,177	*33%*	165,000	*10%*	1,678,651

Source: CUTS2 and UoM

Private Car Usage and Land Use

The share of private vehicles on Kotte and Narahenpita Roads is high due to high-income residential settlements in this area, which is closely aligned to the increasing vehicles ownership in traffic zones closer to Colombo. For example, comparing the northern and southern minor arterials (Low level and Kolonnawa Roads vs. Narahenpita and Horana Roads), the modal share of private vehicles to buses is 30:70 on the northern arterials and 70:30 on the southern arterials. The conclusion is that those in the northern areas are more captive public transport riders, as opposed to those in the south.

Loss of Public Transport Passengers Due to Quality

Buses continue to provide the bulk of passenger movements within the CMR, with 62% at the provincial boundary and 54% at the CMC boundary. The railway carries 18% at the CMR boundary, but only 13% at the CMC boundary.[22] The reduction in public transport riders closer to the city center is offset by the rapid increase in private vehicles, which increases from 20% at the provincial boundary to 33% at the CMC boundary. One reason for the low modal share on railways is the lack of rolling stock and line capacity during peak period on some of the corridors. Off-peak railway travel reduces sharply due to high headways and lower load factors

[22] Estimate based on CMR boundary data, which are included in Appendix 4

on buses. A comparison of bus transport shows a reduction from 1995 in passengers at the provincial boundary as well as the CMC boundary. The reasons for the decrease are:

- Increasing per capita incomes, a wider array of private vehicle choices (motorcycles, cars, minivans, and three-wheelers), and leasing mechanisms that encourage vehicle ownership;
- Lack of bus network rationalization over the last 30 years, which has resulted in increased transfers and an inability to board buses at intermediate stops;
- Lack of service quality improvements to the bus and rail sector, which encourages those who can to find alternative (private) means of transport;
- Breakdown of inter-modal connections such as rail to bus transfers;
- Deterioration of school bus services;
- Low quality of bus personnel in both the private and public sectors; and
- Low frequency during off-peak periods, which has compelled passengers to use three-wheelers or invest in private transport.

As a result, the public transport modal share within CMC has been decreasing, which has resulted in higher travel times and greater congestion.[23]

(4) School and Office Based Travel Demand

There are 125 schools in CMC area, which attract 145,000 students from outside Colombo.[24] Such school based traffic comprises 15-17% of passenger trip along the CMC boundary.[25] School van services are the most common mode used for school transport, with a modal share of about 35%. An additional 30% of the school transport modal share is provided by public transport.[26] The remainder of the modal share is comprised of rail, private vehicle trips, three-wheelers, and walking. As shown below, the modal share differs between school type.

Table 3.5 Modal Share of School and Office Traffic

	Bus & Rail*	Van service	Private car	School/office name
Government Schools (boys)	75%	20%	5%	Mahanama
Government Schools (boys)	30%	40%	30%	Royal College
Government Schools (girls)	19%	34%	47%	Visaka Vidiyalaya
Government Schools (girls)	40%	60%	-	Anula Vidiyalaya
Private Schools (girls)	-	50%	50%	Ladies College
Private International Schools	-	30%	70%	Stafford
Government Offices (large)	80%	17%	3%	RDA

Source: This Study; Estimated based on interviews and related statistics. *) inlcudes walking

Cinnamon Gardens, Maradana, and Nugegoda are major destinations for school transport with about 20,000 students arriving daily. Most government and private schools are located along the perimeter of Colombo's downtown area. International schools, used by wealthier families, have been established throughout Colombo. These schools heavily utilize private vehicles for transport.

[23] By UoM's calculations, the loss of public transport riders is the cause of the increasing economic costs (wasted time and fuel costs) now estimated at around Rs 20 billion annually in the CMR.
[24] Provincial office, Department of Education, including all private and governmental schools, and All Island School Children Transport Association
[25] Estimated by study team, based on number of trip (table 3.4), trip demand, and actual counting prepared by RDC.
[26] Survey by Traffic Police in January 2006

For office traffic, there are approximately 400,000-450,000 office workers in Colombo with major destinations in Fort, Pettah, Hultsdolf, Slave Island-Union Place, and along Galle Road. Due to the urbanization, offices, such as government departments and ministries, have been moving out of Colombo to areas such as Battaramulla, Cinnamon Garden, Baseline Road, and outside CMC. RDA for example is located in Battaramulla and 78% of the employees who work there use RDA's private office bus services to commute, most likely because RDA subsidizes 80% of transport costs.

Reduce Peak Period Traffic Concentration

Before July 2006, government offices and schools started at different times, with a thirty minute difference between them. Private offices provided more flexibility with a one hour difference from school start times. On 1 July 2006, the government modified school start times countrywide and consequently, the gap between the start time of schools and offices (government and private) increased.[27] Details of this change are shown below.

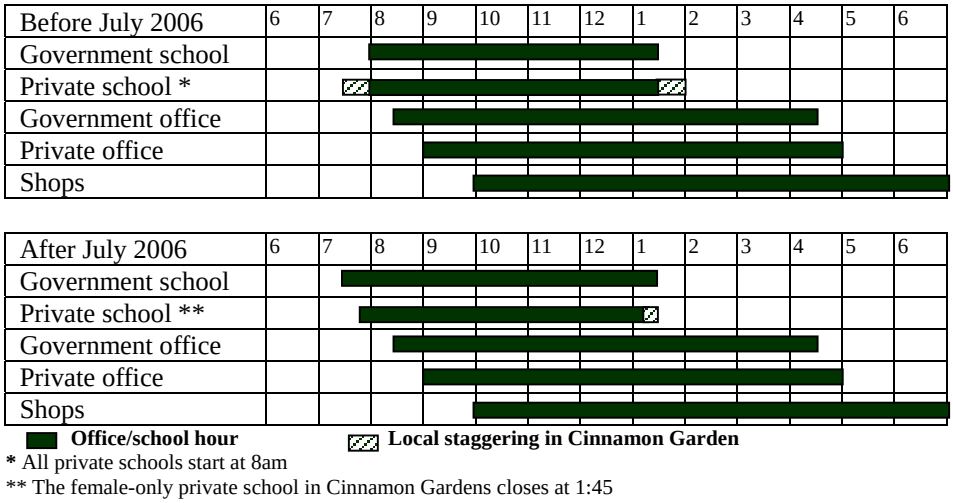
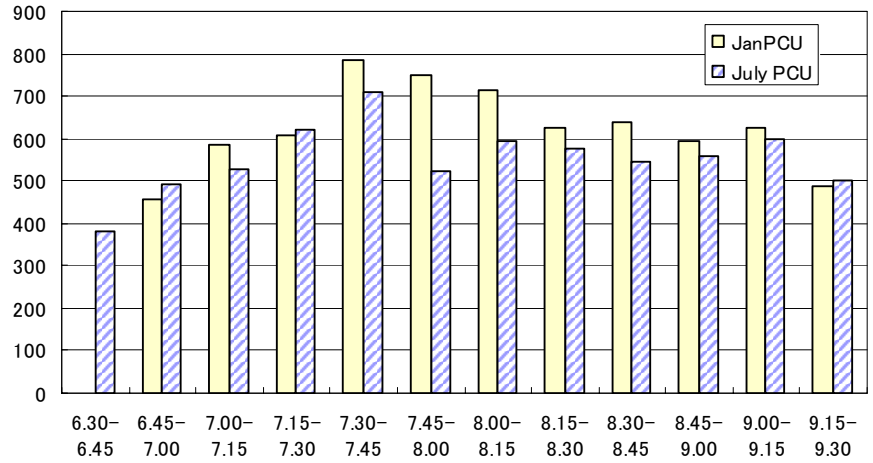


Figure 3.10 New Office Hours

Figure 3.11 below shows details of the temporal distribution of morning traffic on major corridors before and after the change in start times. As can be seen in the figures below, the traffic peak that was previously observed between 7:30-7:45am has leveled after the change in school start time.[28]

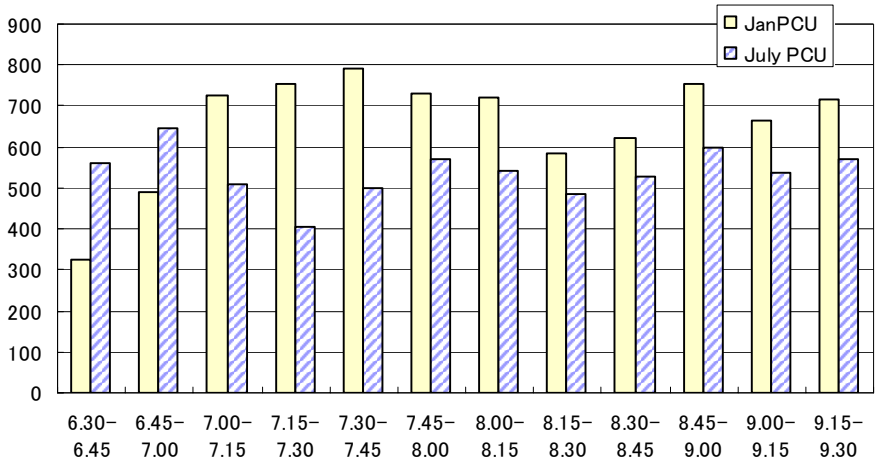
[27] It was announced three months before by the presidential office. Ministry of Public Administration and Ministry of Education ordered government offices and government schools to follow it.

