

SUPPORTING REPORT (1)

ANNEX 4 : LAND USE

**THE STUDY ON STORM WATER DRAINAGE PLAN
FOR THE COLOMBO METROPOLITAN REGION
IN
THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA**

FINAL REPORT

VOLUME III : SUPPORTING REPORT (1)

ANNEX 4 : LAND USE

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CHAPTER 1 OBJECTIVES OF THE STUDY

1.1 Background of the Study

Since the UN International Decade of Natural Disaster Reduction, much more focus has been placed on urban disaster management in the developing countries. There are now about 450 cities worldwide with a population of more than 1 million inhabitants. Of these, 50 cities have a population greater than 3.5 million and 25 cities have populations greater than 8 million. The concern over the risk to these megacities, particularly in the developing world, is their growing vulnerability caused by their hyper-concentrations of population, and dependence on a complex and aging infrastructure.

Among several disasters, such as earthquakes, typhoons and cyclones, landslides, and tsunamis, flooding is one of the typical and frequent disasters in metropolitan areas located in the inter-tropical convergence zone where severe rainfall occurs. In the case of Metropolitan Colombo, flooding is a frequent phenomenon, because the city is extending onto the coastal floodplain.

One of the triggers of these floodings is the conversion of areas to urbanized use, and increased runoff rate. It is reported that the urban fringe is expanding rapidly especially in the form of landfilling in lowlands. These encroachments are mainly by the poor people, who are frequently affected by the flood and suffering from poor drainage of storm water. In this respect, there is a meeting point between urban disaster management and the urban poverty problem, and a combination approach with urban disaster management and poverty reduction strategy is required.

Although there are several dimensions to the urban poverty context, such as income, health, security, education and empowerment, flood problems in a metropolitan context could be regarded as threatening the land security of the urban poor. It means that the urban poor are obliged to live in the area that is prone to disaster due to the lack of adequate mitigation measures and land use policy. Adequate countermeasures should be adopted to save the urban poor from the disaster. In addition, appropriate development and regulation of land use should be established based on the scientific evaluation of the project area.

In this respect, land use planning could be an integral part of urban disaster management, which comprises five sub-components: assessment of risk, preparedness, response and relief, mitigation, and information dissemination. Land use planning also helps to harmonize the development of metropolitan areas and sustainable growth management, especially for the land security of the urban poor.

This could be much more effective with a control of land supply, planning regulation, and zoning of human habitation, which contributes to prevent the encroachment to the lowland as well as the damage from the flood-related disaster. Much more focuses should be placed on the growth management of metropolitan areas from the viewpoint of disaster prevention and environmental protection.

1.2 Objectives of the Study

The central goal for this study is to formulate a storm water/flood-related disaster management plan, or disaster prevention plan, with a focusing on the environmental and social aspect.

The intermediate objective of this study is to propose the appropriate use of land to prevent the flood damage in the lowlands in metropolitan Colombo. The current land use was identified in the course of the study. Special care was paid to the physical and social conditions, as well as scientific evaluation of the land.

In order to attain this, targets for the study were set up as follows;

- 1) To provide a watershed-wide map of present land use for hydrological analysis.
- 2) To prepare a watershed-wide map of future land use patterns.

1.3 Output of the Study

It turned out at the first fieldwork in Sri Lanka that no precise land use plan exists, except for the Colombo Metropolitan Structural Plan, which was mainly focused on the Province-wide aspect, not for the feasibility study area.

Therefore, the needs arise to prepare the present and future land use map, which was intended to be used as inputs for further investigation on the flood-related analysis, such as the hydrological analysis and flood damage survey. It should be mentioned again, that the characteristics of the map of future land use patterns prepared during the study are one of the assumptions for formulating the storm water drainage plan.

- 1) Current land use map in the master plan study area with a scale of 1:50,000
- 2) Future land use map in the master plan study area with a of scale of 1:50,000
- 3) Current land use map in the feasibility study area with a of scale of 1:10,000
- 4) Current land use map in the Feasibility study area with a of scale of 1:10,000

CHAPTER 2 METHODOLOGY

2.1 Available Data on Land Use

In order to determine the present pattern of land use, as well as to estimate future patterns of land use, it is a first-step task to collect several kinds of information: the land use maps, satellite images, aerial photos, and statistics on land-related activities, such as population density, land prices, and transactional data on lands. In forecasting the future patterns of land use, additional data, such as locations of future projects, proposed land use maps, must also be collected. In Sri Lanka, these kinds of data are archived at various kinds of organizations in a fragmented manner. This situation makes it difficult to conduct the study smoothly.

2.1.1 Land Use Maps

In Sri Lanka, three organizations are in charge of preparing the land use maps: the Survey Department under the Ministry of Lands and Agriculture, the Land Use Policy Planning Division under the Ministry of Lands and Agriculture, and the Urban Development Authority (UDA) under the Ministry of Housing and Urban Development.

The Survey Department has been preparing topographic maps with scales of 1:10,000, 1:50,000 and 1:100,000. Several categories of land use, such as urban built-up areas, homesteads, coconuts and rubber plantations can be identified on these maps. The Department has also prepared a digitized land use map with a scale of 1:50,000 in a GIS data format. The data are available with a cost of Rs. 6 /km².

Land Use Policy Planning Division (LUPPD) has prepared more detailed land use maps with a scale of 1:10,000, which focus more on the category of the crops cultivated. The maps were prepared by each DS Division and the activity of digitizing these maps is in progress at the Division. LUPPD has also prepared abandoned paddy maps, which have been identified by the staff of the local office of the LUPPD.

The Urban Development Authority has been preparing a map of urban land use, within each Local Authority under the UDA Development Area. The map includes several categories of zoning such as residential, industrial, commercial, and so on, identified with the IKONOS satellite image data. Table 2.1.1 summarizes the available land use maps.

2.1.2 Satellite Images and Aerial Photos

Two organizations are in charge of archiving the satellite image data: the Center for Remote Sensing under the Survey Department and the GIS Center in the UDA. The Center for Remote Sensing is archiving satellite image data such as the LANDSAT with a ground resolution of 30 meters, while UDA archives IKONOS, higher resolution data of 1 m on the ground. On the other hand, aerial photos with a scale of 1:2,000 are archived at the Survey Department.

Among these three data sources that represent land surface, the IKONOS image would be the best in terms of its quality. The image would be useful in identifying the buildings affected by the flood by overlaying the flood hazard map, as well as identifying the buildings that might be relocated by overlaying the project area of the feasibility study. The disadvantage of this data would be high cost, of about 1,000,000 JPY/100 km².

Compared to the IKONOS image, the LANDSAT image would be of a more reasonable price. However, it might be of limited use, because, in addition to the coarseness of its ground resolution, it could only be identified in three broad categories of land cover such as water, vegetation, and soil, but not in the category of land use. Available aerial photos in the study area had been shot in the 1960's and are outdated at present, although these data might be useful in terms of the baseline information for land use changes in the urban area.

One of the difficulties in obtaining these data is its acquisition cost. Due to copyrights reasons, original data of IKONOS could not be provided by UDA however, several sheets of colored printout could be obtained in a paper form. If original data could have been obtained in a digital form, which carries much more cost, more efficient and effective analysis would have been carried out.

CHAPTER 3 PRESENT LAND USE IN THE STUDY AREA

3.1 Present Land Use Pattern Extracted from the Topographic Map

In order to determine the present pattern of land use in the study area, the topographic maps issued by Survey Department were used. These maps are useful because they are relatively easy to obtain. Three sheets of these maps such as Colombo, Negombo, and Kalutara, which cover the study area, were scanned and stored into GIS. Based on these maps, each category of land use such as built-up areas, homesteads, paddy areas, marsh areas, and water were digitized. Since the topographic map represents land use in 1989, each land use was verified and updated, using the print out of the IKONOS satellite image data. The extent of each land use was summed up on a sub-watershed basis, which was delineated by the hydrologist of the Study Team.

Table 3.1.1 and Figure 3.1.1 show the present land use for each category in the five sub-watersheds. Within the 80,716 ha of the study area, paddy land amounts to 14,229 ha (17.6%), built up area 10,851 ha (13.3%), and marshy area 2,016 ha (2.5%). The share of paddy area is highest in the Ja Ela basin (24.3%). Meanwhile the Greater Colombo basin indicates the highest share of build up area (36.9% for the sum of urban and semi-urban area).

3.2 Abandoned Paddy Land

The spatial distribution of the abandoned paddy land could be regarded as indicators for future urban land use patterns, because it has a high possibility to be converted into urban use. Thematic maps prepared by the Land Use Policy Planning Division (LUPPD) were utilized for the purpose of identifying the abandoned paddy lands around the study area. Results of the field reconnaissance and the IKONOS print out are also referred to verify the situation.

Figure 3.2.1 shows the spatial distribution of the abandoned paddy lands. Most of the abandoned paddy lands were located in the Kesbewa, Kelaniya, and Biyagama DS Divisions. Several reasons are considered for abandoning cultivation of paddy, such as flooding, poor drainage, water shortage, labor shortage, and tenurial dispute.

3.3 Trends in Conversion of Agricultural Land into Urban Use

Statistical indicators such as the number of building permits and the extent of land auctioned indicate the degree of intensity in terms of conversion of agricultural land

into urban use (i.e. urban sprawl). In the Colombo Metropolitan Regional Structural Plan (CMRSP), trends on these indicators are analyzed in three selected areas, such as Gampaha PS, Kesbewa PS and Horana PS. The results indicate that, among the three example areas, Kesbewa PS showed an exceedingly high value both in terms of the number of building permits issued (Table 3.3.1) and the extent of the land auctioned (Table 3.3.2) due to the nearness to the urban built-up area. It was also pointed out that along the roadside area of the Kesbewa PS, a large number of land parcels were auctioned. The CRMSP also indicates that about 1,600 ha of land were auctioned in the eleven PSs located in the outskirts of the CMR (Table 3.3.3).

CHAPTER 4 FUTURE ESTIMATIONS IN THE STUDY AREA

4.1 Existing Land Use Plan

4.1.1 Available Land Use Plan

No available plan except the CMR Structural Plan that covers the whole study area could be found in the course of the fieldwork. The detailed plan for Horana Growth Center and Negombo Growth Center has been finalized at the Planning Committee held on 28, November 2001, although the contents have not been open to the public.

4.1.2 Overview of the Colombo Metropolitan Regional Structural Plan

Since the urban plan formulated by Patrick Geddes, several urban planning works have been carried out in the area of Colombo. In 1978, facing the pressing situation of urbanization, a metropolitan plan was formulated with the assistance of UNDP, which was the predecessor of the Colombo Metropolitan Regional Structural Plan.

The revised Colombo Metropolitan Regional Structural Plan, which is comprised of twelve volumes, as summarized in Table 4.1.1, has been prepared by UDA with the assistance of local and foreign consultants, and was released in May 1998. As the title of each volume indicates, volume 5 focuses on the development plan of the Gampaha District, and from volume 6 to 8 handles the area within the City of Colombo, Volume 12 addresses the Development Guide Plan in the Fort Area. Only the second volume covers the issues of the overall Colombo Metropolitan Region that almost corresponds to the study area.

The Second Volume address the issues and problems from various facets, such as population and land use, economy, environment and ecological zoning, transport network, infrastructure network, health, education, housing, industry, tourism, and agriculture. It also proposes six growth centers¹ that are situated at the outskirts of the CMR and the development plan for the Core Area (Colombo-Greater Kotte Area). The detailed plan for the four growth centers has not yet been finalized in the plan², whilst the Core Area plan was described in the plan, which is comprised of zoning and building regulations including minimum and maximum densities.

¹ The names of the six growth centers are as follows: Negombo Growth Center, Gampaha Growth Center, Biyagama Growth Center, Homagama Growth Center, Horana Growth Center, Matugama Growth Center. Negombo and Matugama Growth Centers are situated outside of the study area, while some part of the other growth center areas are included in the study area.

² The detailed plan for the Horana Growth Center and the Negombo Growth Center was finalized at the Planning Committee held on 28, November 2001, but the contents of the detailed plan have not been opened to the public.

In terms of land use planning, the chapters on population and land use, environment and ecological zoning, and agriculture must be reviewed.

4.1.3 Analysis of the Trends in Urbanization

In Chapter 2 of the plan, the urbanization process is discussed. Analysis was carried out to identify the trends in urbanization and rural-urban fringe, using 15 indicators³. The study area of the CMR plan was grouped into three areas, regions with urbanized characteristics, regions with semi-urbanized characteristics, and regions with rural characteristics. The urbanized area extends along the north-south axes. In the plan, it is commented that the urban-growth has a biased uneven development in terms of direction, which means that in some areas of CMR, the urbanization process has been quite rapid, and conversion of agricultural lands into urban uses have been quite extensive. On the other hand, in other areas, the urbanization process has been very slow, and there is no significant change in land use.

Future urban growth areas are also described in chapter two of the plan. Urban agglomeration, which means towns expanding rapidly beyond their original administrative boundaries, is also identified in the analysis. The plan recommended that twenty-eight urban centers be considered as the contiguous area.

4.1.4 Protected Area Network

The Colombo Metropolitan Regional Structural Plan advocates the concept of a Protected Area Network for paddy land and marsh. According to the plan, for each existing paddy land and marsh, suitability is to be evaluated based on a set of criteria. If the land was evaluated as suitable for agriculture or marsh, the land is incorporated into the protected network, and kept in cultivation or kept as it is in the case of marsh. The report stress that, only within the isolated abandoned paddy lands or marshes that are not included in the protected area network, development for urbanized use should be considered. It is also pointed out that before converting into urbanized use, the possibility of use as a flood retention area must be considered.

The report explains the merits of introducing the protected area network in the following manner. So that types of land available for urban expansion and their location can be clearly identified, and land speculation would be minimized because the owners of land within the protected area network realize that their lands cannot be converted into non-agricultural uses. One of the problems is the set of criteria

³ Indicators used for the analysis are described as follows: location, administration, population, zoning regulations, dwelling age, transition dynamism, land use, employment, population growth, utility service, social activity.

based on the assessment. Although there are some criteria for selecting paddy land, criteria for marsh was not shown in the report.

4.1.5 Core Area Plan

The CMR Plan defines the Core Area which is comprised of the City of Colombo, Sri Jayawardenapura Kotte Municipal Council, and a few local authorities adjoining the City of Colombo and Sri Jayawardenapura Kotte Municipal Council. The area was determined by examining four options that are different in terms of the coverage of the area, and population densities. Zoning and planning supported by planning and building regulations were designed and implemented.

4.1.6 Building Regulations

An important feature for the CMR plan is the introduction of a building regulation area into the plan. The CMR plan considers waterfront area to be valuable for tourism as well as from the landscape point of view, and therefore waterfront area should be protected from the unplanned establishment of buildings. Therefore, the CMP Plan sets a buffer zone along the water front area where buildings cannot be established.

The regulation is mandatory for developers. Prior to the construction of buildings, a developer must submit the proposal to the regulation section of UDA. The Regulation Division checks whether or not it is within the area of building regulations. If the proposal is located outside of the regulation area, the proposal is approved. Unapproved buildings are to be compulsorily demolished by UDA in accordance with the UDA Law. This building regulation system is expected to act as one of the mechanisms to prevent encroachment onto marsh or paddy land. The following table shows the width of the buffer for each of the waterfront areas.

Land Reservation

Water-front Area	Buffer Width
Marshes	20 feet (6.906 m)
Paddy	10 feet (3.048 m)
Rivers	25 m
Lakes	50 m
Canals & Streams	20 feet (6.096 m)

Source: Colombo Metropolitan Regional Structure Plan, UDA

4.2 Future Land Use Patterns

4.2.1 Information for Considering Future Land Use Patterns

Two types of information are crucial in terms of predicting future land use patterns. The first one is the location and physical extent of future projects. The information indicates explicitly the area that triggers the change of land use in future.

Another item of information is within which jurisdiction of the agencies that have an authorization to enforce land use regulations the planning area lies. The spatial extent of this area reveals the area where to be developed or regulated for development.

4.2.2 Future Projects

Future projects are one of the driving forces that determine the future pattern of land use. The projects were investigated by collecting materials and interviewing key informants of the relevant organizations, such as UDA and CEA. The following seven projects are identified in the course of the first fieldwork of the Study:

- 1) Werisala Warehouse Project;
- 2) Peliyagoda Project;
- 3) Mudun Ela Development Project;
- 4) Wedamulla Project - Stage II;
- 5) Muthurajawela and Negombo Lagoon Project;
- 6) Kaduwela- Kolonnawa Development Scheme; and
- 7) Outer Circular Highway Project

The locations of each project site are shown in Figure 4.2.1. Figure 4.2.1 reveals that projects are concentrated in the northern part of the Colombo area, especially in the Kalu Oya Catchment area, where newly constructed roads are supposed to pass through.

4.2.3 Werisala Warehouse Project

The site of the Werisala warehouse project with an area of about 2 ha and is located near Ragama, which is about 10 kilometers from the center of the Colombo. Although the land was originally cultivated as a paddy, it is now abandoned and looks like a marshy area. In 1994, the Colombo Environmental Improvement Project (CEIP) funded by the World Bank, proposed to use this site as the waste dumping site which accommodates all the solid wastes in the Colombo Metropolitan Area, but owing to the opposition of the residents, the plan was deadlocked. After that, another proposal emerged to use the site as a relocation lot for the prison

situated in the City of Colombo, but another candidate site was adopted, thus the area is currently unused.

According to the proposed route plan of the Outer Circular Highway, it is supposed to pass through the area, and, by the construction of this road, the marsh area in Werisala was to be divided into two parts. Because of the change of geographical conditions of the site, the site is supposed to have a high potential for urbanized use, especially as a use for transportation facilities. Originally, the area had been acquired by SLLRDC, but now the land ownership has transferred to UDA. The SLLRDC has already issued the filling permit for this project site with a condition to reserve a retention area, and the site is expected to be used for a warehouse by a private company

4.2.4 Peliyagoda Project

The project site is situated at the junctions between the Colombo-Kandy Road and Colombo-Negombo Road. Two major roads, such as the Colombo Katunayake Expressway and the newly constructed road that connects Kandy Road and Negombo Road, are also planned to pass through the area, and at the junction of these roads a new interchange is being proposed.

The first phase of the Peliyagoda Development Project, with an area of 100 ha (250 acres), was initiated by UDA in 1986. The project site is located in the lowland with the elevation varying from 0.1 m below MSL to 5.0 m above MSL. Therefore, it requires the establishment of a drainage infrastructure. According to the feasibility study report of the first phase project, a self-financing scheme has been proposed that the drainage facilities were to be financed by developing the land that is expected to be sold at a higher value, owing to the construction of the highway. In the first phase of the project, the warehouse and some residential houses for low-income people have been established. More than 1,000 low-income households were living in this area. In the second phase of the project, another 250 acres of lands adjacent to the first phase project site are planned to be developed as a warehouse and residential area for low-income people.

4.2.5 Mudun Ela Development Project

Mudun Ela Development Project is an on-going project carried out by the SLLRDC. The purpose of this project was to reclaim and develop marshy land while improving the drainage system. The site is located adjacent to the UDA's Peliyagoda Project site, with an extent of 8.8 ha (22 acres) of marshy land that are lying off the Colombo-Kandy road on the western side about 4 kilometers from the Kelani bridge.

According to the annual report of SLLRDC, the total estimated cost is Rs. 90 million, and 33 % of the work has been completed during the year 2000.

4.2.6 Wedamulla Project - Stage II

Wedammulla Project has also been carried out by the SLLRDC. The project site is located adjacent to the UDA Peliyagoda site, on marshy land off the Colombo-Kandy Road on the eastern side, 3 kilometers from the new Kelani bridge. The extent of reclaimed marshy land amounts to 14.8 ha (37 acres) and the total estimated costs amount to Rs. 155 million. Seventy six percent of the work has been completed by the end of the year 2000, and is scheduled to be completed by the end of the year 2001.