[28] In addition to levelling the peak, the figures show a decrease in traffic, which can be attributed to the security condition and an increase in the government's provision of free transport on SLTB buses. Details of this program are explained in Section 7.4.



Place: Sugathadasa stadium, A1 Road
Jan: 25th Jan 2006 wed.
July: 7th July 2006 fri
Direction: West -> East
Morning Peak
Standard Deviation
Jan: 99 July: 80

No data available for 630-645 for Jan.



Place: North Dehiwala, A3 Road
Jan: 25th Jan 2006 wed.
July: 5th July 2006 wed.
Direction:
South -> North
Morning Peak
Standard Deviation
Jan: 134 July: 61

Source: This Study

Figure 3.11 Changes in Traffic Distribution Due to Changes in School Start Times

(5) Other Travel Patterns

The following travel pattern information is summarized in Appendix 4 and 5:

- Traffic and modal share on CMR boundary: total daily trips crossing the CMR boundary daily is 400,000 and the modal share by corridor is shown using the same methodology as that of the CMC boundary. It is assumed that most of this traffic will enter the CMC area;
- Vehicle occupancy rate; and
- Time-wise trip distribution at CMC area and CMR boundary.

(6) Freight Traffic Demand

Freight Traffic Distribution

Table 3.6 shows the distribution of freight traffic at three geographical levels. CMR comprises about 95% freight distribution at the national level and of that, Colombo and Gampaha Districts combine to 90%.

Table 3.6 Percentage Distribution of Freight Traffic Outside Port Area

Area	District/Province	Inbound	Outbound	Total
Within Colombo District	CMC	34.9	37.0	35.9
	Colombo (rest of)	21.0	23.3	22.2
Within Western Province	Colombo	55.9	60.3	58.1
	Gampaha	36.6	30.5	33.5
	Kalutara	2.5	3.9	3.2
Within Whole Country	Western	95.0	94.7	94.8
	Others	5.0	5.3	5.2
Total		100.0	100.0	100.0

Source: UoM
The total of each share may not be 100 due to adjustment

Even though the railway offers freight services, the majority of freight movements within the CMR occur on the roads. The percentage of freight vehicles on CMR roads varies across corridors, although the average percentage of freight vehicles on CMR roads is about 8%. Freight movements are heavy focused in the north and east, especially on A3 and A110 and the majority of these vehicles carry either building material or port- bound cargo.

At present, Colombo's port attracts or generates nearly 13,000 vehicle trips daily and around 40% of them are from freight vehicles. The share of container movements is around 25%. Port bound freight traffic is largely confined to specific sections on the main corridors and some selected road links in the vicinity of the port.[29] These truck routes facilitate freight movements within the CMC area and also to locations beyond the city limits. The Port Access Road, a 1.4 km long dual carriageway road is available exclusively for port traffic from Ingurukade Junction (near the northern CMC boundary).

Origins and destinations of port-bound traffic is scattered in and around Colombo city and the container handling facilities are scattered in and around the northern and eastern areas of CMC.[30] Currently, since some of the links and intersections around the port are highly congested, there are long delays during the day. Therefore, future plans must carefully land use, especially for port-related activities so that new projects will not create additional burdens on the existing transport infrastructure.

3.5 Urbanization and Travel Patterns

Urbanization Trends

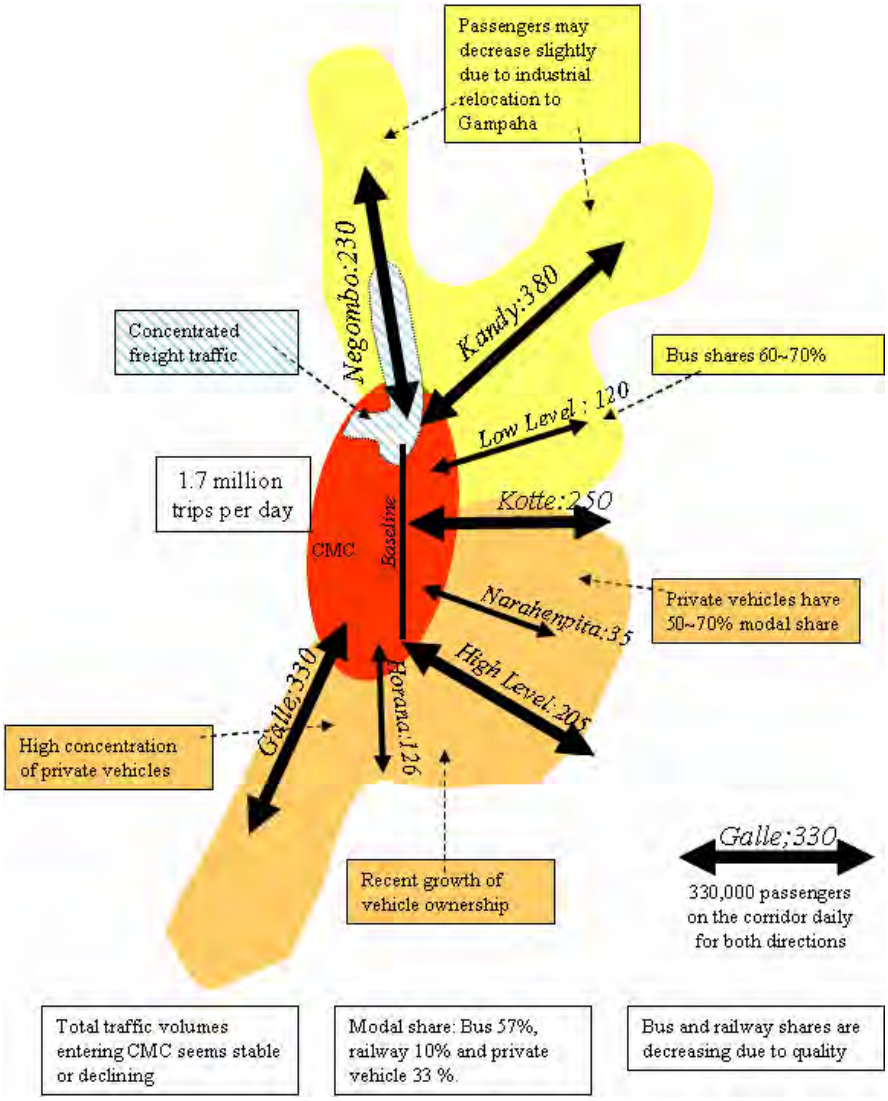
Within CMC, the housing boom occurred in the southern areas and has expanded beyond Colombo. However, due to high land values, other people are settling beyond the city center.

The southern and northern suburbs are opposites. Higher income households tend to live in the southern areas where the land values are rising and they tend to use private vehicles. In the northern suburbs, particularly Gampaha, the population has been high due to affordable land prices and its density is still low due to its mix of land uses. In-migration to Colombo may continue, but people are choosing to move to the suburbs instead of the city center.

[29] See Appendix 6 for more information
[30] See Appendix 6 for more information

Major Travel Patterns and Interaction with Land Use

Figure 3.12 shows major travel patterns and recent changes overlaid on the land use trends introduced in previous section. It shows major radial traffic flows with their respective passenger volumes. The total daily number of incoming/outgoing passengers is 1.7 million, which should remain stable given the recent suburbanization. The figure also shows land use activities and the relationship with traffic patterns. The increase of high income households within the southern area has affected the travel patterns in the southern area, as there are more private vehicles leading to higher traffic congestion. Alternatively, the northern areas show a high captive public transport ridership, although passenger traffic is decreasing here as well. High freight traffic areas are also shown in the figure.



Source: This Study

Figure 3.12 Daily Travel Patterns and Land Use Trends

Chapter 4 Future Vision for Colombo: A Strategic Land Use/Transport Framework

4.1 Introduction

To determine the type of transport system required for an urban area, it is necessary to establish a future vision of the kind of city it is to be. Then, the type of structure and development needed to achieve this goal can be prepared. That is the purpose of this chapter, which also describes potential issues that should be accounted for when carrying out and implementing planning.

4.2 Future Role of Colombo

Over the years, many government agencies, academic institutions, NGOs, private consultants, etc. have prepared a number of master plans and studies (see Chapters 2 and 3 for details) regarding what the role and structure of the Colombo Metropolitan Region (CMR) should be. The most recent plan, or the 2004 Western Region Megapolis Plan (WRMP), is the culmination of all these plans and provides the most up-to-date thinking on the development and structure of the CMR. Given this, the content and thinking of this chapter is based mainly on the WRMP. The role or vision for Colombo can be broken down into a domestic and international context as described below.

(1) Domestic Context

Accounting for about 29% of the country's population, more than 40% of its GDP, and 6 of its 11 universities, the CMR is the hub of Sri Lanka. In fact, Colombo has been the commercial and administrative center of the country for the last 400 years. On the other hand, there has been concern that the CMR is leaving other regions of the country far behind and that more emphasis should be put on eliminating regional disparities. This, however, has been tempered by the recent realization that instead of "spreading growth" around, which is difficult due to much lower levels of development outside the CMR, it would be better to accelerate CMR growth and to have the "spill-over" effects benefit the rest of the nation. This seems to be a more realistic scenario and would benefit both the CMR as well as the rest of the country. Given the preceding, the role or vision for the CMR from a domestic viewpoint is that it is to be an "engine of growth" for the rest of the nation and therefore must continue to provide a business-friendly environment. According to the WRMP, economic growth in the city core should be more than 10% to achieve this.

(2) International Context

From an international context, all recent previous plans have identified the following as being an important part of their vision regarding the development of Colombo:

- **Shipping Center:** Due to its locational advantages, the Port of Colombo has been an important shipping center for the past couple of decades. The continuance of this status quo is important to the economic health of the area; [1]
- **Tourism Center:** Tourism is an important sector in terms of revenue and employment. In 2004, revenue from tourism was about Rs. 2.5 billion and employed more than 53,000 people. Note that a large portion of foreign tourists that come to Sri Lanka stay in the

[1] Note that the Port of Colombo processed a total of 2.45 million TEUs in 2005 for an increase of 15.4% in total volume handled as compared to 2004.

CMR (21.7%) and that the total number of tourists coming to Sri Lanka reached a record of more than 566,000 in 2004[2]; and

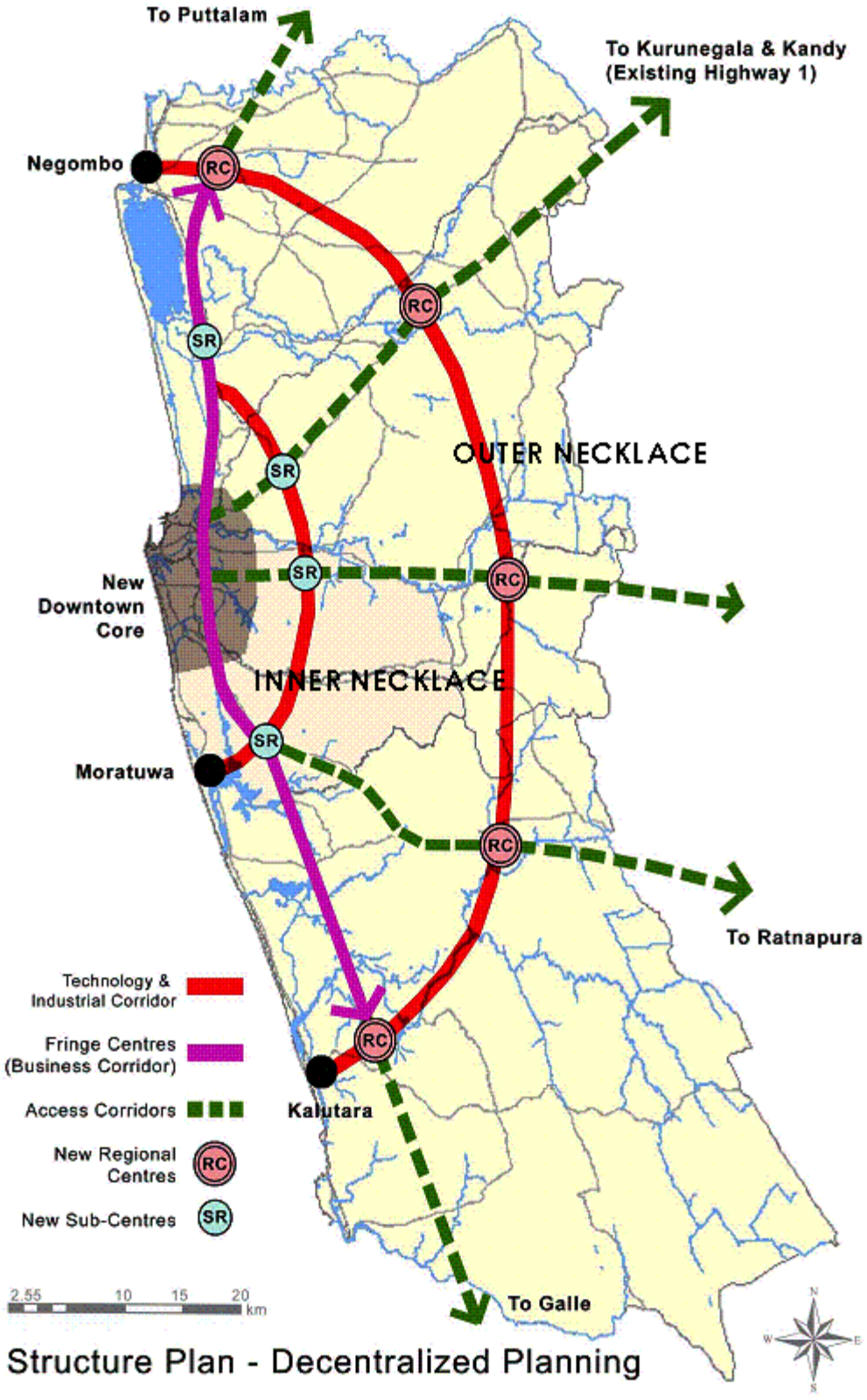
- **Investment Center:** With the liberalization of the Sri Lankan economy in the 1970s, there have been substantial increases in foreign investment that has continued over time. For example, the amount of foreign direct investment in 2001 was US$ 0.08 billion and increased to US$ 0.23 billion in 2003.[3] The goal is for Colombo to become a business hub of the South Asia region.

4.3 Envisioned City Structure and Development

To realize the above-mentioned vision of Colombo, the WRMP proposed the structure and land-use plans shown in Figure 4.1 and 4.2 below. As Figure 4.1 indicates, the CMR would be split into two large areas via the construction of an inner and outer ring road (or Inner Necklace Road and Outer Necklace Road). These structures delineate three areas (peripheral, suburban, core) for different levels and types of development as shown in Figure 4.2, which will have a total forecasted population in 2030 of 7.90 million persons out of 8.4 million for the CMR. A description of the functions of these three areas is as follows:

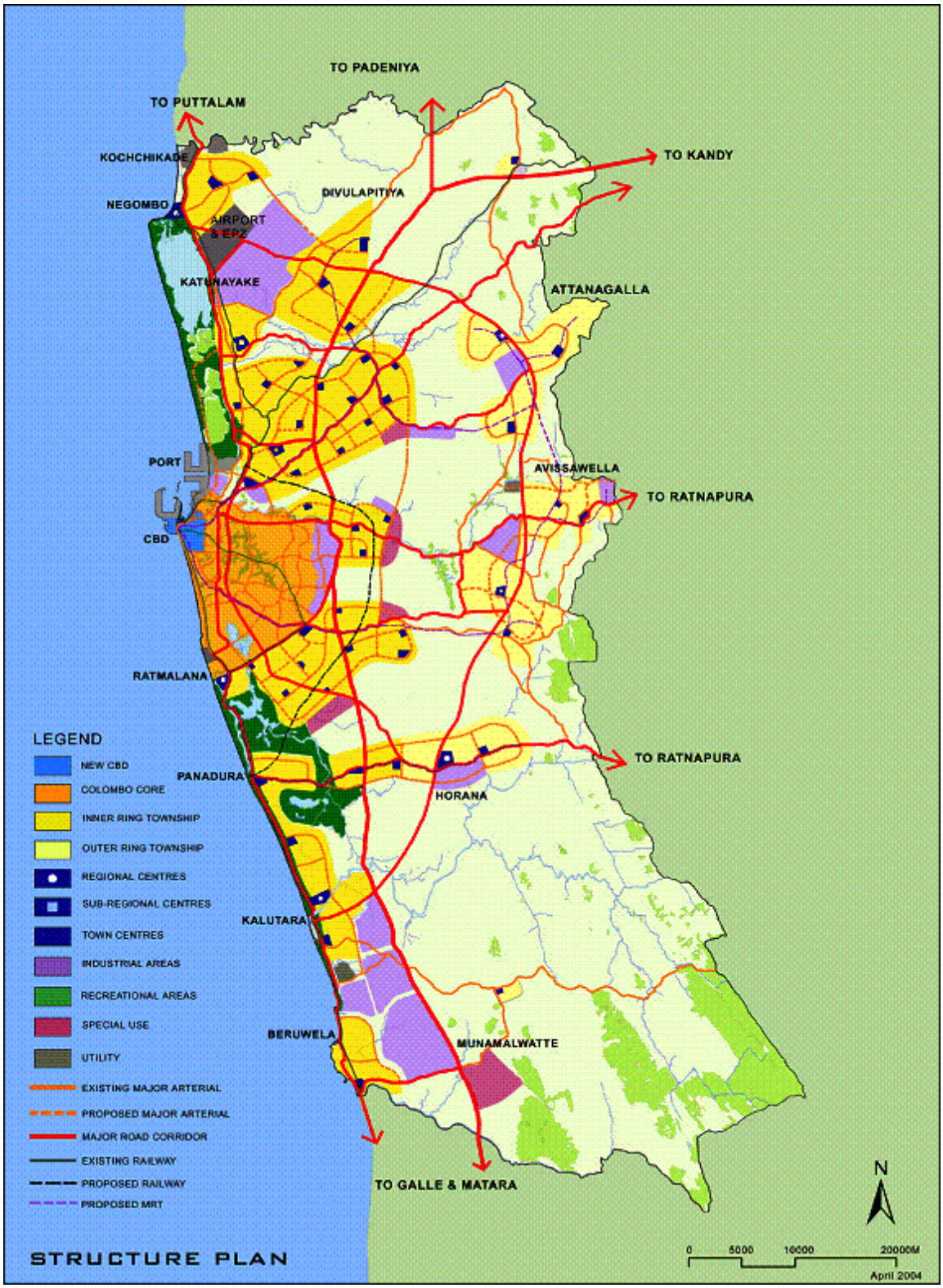
- **Peripheral Region:** This region will be served by the Outer Necklace Road and consist of self-contained low-density development, together with accommodating industry requiring large plots of land. On the other hand, as this region is the most environmentally sensitive, development will be much less than in the other two areas and population is forecasted to be only 1.12 million by 2030 (or approx.14.2% of the total). Note that five regional centers will be located on the Outer Necklace Road, which will be a semi-expressway, and comprise mini-CBDs that integrate various business activities, local government offices, shopping centers, etc., so that it will be unnecessary for residents living in the area to travel to the center of Colombo. These regional centers are Kalutara, Horana, Seethawaka, Attanagala, and Negombo and will be new growth centers;
- **Suburban Region:** The suburban region is where the vast majority of the population contained within the two ring roads will live, or a forecasted 4.84 million people in 2030 (61.3% of the total). This region will consist of medium-density developments and the Inner Necklace Road, which will be an expressway (i.e., the OCH and Southern Expressway), will be a technology corridor that will comprise biotechnology parks, research institutes, and other high-tech enterprises. In addition, the Inner Necklace Road will contain four sub-centers that will cater to surrounding townships; and
- **Core Area:** The core area is forecasted in 2030 to have a population of 1.94 million people (24.5% of the total) and will comprise national administrative organs, the CBD, major hospitals, and national level sporting and cultural facilities. Note that a business corridor, which will consist of wholesalers/retailers and other trading entities, will be located along the Baseline Road near the fringe of the CBD. The core area will be located within the municipal councils of the City of Colombo, Dehiwala-Mt. Lavinia, and Sri Jayawardenapura-Kotte, and will overlap into the boundaries of Kaduwela, Maharagama, Ratmalana, and Kesbewa.