4.2.7 Muthurajawela and Negombo Lagoon Project

Muthurajawela and Negombo Lagoon is one of the largest lagoons in the area with an area of 3,164 ha. The project to conserve this lagoon was funded by the Dutch government. Sustainable use of the lagoon and marsh was examined by considering several factors such as topography, vegetation, soil properties, and based on the information, a master plan has been formulated which consists of several zones, such as a conservation zone, buffer zone, and mixed developed zone. The proposal for establishing a bird sanctuary area has been officially adopted and was gazetted in 1996. SLLRDC are in charge of the land development in the mixed zoning area, and the area has already been being filled. Total development costs are estimated at Rs. 72 million.

4.2.8 Kaduwela - Kolonnawa Development Scheme (Information Center Project)

This project was handled by the UDA. The main purpose of this project is to establish an Information Center. According to the plan, most of the area was zoned for residential use, some of which is reserved for administrative use. In order to construct a road information plan, a proposal for filling of paddy land has been submitted to the related authority, and is under consideration.

4.2.9 Outer Circular Highway Project

The Road Development Authority (RDA) has been in charge of this project. An Environmental Impact Assessment for this project has already been completed. Although the highway is scheduled to be connected to the Southern Highway at the border area between the Homagama and Horana divisions, the exact location of the junction has not been finalized. According to the route plan submitted to SLLRDC, the highway passes through the paddy area along the eastern border of the study area. This suggests that most of these paddy lands located at the upper Bolgoda basin are

supposed to be filled by the construction of the highway, although it might depend on the architecture of the highway. Figure 4.2.2 shows the possible filled area.

4.3 Other Information on the Future Land Use Patterns

4.3.1 Prospects for UDA Declared Area

The prospects for the UDA declared area is very useful information for considering future urban sprawl. If declared as a UDA development area, local authorities in question are required to prepare a zoning plan, and based on the zoning plan, building regulations are imposed. If the owner of the land constructs a building against the regulations, the building is to be demolished by the UDA. Thus, declaring a UDA area means that the area in question is to be incorporated into the built-up area.

The National Physical Planning Department (2001) released a report entitled 'Redefining Urban Centers and Urbanization in Sri Lanka'. The purpose of this report was to furnish the background information in order to formulate a national physical plan, especially future prospects on the spatial extent of urban built-up areas. In the report, several urban centers are defined based on the several indicators selected from the demographic and economic structural points of view. As for the demographic indicator, population growth rate is selected, while, in terms of the economic structure, a centrality index based on the central place theory was also adopted.

Table 4.3.1 shows the list of UDA declared areas at the present. All the Colombo District, some parts of the Gampaha District, and some urban Council areas in Kalutara District have already been declared as UDA areas. A list of areas for future declaration is shown in Table 4.3.2. It must be noted that most areas identified as future UDA Development Areas are situated in the Gampaha District. This result reveals that UDA has an opinion that the Gampaha district is urbanized.

4.3.2 SLLRDC Prospect

SLLRDC is one of the authorities that can issue permits for filling in the lowlands. Therefore, to understand their policy on the filling in of lowlands would be important. SLLRDC has prepared a map of Kalu Oya Basin that shows the areas where filling is allowed. This map is referred to when the applications for filling are judged in the process described in the conservation of lowlands. Proposals that are situated within the permitted area for filling might be allowed for filling. The area is demarcated carefully not to block the natural drainage system.

4.4 Estimating Future Land Use Patterns

In preparing the future land use maps, categories for land use were examined in the first step. In the next step, driving forces of land use change were considered, and criteria and indicators for each category of land use were set. Several factors of driving forces, which are represented in a map form, were overlaid using GIS, and a future land use pattern was predicted.

4.4.1 Categories of Land Use/ Land Cover

Ideally, categories of land use or land cover could be defined according to the analysis carried out using the land use data. From the viewpoint of hydrological analysis, it is beneficial that land classification can be defined in terms of the infiltration capacity, which might be correlated with the physical property of soils. Land-related data required for the hydrological analysis might be described as “land cover” rather than “land use”. On the other hand, if land use data were to be used as an input for the flood damage analysis, the category would be usable to represent the buildings or crops which stand or are cultivated on the land, since the damage value would be calculated, based on the buildings or crops affected by the flood.

In reality, however, it is difficult to obtain these precise data. Due to limited availability of data sources and the constraint of time for processing huge amounts of data, land use categories for this analysis were set as the following categories that could be identified with the topographic map issued by the survey department.

- 1) Built-up area;
- 2) Paddy land;
- 3) Marsh;
- 4) Water; and
- 5) Others.

4.4.2 Driving Forces of Land Use Change

Several driving forces were considered for the change of land use in each category such as built-up areas, paddy land, and marshy areas. Urban sprawl, which means the expansion of built-up areas, could be conditioned by three factors, such as planning factors, population density factor, and transportation factors. Figure 4.4.1 summarizes the sequences of analysis and factors.

4.4.3 Planning Factors

Planning factors determine which areas the planning authority on land use thinks should be developed. In Sri Lanka, UDA is primarily responsible for this matter. Therefore, designation as a UDA development area is one of the indicators for urban

sprawl. Core Areas that are planned in the Colombo Metropolitan Regional Structural Plan are also good information sources for considering the future built-up areas. Future project sites are described in section 4.3. The following spatial extents were considered for determining future sprawl areas.

- 1) The spatial extent of the Core Area which has been described in the Colombo Metropolitan Regional Structural Plan;
- 2) The spatial extent of the UDA development areas;
- 3) The areas of future projects which have been mentioned in section 4.2.2

4.4.4 Population Density Factor

According to the Colombo Metropolitan Regional Structural Plan, the population density of the core area was planned for 100 persons per ha. This figure is equal to the density of population in 1994 in the three DS Divisions of Colombo, Kolonnawa and Nugegoda, which were already built-up areas in 1994. Therefore, population density with 100 persons/ha could be regarded as the criteria for determining the urban built-up area.

4.4.5 Transportation Factor

Transportation is a factor that determines the direction of urban sprawl. In the Colombo Metropolitan Area, there is a railway that extends in the directions of north, south, and northeast. Also, major roads such as Colombo-Negombo Road, Galle Road, Colombo-Kandy Road, Colombo-Horana Road, Low-level road, extend in the directions of north, south, northeast, northwest, and west. Buffers along the transportation route would also be important factors for considering the expansion of the built up area. It is observed in Japan that, within an area 1 km wide along the newly constructed roads and interchanges, there is observed an increase of land value, representing the growth of potential of the land. It takes a decade to fulfil the potential value of land triggered by the construction of infrastructure. It is expected that the same situation will occur in Sri Lanka, although there is no empirical data that supports this phenomenon.

4.4.6 Limiting Factors

A limiting factor for considering urbanization is the area reserved for environmental reasons. From the fieldwork in Sri Lanka, three sanctuary areas, such as the Muthurajawela Sanctuary, the Sri Jayawardenapura Kotte Sanctuary, and the Bellanwila-Attidiya Marsh Sanctuary were identified. These areas are not to be converted into urbanized use.

Abandoned paddy land could be regarded as a source of supply for urbanized land use. By overlaying the map of future project areas and urban sprawl areas onto the

abandoned paddy lands, paddy lands that might be converted into the urbanized use were identified. As for the marshy area, only landfilling triggered by the construction of highways, and the Muthurajawela project area were considered.

4.5 Results

Figure 4.5.1 shows the spatial distribution of future land use patterns in the study area, and Table 4.5.1 shows the percentage of the respective categories of land use in the year 2010. According to the results, urbanization will progress rapidly in the areas of the Kalu Oya basin and the Kelani basin. The percentage of built up areas, which is represented by the sum of both categories of urban and semi-urban, is supposed to be increased in Kalu Oya basin and Kelani basin, from the present level of 18.6% and 19.8%, to 62.2 % and 57.5 % respectively. These values exceed the level of the Greater Colombo basin, which is 56.9 %. In terms of change of paddy lands, the percentage occupied is on the decline in areas of the Ja Ela and Kalu Oya basins, and decreases from 24.3% to 23.7%, and from 16.7% to 14.3% respectively. The percentage of marshy land in the Kalu Oya basin shows a sharp decline from 2.5% to 1.0%, which is triggered by the several projects.

Tables

Table 2.1.1 List of Available Data on Land Use

1) Land Use Map

No	Type of Map	Issuing Organization	Unit Area	Date of Issue	Scale
1	Topographic Map	Survey Department	National Grid	1989	1:50,000
	Topographic Map	Survey Department	National Grid	under preparation	1:10,000
	Topographic Map	Survey Department	National Grid	unknown	1:100,000
2	Land Use Map	Land Use Policy Planning Division	DS Division	1996	01:10.0
3	Abandoned Paddy Land Map	Land Use Policy Planning Division	DS Division	1996~2000	1:10,000/ 1:5,000
4	Land Use Zoning Map	Urban Development Authority	Local Authority	1996~2000	-

2) Satellite Image

No	Type of Image	Archiving Organization	Spatial Coverage	Temporal Coverage
1	LANDSAT	Center for Remote Sensing, Survey Department	Entire Sri Lanka	
2	IKONOS	GIS Center, Urban Development Authority	CMR Region	2000, 2001
3	Aerial Photos	Survey Department	N.A.	1960's

3) Statistics

No	Types of Data	Responsible Organization
1	Population	Department of Statistics

Table 3.1.1 Present Land Use by Five Sub-catchments

Catchment	Area Extent (ha)	Urban	Semi-Urban	Paddy	Marsh	Water	Other
(a) Bolgoda Basin	40,116	2.8%	5.7%	17.1%	0.3%	3.4%	70.7%
(b) Greater Colombo Basin	9,072	21.4%	15.5%	8.5%	4.3%	0.1%	50.2%
(c) Ja Ela Basin	17,485	5.1%	2.9%	24.3%	7.1%	0.1%	60.5%
(d) Kalu Oya Basin	6,066	6.6%	12.0%	16.4%	2.5%	0.0%	62.5%
(e) Kelani Catchment	7,977	7.2%	12.6%	16.7%	1.4%	1.8%	60.4%
Total (a) - (e)	80,716	6.1%	7.3%	17.6%	2.5%	1.9%	64.6%

Table 3.3.1 Building Permits Issued 1991-1995

Area Classification	Kesbewa P.S		Gampaha P.S		Horana P.S	
	Total Nos.	%	Total Nos.	%	Total Nos.	%
(A)	3,054	55%	457	33%	181	21%
(B)	1,605	29%	328	24%	163	19%
(C)	848	15%	590	43%	94	11%
(U)	-	-	-	-	405	48%
Total	5,507	100%	1,375	100%	843	100%