[2] Annual Statistical Report of Sri Lanka - Tourism 2004, Sri Lanka Tourist Board
[3] World Investment Report 2004, UNCTAD



Source: WRMP, Vol. 1, page 11, Board of Investment, 2004

Figure 4.1 Structure Plan for the CMR



Source: WRMP, Vol. 1, page 12, Board of Investment, 2004

Figure 4.2 Land-Use Plan for the CMR

4.4 Strategic Transport Requirements

The strategic transportation requirements deemed necessary by the WRMP up to the year 2030, from the perspective of new or improved physical infrastructure in order to realize the structure and land-use described in Section 4.3, are as illustrated in Figure 4.3 and 4.4. The main improvements and construction of WRMP in the case of road facilities, which accepts the need for the road facilities proposed by the Road Development Authority (i.e., Southern Expressway, Colombo-Katunayake Expressway, Outer Circular Highway, Baseline Road (Phase 3), Colombo-Kandy Expressway, and Katunayake Highway) are as follows:

- **Outer Necklace Road:** This will be a semi-expressway structure and will connect the airport and export-processing zone (EPZ) to the north with an industrial zone to the south, while linking up the townships located on the Outer Necklace itself. As traffic demand will initially be low, a two-lane road will be constructed, followed by upgrades as needed;
- **Inner Necklace Road:** This expressway actually consists of parts of the proposed Outer Circular Highway and the ongoing Southern Expressway. It will serve to connect the airport with the Southern Expressway, as well as the townships on the necklace itself. The road is to be initially constructed as a 4-lane facility;
- **Urban Semi-Expressway:** This road facility, which will be constructed initially as a four-lane road, will link the Colombo- Katunayake Expressway with the Southern Expressway and serve as the main spine for connecting the airport, EPZ, Inner Necklace Townships, the City of Colombo, and the southern industrial zone;
- **Other Semi-Expressways:** Other semi-expressways indicated in Figure 4.3 will be constructed initially as four-lane roads and will have the function of carrying much of the traffic entering and leaving Colombo; and
- **Major Arterials:** The function of these roads is to complement the expressway and semi-expressway network to serve inter-town traffic demand and will be constructed initially as four-lane facilities.

Note that almost all of the road projects mentioned above, including those of the RDA, were originally scheduled for completion in 2010 and were to be upgraded thereafter via an increase in the number of lanes from 2 to 4 to 6 lanes or from 4 to 6 to 8 lanes over a period till 2030.

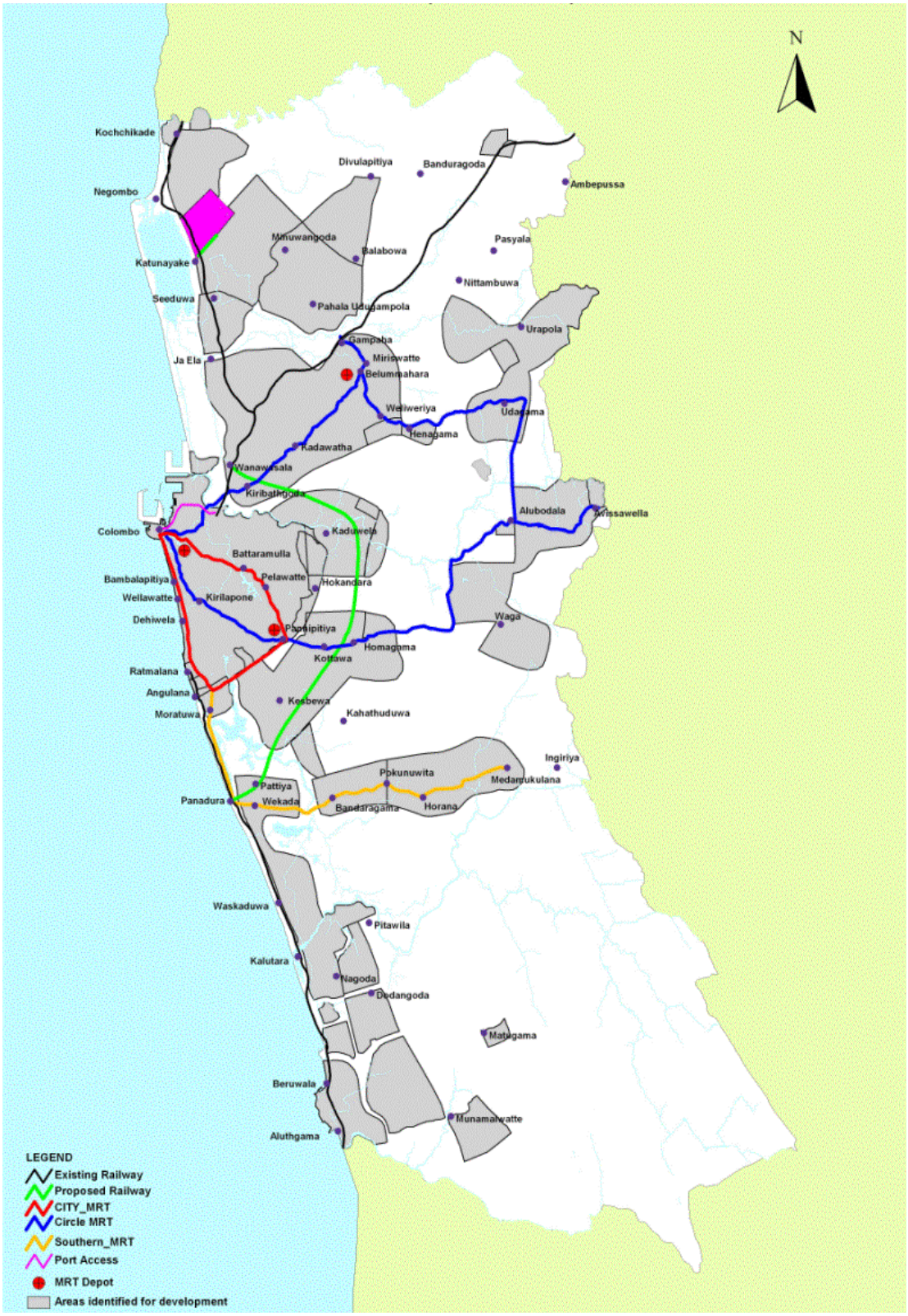
The main improvements and new construction in the case of rail facilities are described below. Note that the transit systems will run along existing highways to minimize social impacts, while the proposed new rail line will pass through uninhabited marshy area or abandoned paddy fields.

- **Mass Rapid Transit (MRT):** The WRMP proposes that three MRT systems be built (i.e., a City, Circle, and Southern MRT). The City MRT would serve commuter traffic within the Colombo core and run from Dematagoda to Ratmalana via Battarmulla and Maharagama. The Circle MRT would be a medium rail transit system and link Inner and Outer Necklace townships to the core area and run from Colombo to Udagama, Avissawella, and Kottawa. The Southern MRT would also be a medium rail transit system and would serve the Horana region. All MRTs would be integrated;
- **New Rail Line:** This will essentially run along the Inner Necklace Road, serving an area with a large population that is also heavily traveled. This line will connect the EPZ, the southern industrial zone, and Inner Necklace Road townships;
- **Existing Railway:** In order to free up high value lands for development, the section of existing rail between Ratmalana and Colombo will be abolished; and

- **Port Access:** A rail extension from the Port to Orugodawatta would be built to connect with a logistics center in order to increase the processing capacity of the Port as well as to handle the forecasted increase in truck container traffic.

Source: WRMP, Vol. 1, page 39, Board of Investment, 2004

Figure 4.3 Road Network in 2030



Source: WRMP, Vol. 1, page 46, Board of Investment, 2004

Figure 4.4 Railway Network in 2030

4.5 Policy Implications

Some of the potential issues that should be taken into account regarding the execution of the WRMP's master plan for the CMR are as follows:

- **Non-Physical Measures for Congestion:** In addition to the physical infrastructure that has been described in Section 4.4, it is also necessary to consider soft or non-physical measures to meet the needs of the transport sector and should include traffic management and traffic demand management measures such as parking management, intersection signalization, calibration of signaling, traffic calming, staggered travel times, telecommuting, HOV lanes, and bus prioritization, as well as changes in the operation of public transport that would improve the quality of service such as the franchising of bus routes; [4]
- **Pro-Poor Measures:** Transport facilities and services should be made more available to the poor so that the levels of poverty[5] and the unemployment rate, which is currently 8% in the Western Region, can be reduced;
- **Population Distribution:** In order for the above-mentioned infrastructure to be cost-effective, it is important that self-contained developments of sufficient density be located nearby. At present, the majority of the population lives in small communities sprawled across the region making this difficult to achieve;
- **Land Acquisition:** Ensure that the land necessary to realize the previously mentioned developments along the proposed road and rail infrastructure is available. This will require long-term planning and is complicated as much of the property in Sri Lanka is in private hands. On the other hand, any master plan requires land acquisition and without it, the master plan cannot be realized;
- **Zoning Enforcement and Urban Sprawl:** Another crucial aspect to realizing the physical structure as proposed by the master plan of the WRMP is the enforcement of zoning laws and regulations; otherwise, it will be impossible to prevent the ad hoc distribution pattern of settlements and the resulting urban sprawl. It seems that this has been an issue in the past with there being a failure by the relevant authorities to carry out the legitimate enforcement of planning guidelines;[6]
- **Environmental Issues:** In terms of transport, vehicle inspection and maintenance regulations should be examined[7], which in the past has focused on vehicle condition and not emission levels, as well as the impacts of new road and rail infrastructure; and
- **Costing and Prioritization:** As in the case of almost all previous plans, the WRMP has provided no information on the approximate cost of projects and where funding would come from. Moreover, the projects of the WRMP are not prioritized. This seems more like a wish list and is difficult to implement. In this Study, in order to maximize the possibility of implementation of the projects to be proposed, it is recommended that project costing in addition to prioritization be carried out.

[4] According to a July 2003 survey by the NGO Centre for Policy Alternatives, approximately 77% of riders who use a declare that is either always or most of the time overcrowded.
[5] According to the *Colombo City Development Strategy Report* of November 2001, which was prepared by the UN's Urban Management Program in association with the consultancy SEVANATHA and the Colombo Municipal Council, approximately 40% of the population in the Colombo core area lives in low-income settlements.
[6] *Western Region Physical Structure Plan*, Volume 1, National Physical Planning Department, Ministry of Western Region Development, 2002
[7] According to the World Bank's 1996 *Sri Lanka Transport Sector Study*, the transport sector is the biggest contributor of air pollutants in the Colombo Metropolitan Region.

Chapter 5 Urban Road System and Traffic Conditions

5.1 Introduction

This chapter outlines the characteristics of urban road systems in the Colombo Metropolitan Region (CMR) with regards to (i) current conditions; (ii) standard design practices; (iii) vehicle traffic characteristics; (iv) congestion spots; (v) road development plans; (vi) pedestrian facilities; and (vii) maintenance activities. The chapter discusses issues and shortages in the road network, which were also identified by the Road Development Planning Working Group (RDPWG). RDPWG also prioritized the issues raised.[1]

5.2 Existing CMR Road Network

(1) Overview

The present road network is 14,783 km in length within the Western Province (WP) and can be placed in three categories, as shown in Table 5.1.

Table 5.1 Road Classification, Administrative Responsibility, and Length

Category	Classification[1)]	Maintenance and Improvement Responsibility	Length of the Road (km)	
			WP	Within CMC
National Roads	A and B class	RDA	1,543	39
Provincial Roads	C and D	Western Provincial Council	1,945	(441) [2)]
Local Roads	E class	Local Authorities	11,295	
		Total	14,783	480

Source: RDA, CMC
1) Definition of road classification is discussed later.
2) Length of road of C, D and E class in the CMC area was not apparent due to the fact that RDA road database does not keep relation with local administrative boundaries.

Slow Progress in Road Development

An international comparison study on road density is shown in Table 5.2. The table shows that the road length per area in the Colombo Municipal Council (CMC) area is greater than that of Singapore. However, the amount of roadway in the other districts is much less than that of other Asian cities. Particularly, the road length per population and the road area per population in Colombo District is much less than the WP average.

[1] The study team facilitated 6-hours discussion for road development issues in the Working Group for Land Use and Transport.

Table 5.2 An International Comparison of Road Density

	Population (million)	Total Area (sq km)	Road Length (km)	Length/ Pop. (m/head)	Length/ Area (km/sq km)	Road Area/Pop. (sq m/ head)	Road Area /Total Area (%)
WP.	5.471	3,684	3,451	0.63	0.94	3.91	0.58
Colombo Dist	2.305	699	823	0.36	1.18	2.27**	0.75**
Gampaha Dist	2.089	1,387	1,578	0.76	1.14	4.68**	0.71**
Kalutara Dist	1.077	1,598	1,050	0.98	0.66	5.92**	0.40**
CMC	0.647	37.31	480	0.74	12.87	7.22*	12.52*
Singapore	4.24	699	3,188	0.752	4.56	9.85***	6.0***
Delhi NCT	13.85	1,483	30,949	2.24	20.9	--	--
Tokyo CBD	8.35	621	11,817	1.41	19.0	11.76	15.8

Source: Sri Lanka; Population data-2001 from Dept. of Census and Statistic, Road length data-2003 from RDA, Road area for A and B class in District Level were prepared by RDA.
*) Assumed 18.0m for average width of A&B class in CMC, and 9.0 m for average width of other class roads.
**) Assumed 6.0 m for average width of other class roads.
Singapore; Land Transport Authority (2004) ***) estimated based on Lane-Length data.
Delhi National Capital Territory; Government of NCT of Delhi (2004)
Tokyo CBD; Tokyo Metropolitan Government (2004)

Four-Lane Road Lengths Are Limited

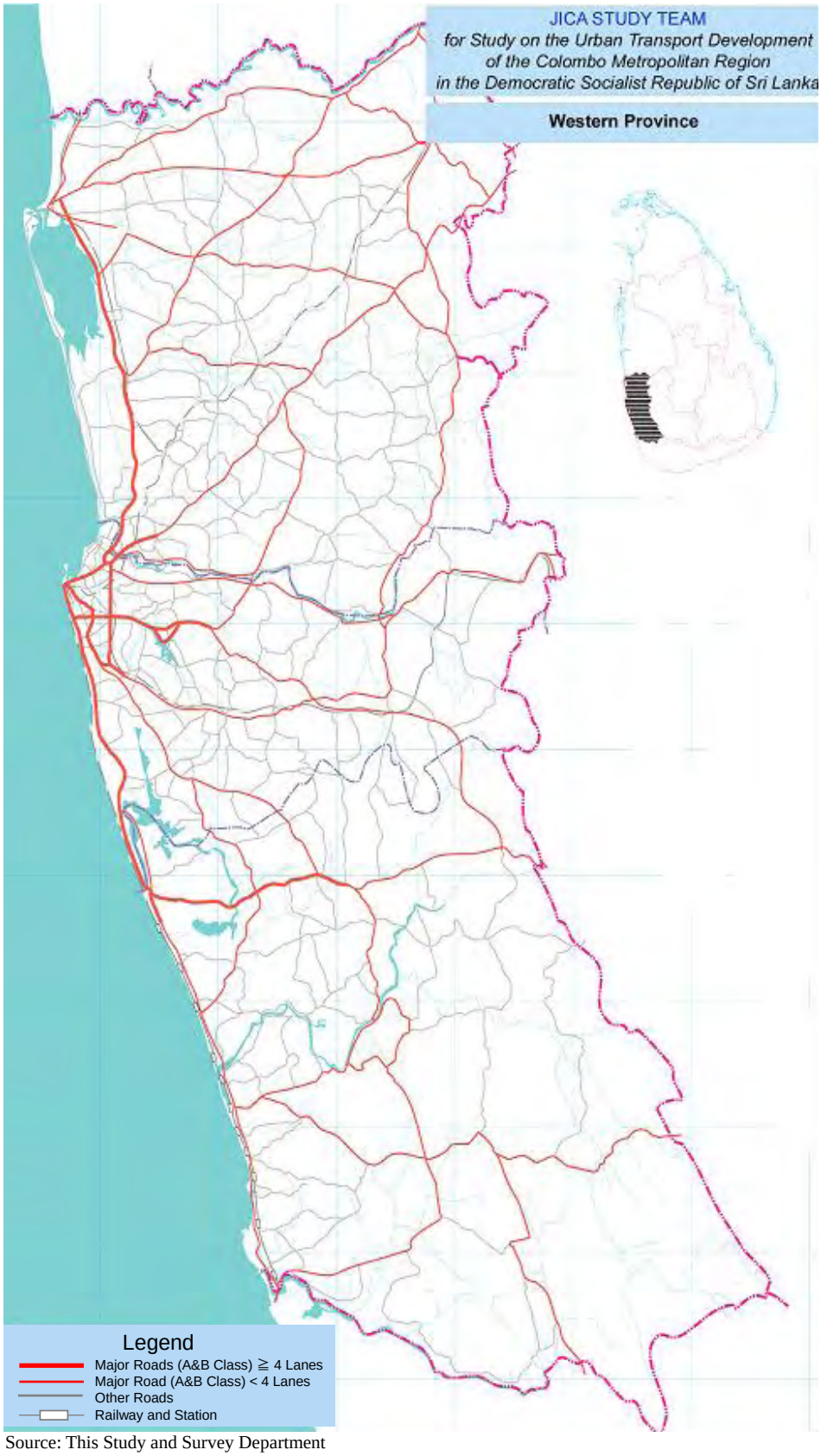
The road network configurations for CMR and the strategic planning area are shown in Figures 5.1 and 5.2. These figures also show width classification and road category.[2] Figure 5.3 shows the CMC road network configuration, which has road classification categories including national roads and major CMC roads, as well as the road width.[3,4] As shown in the figures, most of the CMR network is comprised of two-lane roads, particularly in suburban areas. In the CMC area, several major links are served by two-lane roads. Below is a summary of four-lane road development in CMR and CMC.