Notes (A) Area adjacent to Transport Routes

(B) Area with Towns

(C) Agricultural Area

(U) Urban Council Area

Source: Colombo Metropolitan Region Structural Plan, p.250

Table 3.3.2 Land Auctioned

Area Classification	Kesbewa P.S		Gampaha P.S		Horana P.S	
	ha	%	ha	%	ha	%
(A)	445.91	56%	15.80	35%	130.38	68%
(B)	202.22	25%	7.91	18%	16.33	8%
(C)	149.56	19%	21.28	47%	45.71	24%
(U)	-	-	-	-	-	-
Total	797.49	100%	44.99	100%	192.42	100%

Notes (A) Area adjacent to Transport Routes

(B) Area with Towns

(C) Agricultural Area

(U) Urban Council Area

Source: Colombo Metropolitan Region Structural Plan, p.250

Table 3.3.3 Land Auctioned in Selected Pradeshiya Sabha in the CMR

Pradeshiya Sabha	1992 (ha)	1995 (ha)	1992-1995 (ha)
Colombo District			
Homagama	5.78	128.85	192.42
Kesbewa	147.67	199.77	797.49
Gampaha District			
Gampaha	6.43	14.14	44.99
Divulapitiya	12.96	26.17	100.08
Biyagama	0.39	60.22	73
Mahara	4.83	7.89	50.13
Minuwangoda	2.63	17.63	49.27
Kalutara District			
Horana	5.78	128.85	192.42
Dodangoda	1.2	6.47	23.75
Beruwala	6.1	14	33.21
Bandragama	13.18	0.13	64.02
Total	206.95	614.12	1620.78

Table 4.1.1 List of Volumes on Colombo Metropolitan Region Structural Plan

Volume	Title
1	Synthesis;
2	the Plan;
3	Data Profiles;
4	Planning & Building Regulations;
5	Gampaha District Development Plan;
6	Land Use survey 1996- City of Colombo;
7	Study on Floor Space & Floor Area Ratio- City of Colombo;
8	Study on Three Dimensional Form- City of Colombo;
9	Study of Colombo Central Business District;
10	Study of Colombo Central Business District;
11	A study of Urban Characteristics-City of Colombo;
12	Transport Data Profile;
13	Specimen Development Guide Plan (Fort).

Table 4.3.1 List of Current UDA Declared Area

1. Colombo District
1) All the Colombo district declared under UDA
2. Gampaha District
1) Negombo Municipal Council
2) Gampaha Urban Council
3) Minuwangoda Urban Council
4) Ja-Ela Urban Council
5) Part of Gampaha Pradesiys Sabah (all the villages of Indigolla, weediawatta, Kehelwatugoda, Galthorummula, Henpita mulla, Miriswatta, Kahadamulla, Bandarawatta. Falling within parts of GN Divisions of Mahipalagoda (230), Yakkala (231), Henarathgoda (232), Bendiyamulla (234), and Gampaha Aluthgama (225/227)
6) Part of Ja-Ela Pradeshiya Sabha (Ragama T.C.)
7) Part of Mirigama Pradeshiya Sabah
8) Part of Divulapitiya Pradeshiya Sabah
9) Dankotuwa
10) GN Division of 246- Kendaliyadda Palua of Mahara Divisional Secretary
11) Dandugamperuwa
12) Part of Wattala Pradeshiya Sabah
3. Kalutara District
1) Kalutara Urban Council
2) Beruwala Urban Council
3) Panadura Urban Council
4) Horana Urban Council
5) Coastal zone covered the following sub units (Kalutara, Bedda, Malewana, Payagala, Wskaduwa, Keselwatta, Aluthgama, Wadduwa)
6) Matugama
7) Dodangoda

Note: Number in parenthesis indicates the number of DN Division

Source: Redefining Urban Centers and Urbanization in Sri Lanka 2001

Table 4.3.2 List of Future UDA Declared Area

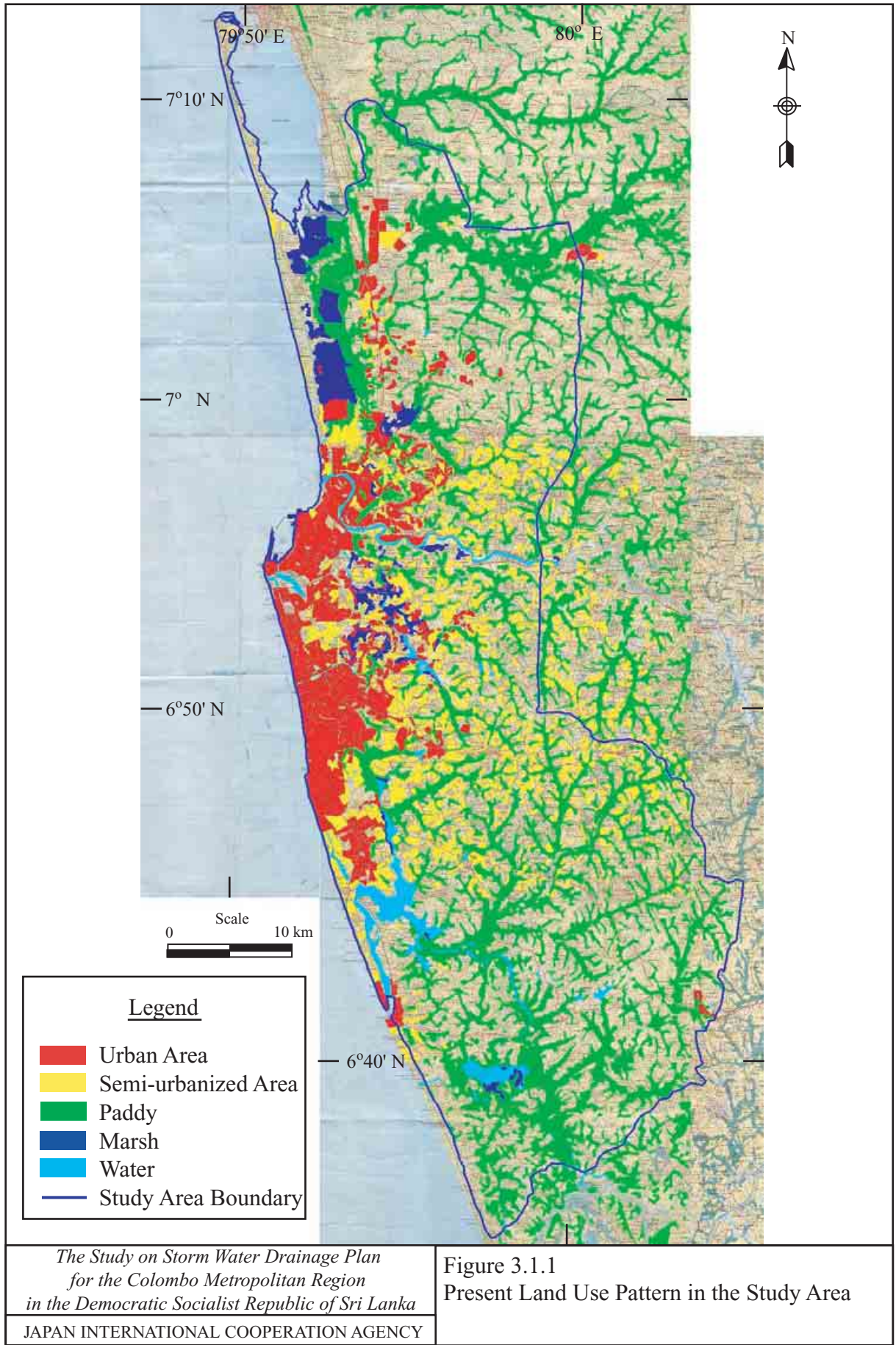
Gampaha District
1) Seeduwa-Katunayake Urban Council
2) Wattala Urban Council
3) Peliyagoda Urban Council
4) Veyangoda Urban area
5) Nittamubuwa- Watupitiwela Urban area
6) Kiribathgoda Urban area
7) Biyagama Urban area
8) Ja-Ela Pradeshiya Sabah
9) Amalgamation of Maradagahamula, Dunagaha and Badalgama Urban area to already declared area of Divulapitiya