Table 5.3 Ratio of Four-Lane Roads

	CMR		CMC	
	A class	B class	A&B class	All Other Roads
Road Length (km)	362.2	1194.6	39	441
Four-lane Road (km)	108.8	0	39	68.2
Ratio of Four-lane Roads to Total Road Length (%)	30%	0%	100%	15.4%

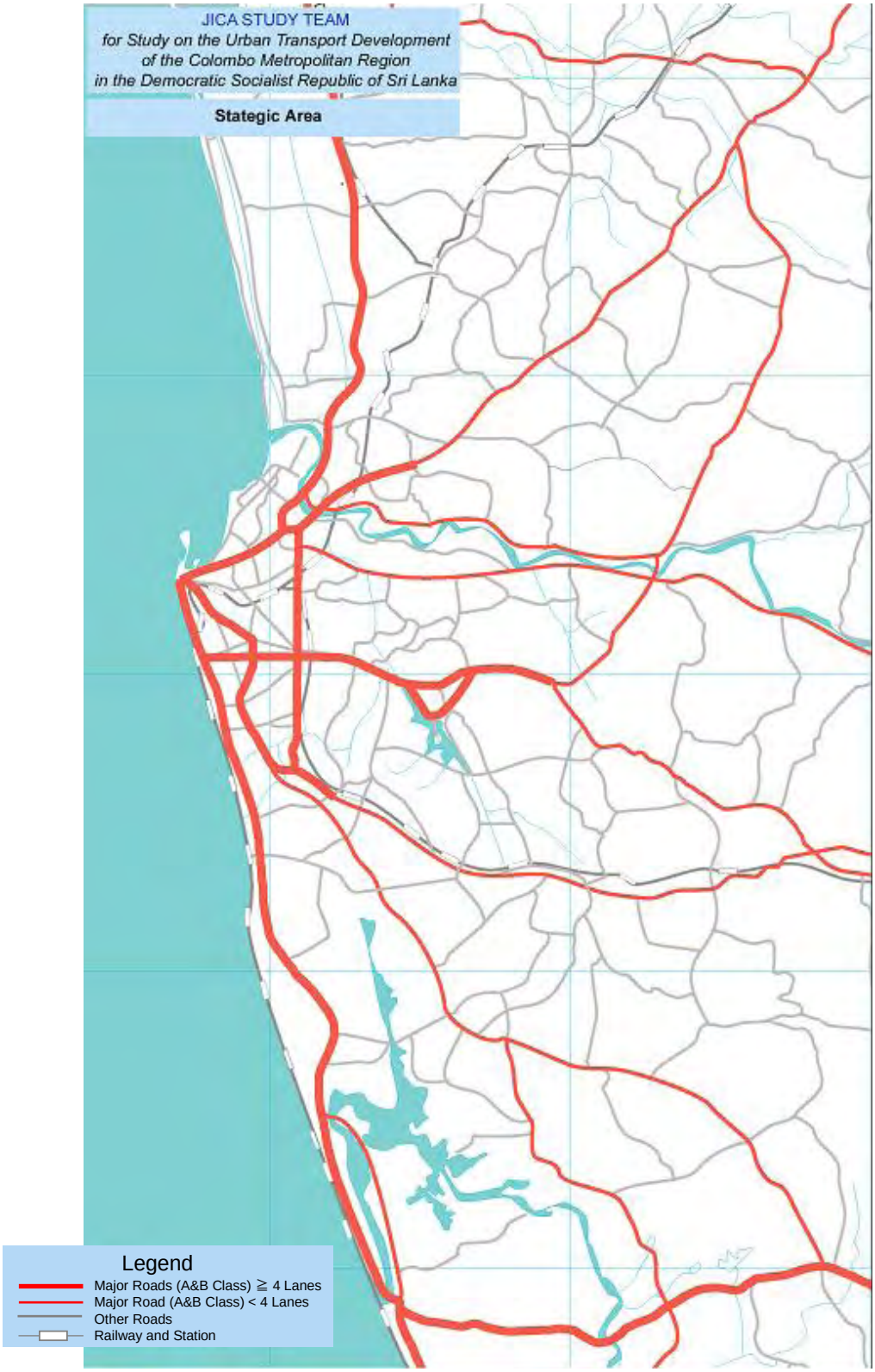
Source This Study

[2] An observation survey in CMC and WP was conducted in December 2005 and January of 2006.
[3] The Survey Department's maps were used as a basis to define major CMC roads.
[4] An observation survey in CMC and WP was conducted in December 2005 and January of 2006 to identify road width.



Source: This Study and Survey Department

Figure 5.1 CMR Road Network Configuration



Source: This Study and Survey Department

Figure 5.2 Strategic Planning Area Road Network Configuration

Source: JICA Study Team and SL Survey Department

Figure 5.3 CMC Road Network Configuration

(2) Central Area of Colombo

Urban Structure of Colombo

Colombo's central area is approximately equivalent to the CMC administrative area except at the eastern boundary. The central area is located west of Baseline Road, extending north to the Kelani River, and bounded by Kirillapone Canal to the south. The area is developed, but the level of development varies greatly. Fort and Pettah were the first areas to be developed, while other areas, particularly the southern and eastern areas, were relatively recently developed. Galle Road (A2) was developing as a highly commercial corridor up to Ratmalana, while most other areas were developed as mixed with both commercial and residential activities. Although Colombo City is a relatively small area, it is common to have mixed land uses citywide. There are several commercial zones scattered throughout the city in Pettah, Slave Island, Borella, Kollupitiya, and Bambalapitiya. Cinnamon Garden is the prime residential and diplomatic area and is located at the center of Colombo. Most of the government organizations, hotels, supermarkets, hospitals and schools are concentrate central Colombo, which generates significant employment opportunities, as well as the corresponding traffic congestion during peak periods.

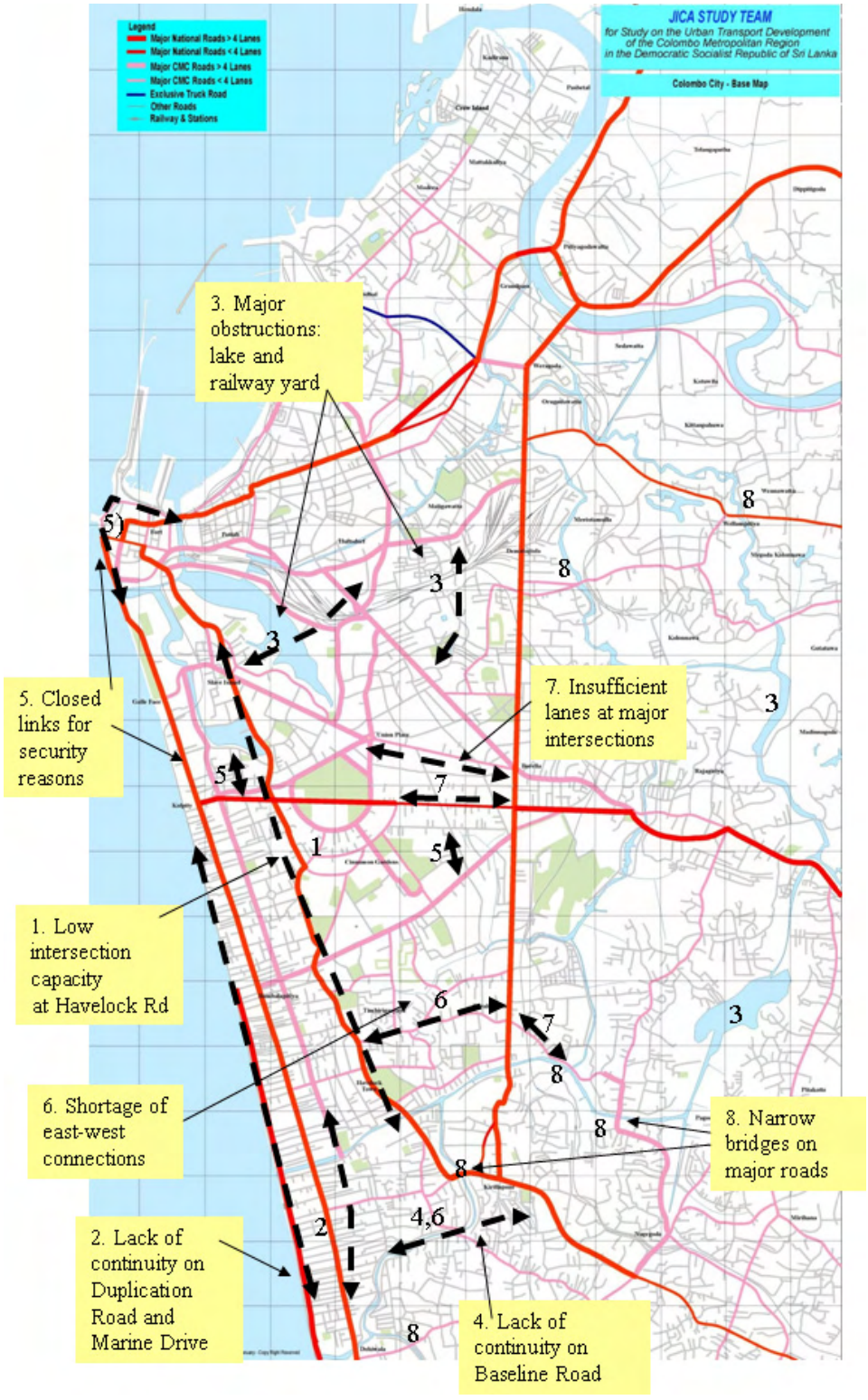
Road Network Configuration

The road network has a somewhat radial and circumferential configuration with Fort as a focal point as shown in the above figure. George R. De Silva Mawatha, Sri Sumanatissa Mawatha, Sri Sangaraja Mawatha, Panchikawatta and T. B. Jayah Mawatha, a set of road sections, form an inner ring road, although it is incomplete, as it abruptly ends at Union Place. Likewise the Port Access Road and Baseline Road form a second ring road, but it too is incomplete. The second ring road ends in the middle at Prince of Wales Avenue (north) and High Level Road (south) and does not connect to the radial roads of Alutmawatta Road and Galle Road (A2). There are several straight arterial roads like Baseline Road, Galle Road, Horton Place, Maradana Road, but their direction diverges largely from the radial and circumferential configuration.

Weakness of the Network[5]

The study team identified several weaknesses of the central area's road network as shown in Table 5.4. Locations of the weak sections are shown in Figure 5.4.

[5] The Colombo Urban Transport Study Stage 1 (CUTS1) identified several weaknesses of the network configuration. Some of them have been improved such as Maradana intersection and Baseline Road; however, some issues still remain. The Colombo Urban Transport Study Stage 2 (CUTS2) did not evaluate CMC's network.



Source: This Study

Figure 5.4 Network Weaknesses in Colombo's Central Area

Table 5.4 Central Area Network Weakness

	Weakness	Descriptions
1.	Low intersection capacity on Havelock Road and connectivity to southern areas	Continuity is insufficient; therefore, most intersections and curved sections are oversaturated. Consequently, more traffic travels on Galle Road and Duplication Road.
2.	Lack of continuity from Duplication Road and Marine Drive to Galle Road	An extension project for Duplication Road was prepared, but not implemented. Marine Drive's capacity is underutilized due to the missing links with Galle Road.
3.	Major network obstructions: lakes and rail yards	Beira Lake obstructs the inner ring road. One-way regulations proposed in CUTS2 improved connectivity slightly. In suburban areas, reservoirs prevent network development. The railway stockyard in the city center obstructs traffic.
4.	Lack of continuity on southern end of Baseline Road	The Phase 3 extension of the Baseline Road is expected.
5.	Closure of Marine Drive/Church Road for security reasons	The links are still closed with no plans to open for security reasons. This is also the case in some sections in Kolpitty and Cinnamon Garden.
6.	Shortage of east-west connections in Southern area	Recent growth in the southern and eastern areas has led to unbalanced radial road connections to Fort. Specifically, circumferential links between Galle-Havelock-Baseline-Kotte Roads are lacking, which increases congestion on smaller links.
7.	Insufficient lanes on major roadways	Some trunk roads lack sufficient road width, particularly Ward Place and Horton Place.
8.	Narrow bridges on major roads	Narrow bridges on major four-lane roads are bottlenecks.

Source: JICA Study Team. See Figure 5.4 for diagram.

Lack of Functional Road Hierarchy

A functional road hierarchy has not been established in the road network. The two major arterial roads, Baseline Road and Galle Road, have design standards for long distance through traffic, otherwise known as High Mobility Corridors (HMC), but significant roadside commercial development has reduced the throughput of traffic. Secondary or distributor roads, whose function is to distribute traffic between primary and local roads, are also not clearly defined. They often have a narrow carriageway, no sidewalks, and many curves, none of which are compatible with their function. Because of their low traffic handling capacity, congestion is common on secondary roads. Local roads that provide access to property and buildings are narrow with poor pavement and lack road facilities like street lighting and traffic signs. Many of them are dead-end roads which intersect directly with primary and secondary roads. The Colombo Urban Transport Study 1 (CUTS1) proposed a three level hierarchy and access control for CMC. The principles still appear relevant and include: (i) area should be expanded to include Kotte and Nugegoda at a minimum; and (ii) the level of hierarchy should be revised in CMC's eastern and southern areas due to recent development. The proposed CUTS1 road hierarchy is shown below.

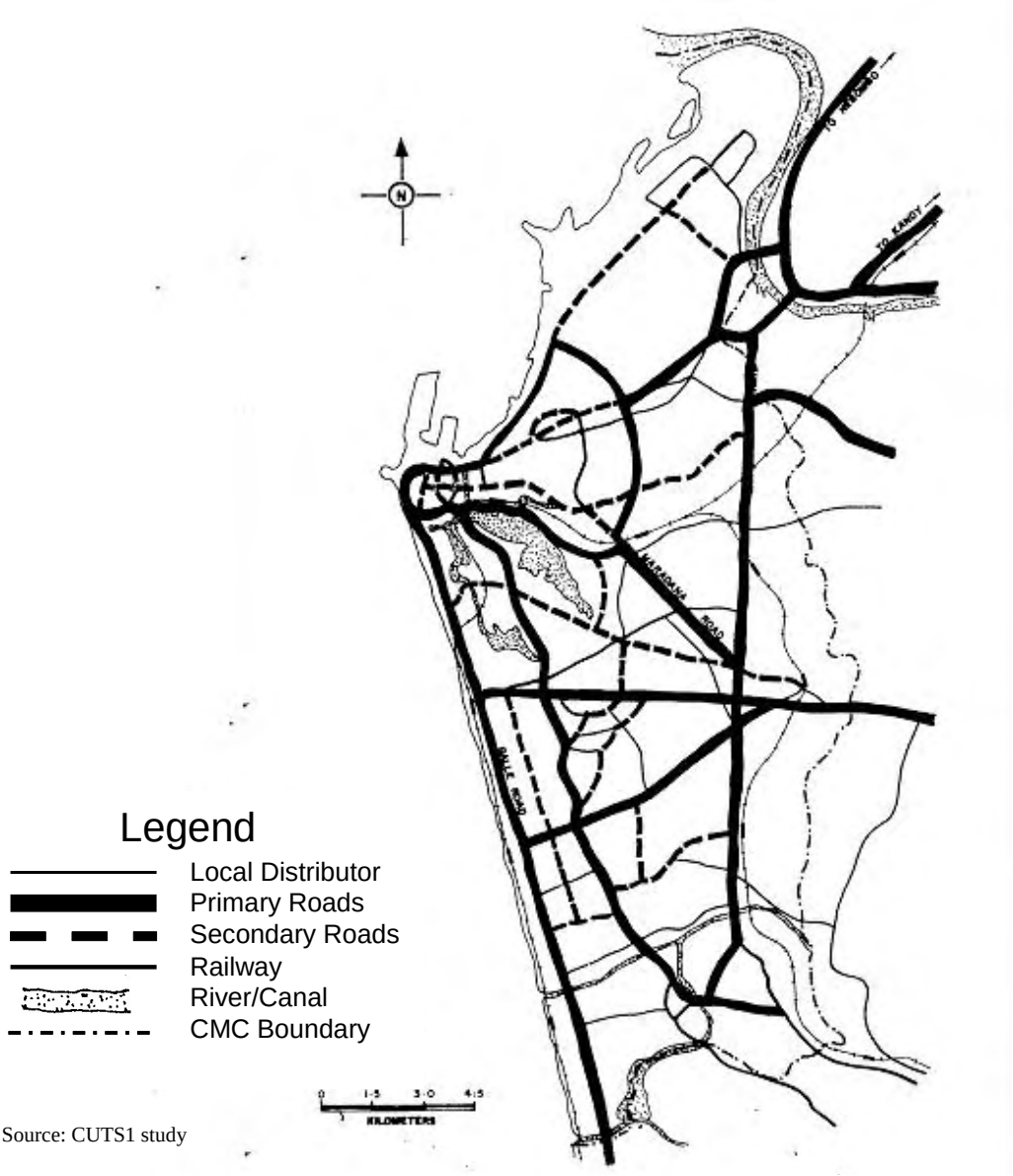


Figure 5.5 Proposed Road Hierarchy (CUTS1)

Lack of Bus Priority Lanes

In spite of high occupancy of bus vehicles of road use, there are few functions to serve public transport on road. There are no exclusive lanes for buses in Central Area.