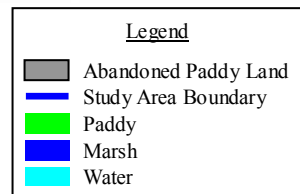
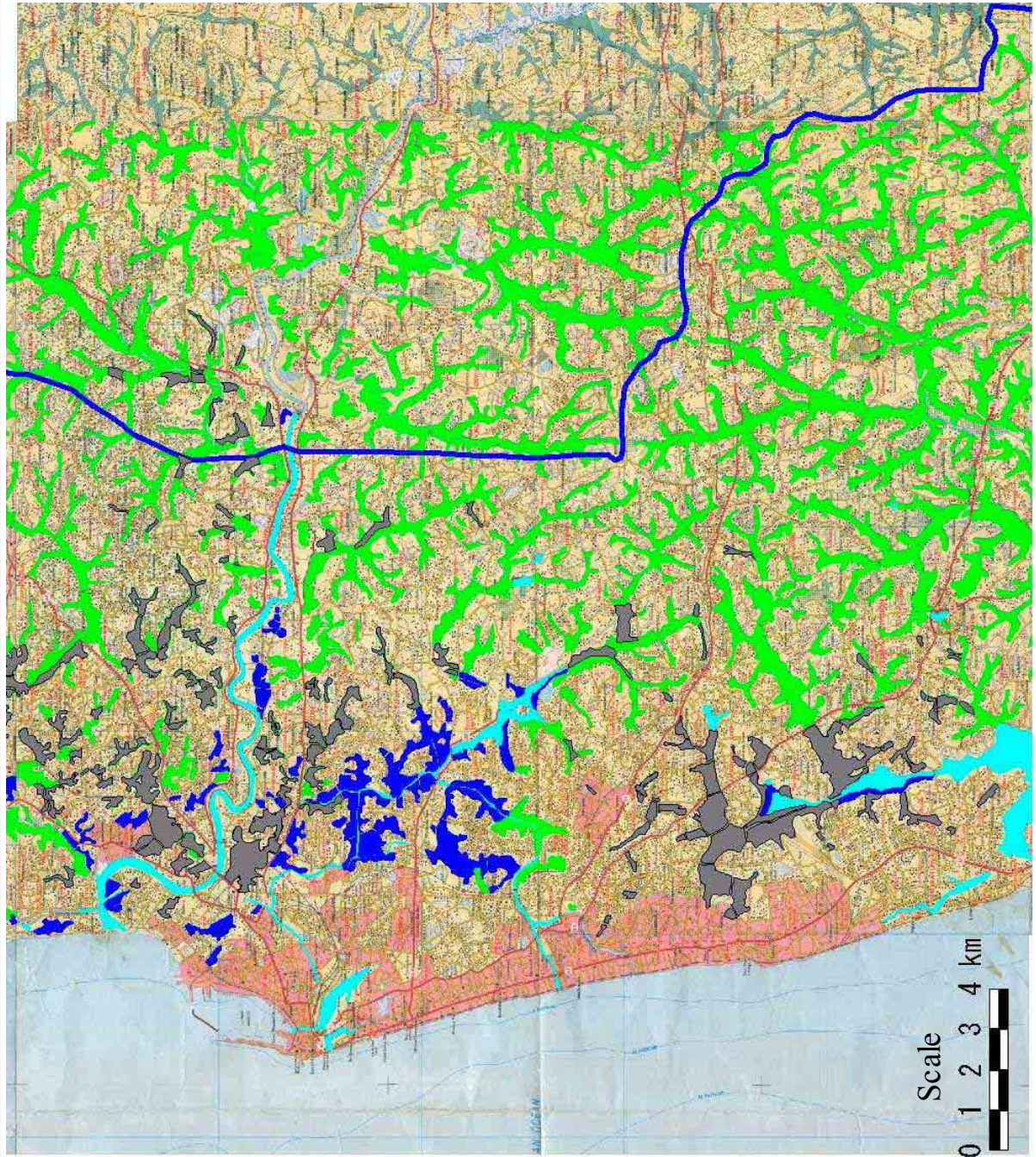
Source: Redefining Urban Centers and Urbanization in Sri Lanka 2001

Table 4.5.1 Future Land Use by Five Sub-catchments

Catchment		Urban	Semi-Urban	Paddy	Marsh	Water	Other
(a) Bolgoda Basin (40,116 ha)	Present	2.8%	5.7%	17.1%	0.3%	3.4%	70.7%
	Future	10.1%	16.7%	16.2%	0.3%	3.4%	53.4%
(b) Greater Colombo Basin (9,072 ha)	Present	21.4%	15.5%	8.5%	4.3%	0.1%	50.2%
	Future	33.1%	23.8%	8.3%	4.3%	0.1%	30.4%
(c) Ja Ela Basin (17,485 ha)	Present	5.1%	2.9%	24.3%	7.1%	0.1%	60.5%
	Future	8.0%	11.8%	23.7%	7.1%	0.1%	49.4%
(d) Kalu Oya Basin (6,066 ha)	Present	6.6%	12.0%	16.4%	2.5%	0.0%	62.5%
	Future	16.3%	45.9%	16.0%	1.0%	0.0%	20.7%
(e) Kelani Catchment (7,977 ha)	Present	7.2%	12.6%	16.7%	1.4%	1.8%	60.4%
	Future	16.7%	40.8%	14.3%	1.3%	1.8%	25.2%
Total (a) - (e): 80,716 ha	Present	6.1%	7.3%	17.6%	2.5%	1.9%	64.6%
	Future	13.3%	21.0%	16.7%	2.4%	1.9%	44.7%

Figures

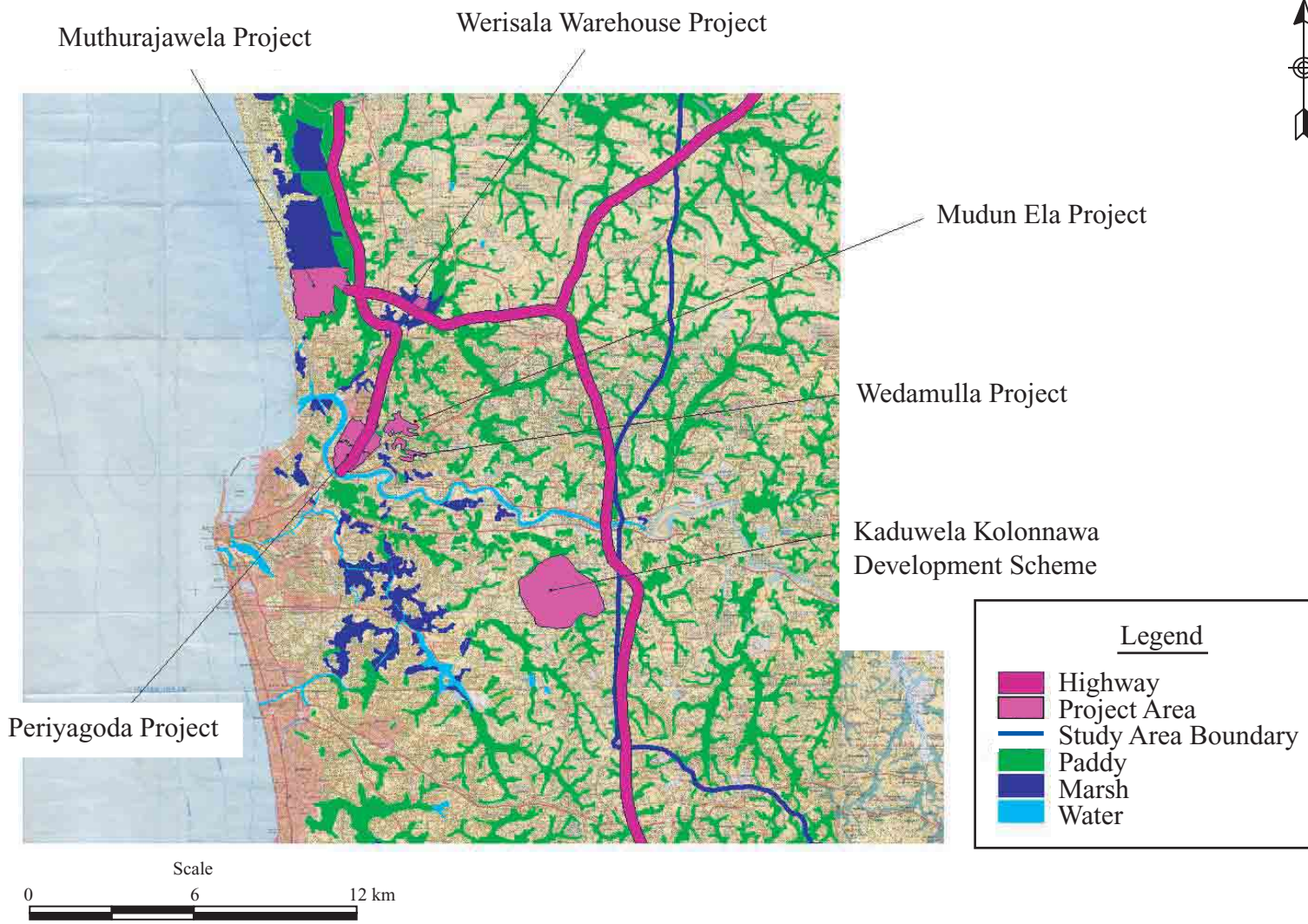




*The Study on Storm Water Drainage Plan
for the Colombo Metropolitan Region
in the Democratic Socialist Republic of Sri Lanka*

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Figure 3.2.1
Geographical Distribution of Abandoned
Paddy









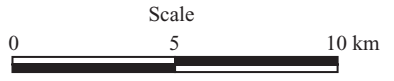
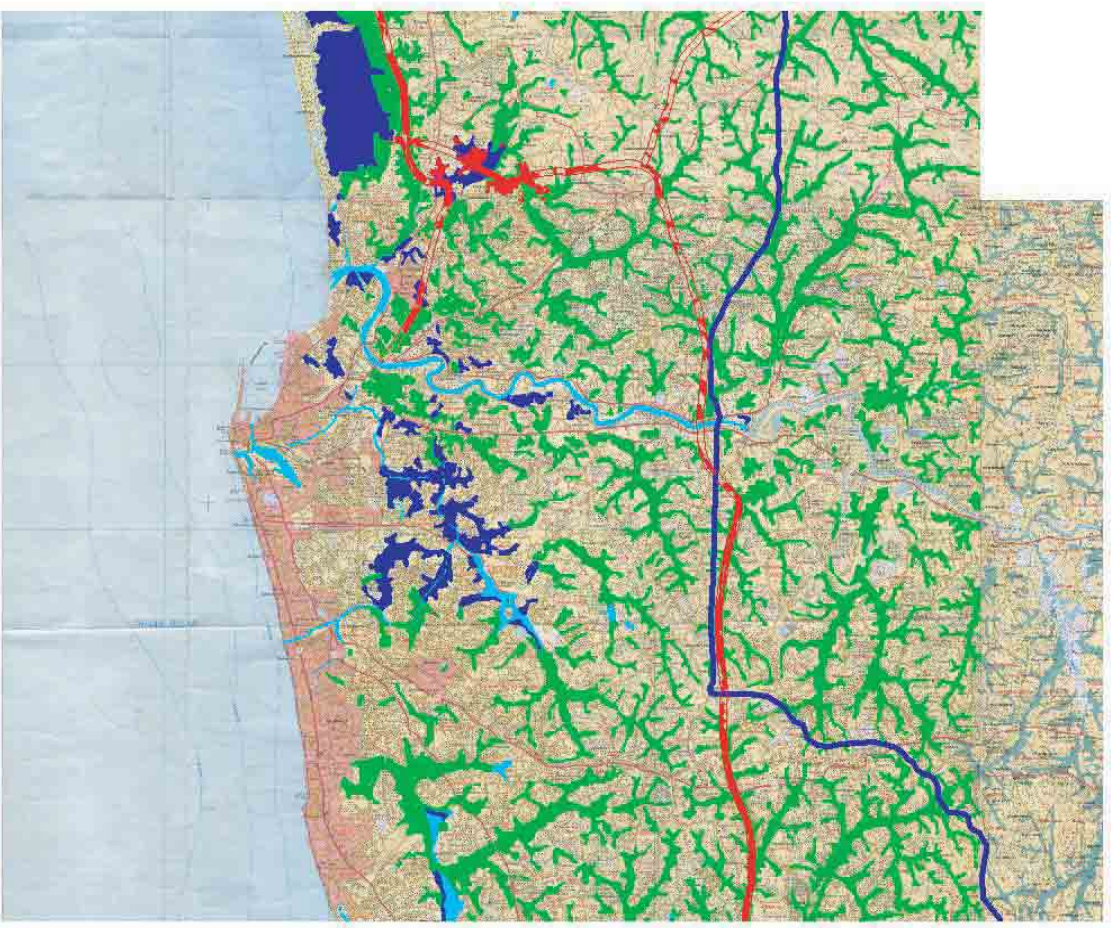
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Figure 4.2.1
Locations of Project Site



Legend

	Highway
	Possible Filled Area
	Study Area Boundary
	Paddy
	Marsh
	Water



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Figure 4.2.2
**Possible Filled Area by Construction
of Outer Circular Highway**

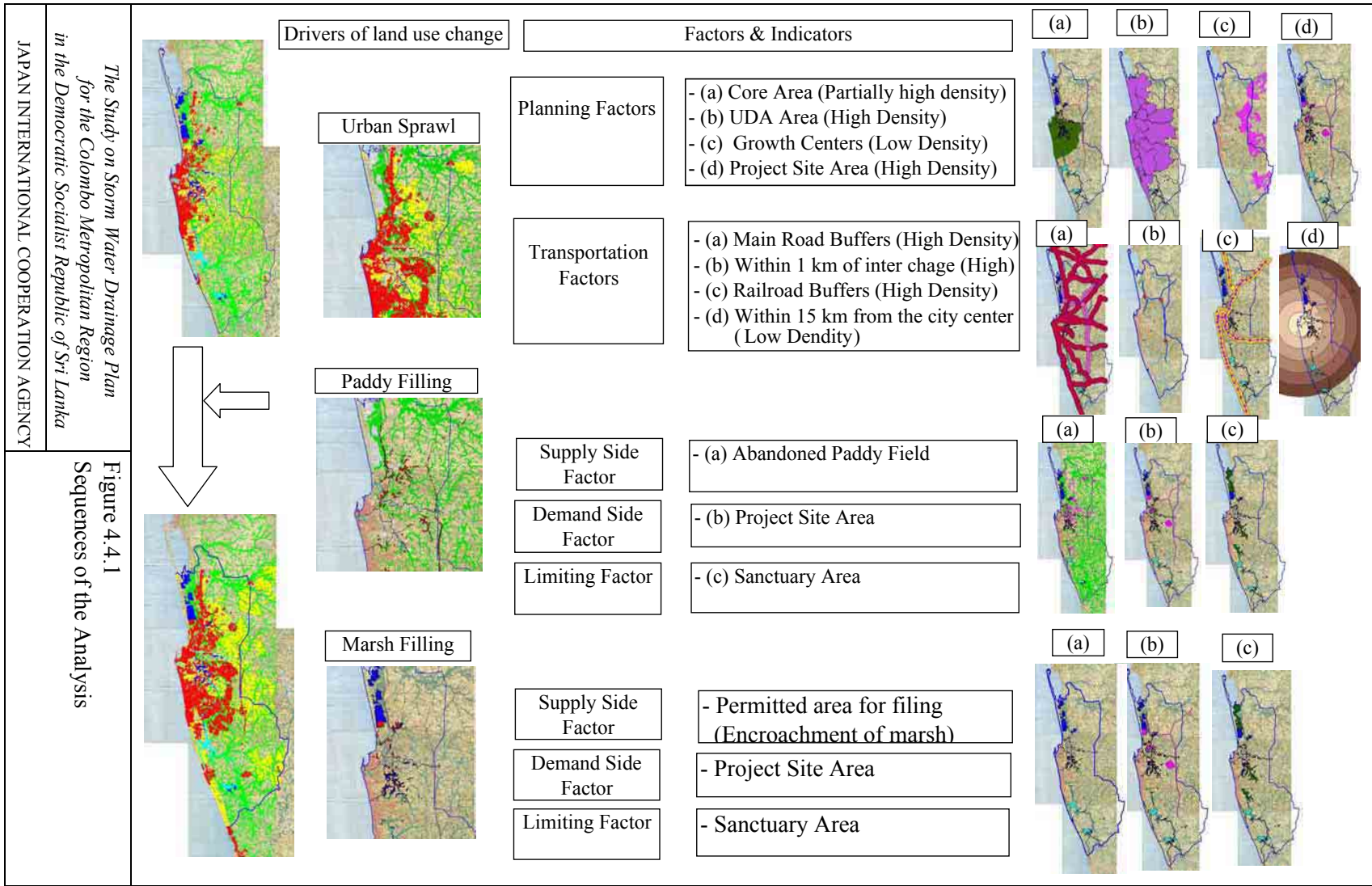
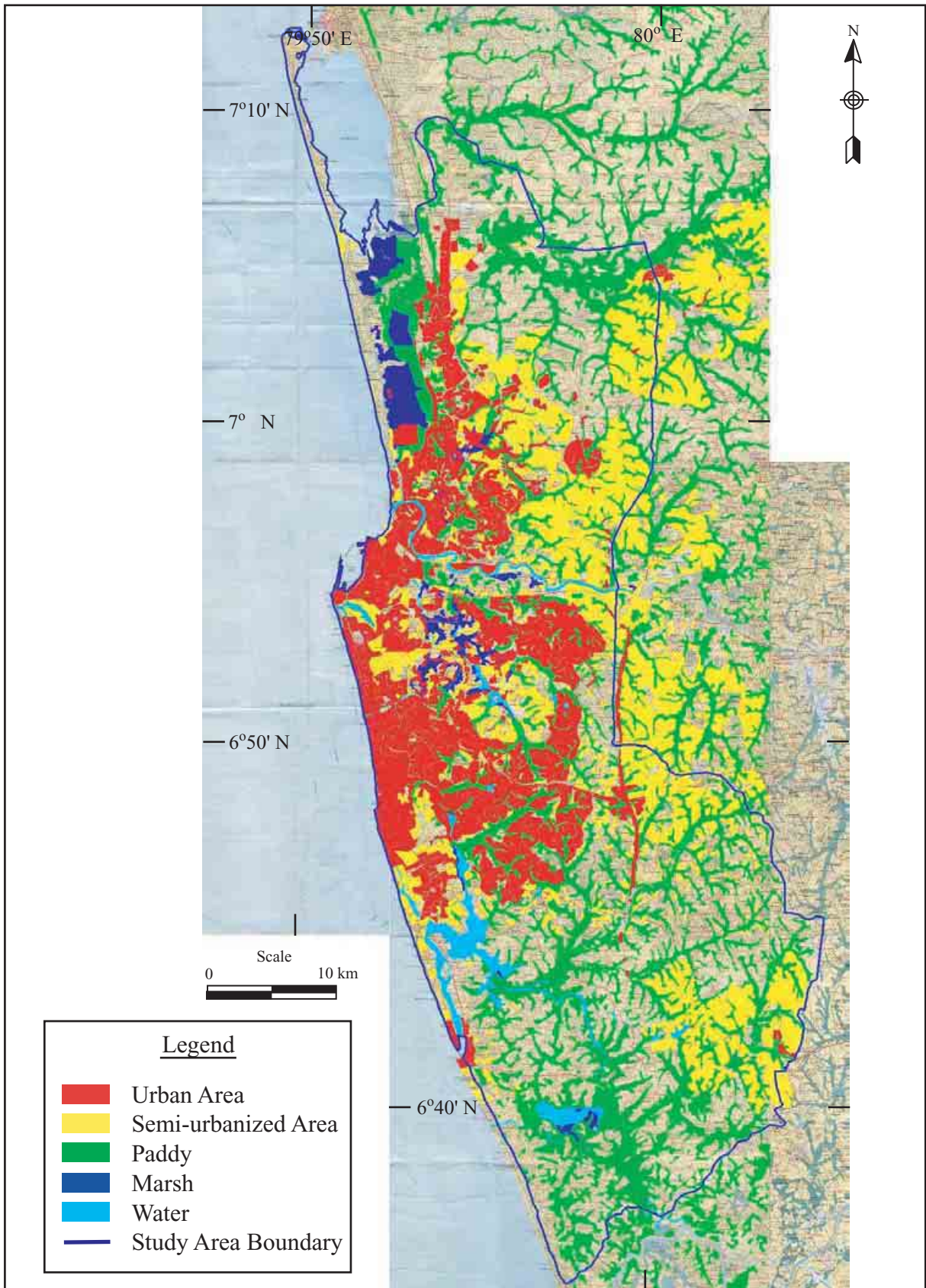


Figure 4.4.1
Sequences of the Analysis



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Figure 4.5.1
Future Land Use Pattern in the Study Area

SUPPORTING REPORT (1)

ANNEX-5 : ENVIRONMENT

**THE STUDY ON STORM WATER DRAINAGE PLAN
FOR THE COLOMBO METROPOLITAN REGION
IN
THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

FINAL REPORT

VOLUME III : SUPPORTING REPORT (1)**

ANNEX-5 : ENVIRONMENT

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CHAPTER 1 PRESENT CONDITIONS OF THE NATURAL ENVIRONMENT

1.1 General Environmental Conditions in the Study Area

Environmental features of the study area can be represented by studded marshes with connecting water systems in the urban area. The study area is located in a southwestern coastal area and belongs to the wet zone where much of Sri Lanka's biodiversity is concentrated. Lowlands, where most of the lands are abandoned paddy and vacant land, form marshes, especially the upper catchments of the basins. Among the marshes, protected areas in the study area such as Muthurajawela Marsh and Bellanwila-Attidiya Marsh are the best birding sites for endemic and migratory birds in Sri Lanka.

In the Ja Ela Basin, the Muthurajawela Marsh (3,068 ha) extending southward from the Negombo Lagoon (3,164 ha) receives surface water in the basin through the Ja Ela and Dandungam Oya. The marsh also connects the Old Negombo Canal and Hamilton Canal flowing to the Kelani Ganga.