(3) CMR and Strategic Planning Area (Outer Central Area)

Network Arrangement and Urbanization

The network density decreases as the distance from Colombo increases. Several Class A and B roads serve the study area and WP and there are supplemental and connector roads between suburban areas as well. Due to the terrain, most of the roads are two-lane undivided winding roads. The major exception is Kandy Road, Class A road otherwise known as A1, which is a

four-lane undivided road connecting Colombo and Kandy. It is currently being widened in sections shown in Figure 5.1 and 5.2. Beyond the central area, suburban areas have sprouted, although the road network is poorly developed and less dense than in the central area. Ribbon development is found along the major roads, most of which are two-lane undivided roads without sidewalks.

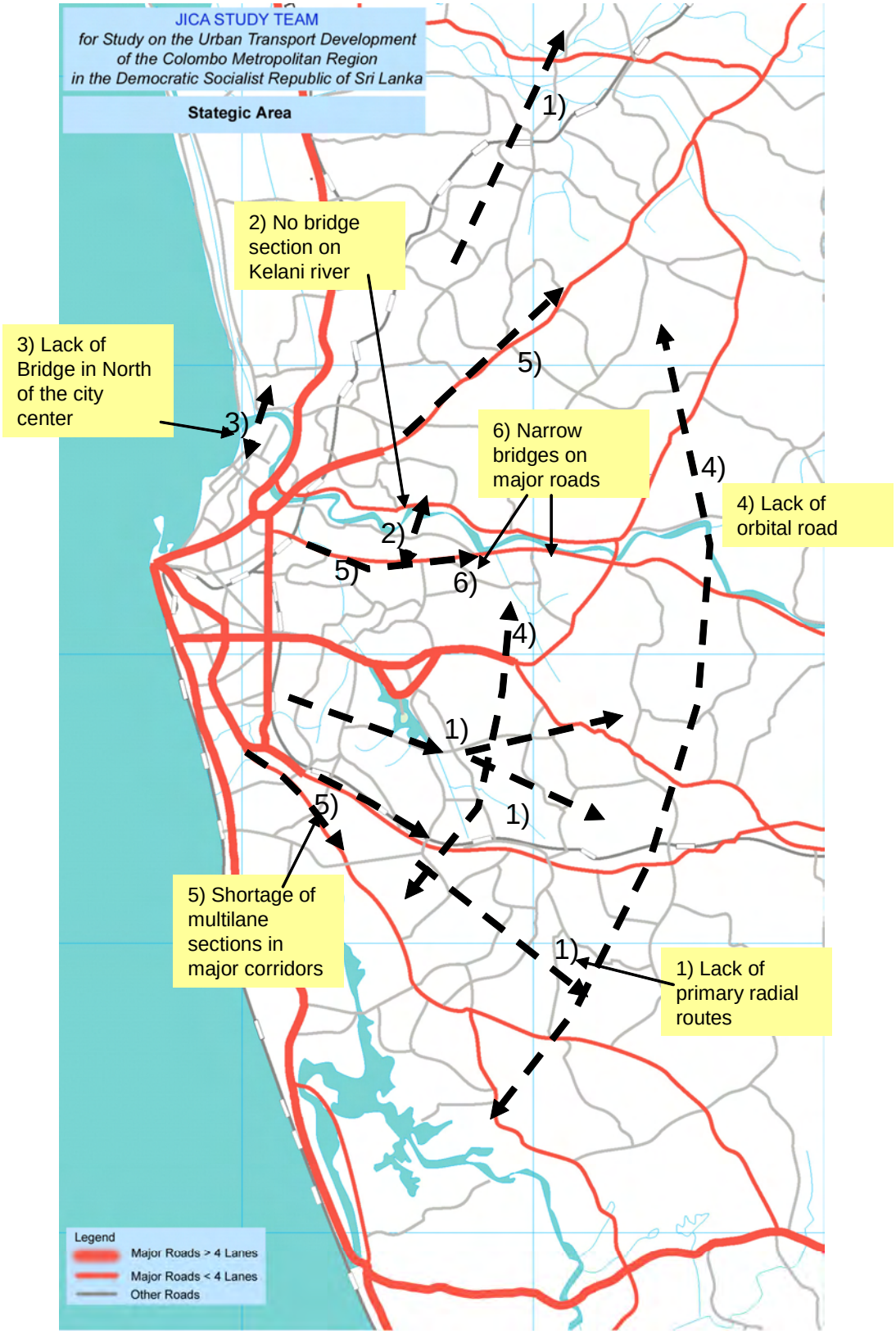
Road Network Weaknesses

The study team identified several weaknesses of the network as shown in the Table 5.5. Figure 5.6 also shows the location of those weaknesses.

Table 5.5 Weakness of Road Network in Strategic Planning Area

	Weakness	Description
1)	Lack of primary radial routes	CUTS1 pointed same weakness of the direction to Eastern area, including Low Level Road, Parliament Road, High Level Road and Horana Road. Their capacity still lower than peak demand. This study can point out the lack of density of those radial routes. There is no primary radial between Negombo Road and Kandy Road, and Parliament Road and High Level Road.
2)	No bridge on Kelani River between Kaduwella and Kaduwela	The 12 km section between Victoria and Kaduwella Bridge is impassable and divides Biyagama and Kaduwella. The Board of Investment (BOI) is building industrial development sites in this area.
3)	Lack of bridge to the north of the city center	Mattakuliya Bridge was completed, but has not opened due to lack of connection roads.
4)	Lack of ring road	The Outer Circular Highway (OCH) was proposed, but not implemented. Baseline Road also should be completed as ring road. Sub ring road is necessary for connection of growing sub-centers (Nugegoda, Battaramulla, Kelaniya, etc.)
5)	Major roads are two-lane roads	Kandy, High-Level, Low-Level, Horana Roads are two-lane roads outside Colombo.
6)	Narrow bridges on major roads	Low-Level Road parallels the Kelani River and has several bridges that cross feeder streams. The bridges' width is insufficient to simultaneously allow the crossing of two heavy vehicles; therefore, they form long lines at each bridge.

Source: This Study



Source: This Study

Figure 5.6 Network Weaknesses within Strategic Planning Area

(4) Design Standards

Design standards are discussed extensively in Chapter 6. To summarize, except for a few roadway sections, most roads in Colombo were not constructed with consistent design standard and the road widths vary between sections, resulting in poor visibility and low capacity. Many intersections are merely a crossing point of two streets, with no engineering considerations given to intersection design.

Intercity Road Standards Applied to Intra-City Roads

Design standards have five classes of roads and six categories of cross sections, as well as desired speeds and pavement structures specified in detail. They are typically prepared based on British and Australian standards, which are not entirely relevant for the Sri Lanka context. Therefore, there is a considerable gap between the standards and current practice.[6] The following tables show road class and cross section definitions. Other standards are shown in Appendix 7.

Table 5.6 Definition of Road Class

Class	Definition
A	Main arterials or long distance routes typically used for inter-city traffic. They are paved or bitumen surfaced with a carriageway between 7.4 m and 21 m.
B	Used to distribute traffic between residential areas, industrial areas, town centers and as feeders to Class A roads. They are paved or surfaced with a carriageway between 6.2 m and 14.8 m.
C	Main collectors and distributors that act as feeders to Class A and B roads. These roads belong to Provincial Councils and most are paved. Carriageways vary between 3.5 m and 6.2 m, based on road capacity and locality.
D & E	These are local roads that provide access to settlements and villages. The carriageway is about 3.5 m.

Source: Road Development Authority, Geometric Design Standards of Roads

Table 5.7 Definitions of Cross Sections Based on Traffic

Cross Section Type	Number of Lanes	Design Volume (PCU/day)	Applicable Road Class
R0	6	72,000-108,000	A
R1	4	40,000-72,000	A
R2	4	25,000-40,000	A, B
R3	2	18,000-25,000	A, B
R4	2	300-18,000	C, D
R5	1	<300	D, E

Source: Road Development Authority, Geometric Design Standards of Roads

Discussions with the Road Development Authority (RDA) and the RDPWG indicated that there are no road design standards for urbanized areas that focus on mixed traffic. As shown in Table 5.6, there are no standards for urban roads. WG participants are very keen to prepare standards for city streets and roads with mixed traffic.

[6] According to interview of CMC engineers, CMC applies the RDA standards to their road. However, due to land acquisition difficulties, some sections do not meet RDA standards at present.