In the Kalu Oya Basin, the urbanized area is concentrated in the downstream area of the basin where road transportation has been developing while the upper catchment has not yet urbanized, partly extending abandoned paddy. Surface water from the Kalu Oya flows into the Kelani Ganga through the Old Negombo Canal.

In the Greater Colombo Basin, there are three main marshes: Kolonnawa, Heen and Kotte Marshes, which are known as the Colombo Flood Detention Areas. The marshes along with the Parliament Lake constitute the green belt linked by the canals. Beira Lake has received large volumes of urban pollutant and suffers from high eutrophication at the urban center.

In the Bolgoda Basin, the Bellanwila-Attidiya Marsh (372 ha) in the upper catchment of the Weras Ganga receives part of surface water from the surrounding urbanized area. The Weras Ganga flows down to North Bolgoda Lake, and then to Panadura River and South Bolgoda Lake. At the west coast of the basin, the Lunawa Lake is located though it is said no aquatic fauna exist due to pollution.

1.2 Environmental Protected Area

An Asian Wetlands Inventory Project was carried out in the 1980s. In the Directory of Asian Wetlands (Scott, 1989), 41 wetlands of Sri Lanka have been listed. Based on the inventory, the legally constituted protected areas under the Fauna and Flora Protection Ordinance (FFPO) were subsequently listed including the following

protected area located within or in the surrounds of the study area. The locations of environmental protected areas in the study area are shown in Figure 1.2.1.

- 1) Sri Jayawardanepura sanctuary: 449 ha of the sanctuary declared in 1985, where partial protection is enforced, i.e. locally, sustainable extractive uses are permitted;
- 2) Bellanwila - Attidiya Marsh: 372 ha of Wildlife Sanctuary declared in 1990 by the Department of Wildlife Conservation;
- 3) Muthurajawela Marsh and Negombo Lagoon complex: 1,285 ha of sanctuary declared in 1995/1996.

According to the FFPO, all wild animals are fully protected within the Sanctuary, while trees, other plants and habitats in general are only protected in the State lands. As most of the land in the Bellanwila-Attidiya Marsh is privately owned, legal control over the vegetation, i.e. land exploitation for development, in the majority of the marsh has not been implementable¹.

A list of 35 additional wetlands considered to be of national importance were prepared locally and includes Beira Lake, Bolgoda Lake, Colombo Breakwaters, and the Colombo Flood Detention Area.

The Environmental Management Strategy (EMS) for the urbanized area by UDA (1994) has estimated the total area of marshes in the urbanized area at nearly 4,000 ha, which includes the Muthurajawela Marsh in the Wattala Local Authority area with an area of 3,068 ha. Over 200 ha of marshy lands have been filled for urban and industrial infrastructure development. Little data is available on the present conditions of the marshes, except for Muthurajawela and Bellanwila-Attidiya Marsh. However, according to the field observation in the Study, the environmental conditions in the marshes are poor due to solid waste dumping, unauthorized settlement, unplanned reclamation and inflow of polluted water.

In the Muthurajawela Marsh and Negombo Lagoon complex, the Conservation Zone includes both the Negombo Lagoon and the northern part of the Muthurajawela Marsh. The rest of the marsh is left as the Buffer Zone (middle part) and the Mixed Urban Development Zone (southern part - sand filled for an industrial zone).

The major lakes in the study area are Beira Lake, Parliament Lake, Bolgoda Lake, Lunawa Lake and Negombo Lagoon. The Beira Lake and Lunawa Lake are seriously polluted. Negombo Lagoon is still a very valuable eco-resource because of its rich aquatic life and its vegetation containing mangroves and sea grass. It is an important

¹ Wetland Site Report & Conservation Management Plan: Bellanwila- Attidiya Marsh, CEA/Euroconsult, 1993

breeding ground for the local fisheries and an important economic resource because of its high fish yield. Lunawa Lake is now devoid of life due to pollution.

1.3 Water Pollution

Surface water pollution is the most serious issue among the environmental problems in the study area. Pollution of urban water bodies by domestic wastewater and industrial wastewater causes environmental problems as well as health hazards. Most of the surface waters of the urbanized area in the study area are polluted to some extent. The serious water pollution problems exist in the canals and lakes in the western part of the study area, including Colombo MC, Kolonnawa UC, Dehiwela-Mt. Lavinia MC, and Moratuwa UC.

The main causes of surface water pollution are:

- 1) Discharge of urban drainage water mixed with waste of industrial and domestic origin to natural streams (This includes runoff from open markets and garbage dumps);
- 2) Unauthorized connections of domestic wastewater pipes into drainage canals;
- 3) Direct discharge of industrial wastewater into rivers, lakes, canals and lowlands;
- 4) Uncontrolled and illegal dumping of waste of industrial and domestic origin in waterways, embankments and lowlands;
- 5) Discharge of sewage into canal/surface water bodies mainly by shanty settlements along canals and around the lowlands such as marshes;
- 6) Insufficient maintenance and cleaning of watercourses and embankments resulting in siltation, blockage and aquatic plant growth.

The Colombo Municipal Council (CMC) area is served with a sewerage drainage system that consists of a raw sewage drainage system draining into the sea via two sea outfalls and a storm water drainage system discharging into the canals. Since their construction at the beginning of the century, very few improvements and extensions have been made despite the considerable development in housing and industry. As a result, both systems are overloaded and in a poor state of repair and hence, lead to water pollution. Septic tanks and latrines that discharge effluents to soakage pits serve most of the houses around the lowlands. Overflow of septic tanks and ingress of sewerage into storm water drains is a common feature, mainly during heavy rains.

Beira Lake offers example of typical polluted urban water lakes. Eutrophication and blooming are major water polluting issues in water bodies like Beira Lake due to wastewater and nutrient rich substances. It is reported that the Lunawa Lake, which had a healthy aquatic ecosystem in the past, is now devoid of almost all aquatic life due to pollution.

The groundwater quality in the urbanized area in the study area is likely being adversely affected by the following factors:

- 1) Faecal contamination by seepage of domestic wastewater from sanitation facilities;
- 2) Chemical contamination by seepage of wastewater from industries and solid waste dumping sites;
- 3) Seawater intrusion into groundwater especially due to over-extraction from wells along the coast.

Regarding coastal water pollution, little data on the quality of the seawater are available. These waters receive liquid waste from Kelani Ganga, Beira Lake spillover, Wellawatta and Dehiwala Canals, Lunawa Lake and Bolgoda Lake, two sea outfalls of the CMC sewerage system at Mutwal and Wellawatta and some minor wastewater discharges from coastal communities. Colombo Harbor is also a source of coastal water pollution. In the near coast waters, fishing is of minor importance as most of the fishing is carried out offshore at the edge of the continental shell.

1.4 Waterborne Disease

The National Environmental Action Plan (NEAP) 1998-2001 Report states that the most acute environmental health problems occur in urban low-income settlements, where sanitation and clean water are lacking, drainage is poor and exposure to vector borne diseases is high. This is a very serious issue as one third of the urban population in the Western Province presently lives in low-income settlements (UDA, 1996).

A field survey conducted by the Central Environmental Agency (CEA) in 1995 has revealed that many of the canals, drains and minor waterways are blocked by garbage and unplanned landfills. This has resulted in overflow of drains even after minor rains. After heavy rains the situation becomes worse with septic tank overflow. Excavation of earth for bricks, sod and ditches has created puddles as breeding sites for mosquitoes. Consequently, the most prominent health problem has been those water-related diseases, particularly mosquito-borne diseases. Filaria and hepatitis were common among the residents, while fever, stomach and intestinal disorders

were common among the children. Malaria and Japanese encephalitis have shown a decline but filariasis has been on the increase and there was a recorded outbreak of dengue in the year 2000.

Preventive health programs for the above waterborne diseases are launched mainly by Public Health Inspectors through public awareness programs. This subject is covered by the Health Department and also by some NGOs, e.g. Sarvodaya. There are special projects, for instance the “Green Star Home Project” launched by the Public Health Department of the CMC.

1.5 Soil Pollution

In the study area, among the superficial soil deposits of recent origin are alluvium in the river floodplains and loose unconsolidated sands in the coastal belt. These materials will not pose significant environmental impacts in case of dumping of material excavated for various constructions. However, most soils in the lowlands and swampy areas consist of peaty soils, while adjoining lands are covered with Red Yellow Podzolic soils.

These Podzolic soils contain Plinthite as dark reddish mottles in a rectangular pattern in a continuous phase within 1.2 m of the soil surface. That makes the soil acidic and subsequently, unsuitable for most crops. Acid sulphate conditions are obvious in sub-soils between Welikada and Battaramulla. When exposed (excavated and dumped) acidic conditions develop in these soils with oxidation. Similarly, in swampy areas, for instance, soil in the marsh segment of the Muthurajawela, is uniformly potential acid sulphate soil.

Considerable limitations for crop growth occur in these soils. The peat (in substrata) quality of the marsh is of high sulphur content. Therefore, if the excavated material is from lowlands or other potential acid sulphate soils, caution is needed in disposal. If disposed into sensitive ecosystems or productive agricultural lands, adverse impacts could result.

With respect to soil pollution resulting from disposal of dredged materials from canals and lake bottoms very little information is documented. SLLRDC carried out dredging of Beira Lake. As reported by officials of SLLRDC, no qualitative studies were carried out on the dredged material. It is generally disposed of in lowlands that require reclamation.

It is reported in the Beira Lake Restoration Study (UDA, 1993), based on an analytical survey carried out on the deposited sediments, that the dredged material will comprise high concentrations of volatile solids, phosphorous, nitrogen and total

organic Carbon, high BOD, COD, low redox potential and sufficiently high metal concentrations that could affect sensitive benthic organisms.

It is evident that dredged soil from water bodies consists of high concentrations of nutrients and contains potentially toxic materials. When disposed on land it would cause contamination of soil and ground water resources. Furthermore, these sediments consist of a high proportion of silt, clay and organic material. Therefore, reclaimed land with such soils would have weak bearing capacity and would be deemed unsuitable for construction purposes.

CHAPTER 2 INITIAL ENVIRONMENTAL EXAMINATION

2.1 Initial Environmental Examination Study for Proposed Measures

Through the Study, environmental considerations for the proposed plans have to be examined in each stage of the Study based on the JICA Guidelines on the Environment². In the master plan stage of the Study, an Initial Environmental Examination (IEE) Study has been done by collecting data on present environmental conditions in the study area, conducting screening and scoping on the proposed plans, and reviewing environmental considerations in the past projects in Sri Lanka.

The term “IEE” used here in the Study means the environmental clearance activities prescribed under national legislation on the Environmental Impact Assessment (EIA) process in Sri Lanka, which is different from the IEE mentioned in the JICA Guidelines on the Environment. Accordingly, the term “IEE Study” is alternatively used in this Study to refer to the “IEE” described in the JICA Guidelines on the Environment.

2.1.1 Environmental Legislation in Sri Lanka

(1) Environmental Laws, Regulations and Standards

The National Environmental Act No.47 of 1980 (NEA) is the basic national charter for protection and management of the environment. Under this Act, the Central Environmental Agency (CEA) was formed as the agency charged with the responsibility of implementing the provisions of the NEA. The subsequent amendment to this Act empowers the CEA to implement a scheme for the control of pollution and to assess impacts on the environment from development activities. Environmental laws, regulations and standards, especially related to the Study, are shown in Table 2.1.1.

(2) EIA System

Only large-scale development projects likely to have significant impacts on the environment are listed as prescribed projects for the EIA process and given in the Gazettes No.772/22 of 24th June 1993 and No.859/14 of 23rd Feb. 1995. The project-approving agency (PAA) will be the agency responsible for administering the EIA process. If the PAA is the project proponent, CEA will act as the appropriate PAA. CEA is charged with the responsibility of implementing the required provisions

² JICA Guidelines for Environmental Considerations in the Development Study: “V. River & Soil Erosion Control” and “VII. Sewerage System” (unofficial translation from Japanese title)

of the NEA, and will promptly advise PAA of any amendments to the relevant acts, orders and regulations. The EIA procedure is shown in Figure 2.1.1.

2.1.2 Review of the Environmental Considerations in the Previous Projects

In the Phases 1 to 3 of the Greater Colombo Flood Control and Environmental Improvement Project (GCFC&EIP), neither IEE nor EIA were required under consultations with CEA due to the environmental improvement features of the Project. Instead, letters of environmental conditions were given by CEA to SLLRDC to implement environmental mitigation measures in the construction stage of the Project. Main items of the conditions to be taken care of are 1) disposal of waste & dredged material, 2) transport of material and equipment, 3) noise from construction activities, 4) safety during the construction, 5) surface drainage and erosion prevention, 6) temporarily used areas, and 7) resettlement of affected persons.

2.1.3 Environmental Screening and Scoping on the Proposed Storm Water Drainage Plans

Based on the JICA Guidelines on the Environment and information from the previous projects, collection of the data and information for the IEE Study was conducted by the subcontracted local consultant to determine current natural and social environmental conditions in the study area. Subsequently, environmental screening and scoping were done to preliminarily identify potential environmental impacts caused by the proposed measures. Potential environmental impacts caused by location and implementation of the proposed measures, by basin, were examined as follows.

(1) Ja Ela Basin Storm Water Drainage Plan

Effective collection of storm water from the basin by the proposed channel improvement will cause an increase in the storm water inflow from the Ja Ela and Dandungam Oya into the Negombo Lagoon through the Muthurajawela Marsh. It will cause inundation of the wetland vegetation in the marsh by a water level rise for a short time during and just after the storm rainfall with inflow diverted from the Kalu Oya basin by the Kalu Oya Basin Storm Water Drainage Plan. As a result, nesting sites for some kinds of birds on the vegetation in the marsh might be affected by the inundation in the case where breeding season falls in the storm period. The contribution to the potential negative impact by the Ja Ela Basin Storm Water Drainage Plan will be lower than that of the Kalu Oya Basin Storm Water Drainage Plan since Ja Ela and Dandungam Oya are presently flowing into the marsh while the Kalu Oya Basin Storm Water Drainage Plan will newly divert the storm water into the marsh. On the other hand, environmental impacts to feeding grounds for fauna in the marsh barely occur since the fauna such as birds can temporarily evacuate to a

safe place during storm rainfall. Regarding any negative environmental impact to flora in the marsh, it is not expected to occur due to the short time of inundation.

Regarding the water quality flowing into the Muthurajawela Marsh and Negombo Lagoon through the canal system in storm rainfall, urban wastewater from the Ja Ela and Dandungam Oya basins through the Ja Ela and Dandungam Oya flows into the marsh and lagoon to some extent at present. If the present sewerage drainage condition whereby some wastewater flows directly into waterways such as the canal, is not improved through implementation of the plan, more pollutants will flow into the marsh and lagoon. This would cause negative impacts such as water pollution and vegetation loss since urbanization along the Negombo Road will be more advanced along with on-going and future transportation development plans in the near future. However, the potential environmental issue is not relevant to negative environmental impact directly caused by the proposed measure since the issue will be caused under the existing storm water drainage system.

Regarding the social environmental impact, some 570 houses located in riverside land might be subject to resettlement in connection with the land acquisition and regulation of land use by the proposed measures. In the case of resettlement, necessary assistance should be provided for the households to be resettled such as preparation of a resettlement site and assistance for livelihood recovery in the post-resettlement period. Since the Ja Ela basin area is not so urbanized yet, resettlement sites can possibly be secured nearby present residential places.

In addition, some 1,200 houses frequently inundated in the storm season will be a part of the potential direct beneficiaries by the proposed measures in relation to improvement of storm water drainage and upgrade of storm water-related infrastructure on-site and off-site. These numbers were preliminary estimates by the Community Inventory Survey.

(2) Kalu Oya Basin Storm Water Drainage Plan

The storm water will be channeled into the Muthurajawela Marsh by the proposed channel improvement measures. It will cause inundation of the wetland vegetation in the marsh by a water level rise for a short time during and just after the storm rainfall. As a result, nesting sites for some kinds of birds on the vegetation in the marsh might be affected by the inundation in the case where breeding season falls in the storm period. However, environmental impacts to feeding grounds for fauna in the marsh barely occur since the fauna such as birds can temporarily evacuate to safe place during storm rainfall. Regarding any negative environmental impact to flora in the marsh, it is not expected to occur due to the short time of the inundation.

Areas surrounding the proposed Kalu Oya retention area will be well urbanized in the future according to the future land use plan. Therefore, regarding the storm water quality channeled into the Muthurajawela Marsh under the proposed plan, there is a possibility that a large volume of pollutants flowing into the Muthurajawela Marsh through the Old Negombo Canal might cause a negative environmental impact to the habitat for flora and fauna in the marsh and lagoon such as water pollution and vegetation loss. However, the potential environmental impact can be avoided, or at least mitigated, by implementing proper wastewater disposal along with the urbanization in the basin.

Regarding the social environmental impact, some 730 houses located in riverside land might be subject to resettlement in connection with the land acquisition and regulation of land use by the proposed measures. In the case of resettlement, necessary assistance should be provided for the households to be resettled such as preparation of a resettlement site and assistance for livelihood recovery in the post-resettlement period. Since the Kalu Oya basin area is now being urbanized, it may be difficult for each household, by themselves, to be resettled in some urbanized locations nearby present residential places. Therefore, new resettlement site development in some areas might be required.

In addition, some 3,000 houses frequently inundated in storm season will be a part of the potential direct beneficiaries of the proposed measures in relation to improvement of storm water drainage and upgrade of storm water-related infrastructure on-site and off-site. These numbers were preliminary estimates by the Community Inventory Survey.

(3) Greater Colombo Basin Storm Water Drainage Plan

Active conservation of marshes as storm water retention areas by land use regulation in the Kolonnawa, Kotte and Heen Marshes will bring about positive effects for both ecological and urban environment contexts under rectifying the present shortsighted exploitation of the encroachment of vacant land like the marshes in the basin.

A CMC dumping site is located adjacent to the Main Drain to the northeast of the junction of the Port Access Road and the Main Drain. Contaminated leachate from the dumping site has been seeping out and polluting the canal water. Measures to prevent the leachate from the dumping site flowing into the canal should be conducted before the proposed measures for the restoration of the existing Mutwal Tunnel and construction of new Mutwal Tunnel are commenced. Otherwise, contaminated water will flow down to the Mutwal Tunnels through the Main Drain by implementation of the proposed measures, so that the coastal ecosystem near the

Mutwal tunnel mouths will be negatively affected by the polluted water coming through the Main Drain.

Regarding the restoration of the existing Mutwal Tunnel and construction of the new Mutwal Tunnel, resettlement in connection with land acquisition will be unavoidable at both the intake and open excavation sections because the settlement is concentrated in those areas.

With regard to the Madiwela South Diversion Construction, most of the construction site passes through abandoned paddy field and vacant land. However, resettlement on a small scale might be expected from the southern area of the Parliament Lake. The diversion of storm water from the Parliament Lake basin into Weras Ganga will bring about a water level rise in the Bolgoda Lake. Since the water level is estimated to raise some 10 cm at most, resettlement due to expansion of the inundated area from the high water level will be relatively small scale.

Regarding the social environmental impact, some 1,050 houses located in riverside land might be subject to resettlement in connection with the land acquisition and regulation of land use by the proposed measures. In the case of resettlement, necessary assistance should be provided for the households to be resettled such as preparation of resettlement site and assistance for livelihood recovery in the post-resettlement period. Since the Greater Colombo basin area has already been well urbanized and the number of the households to be resettled is relative large, it will be difficult for each household to secure a resettlement site nearby present residential places. Therefore, use of existing housing schemes and/or new resettlement site development will be required.

In addition, some 2,500 houses frequently inundated in the storm season will be a part of potential direct beneficiaries by the proposed measures in relation to improvement of storm water drainage and upgrade of storm water-related infrastructure on-site and off-site. These numbers were preliminary estimates by the Community Inventory Survey.

(4) Bolgoda Basin Storm Water Drainage Plan

The proposed plan will cause higher water level in the Weras Ganga and Bolgoda Lake by increase of inflow into Weras Ganga due to urbanization in the upper basin of the Weras Ganga, while flood damage in the Weras Ganga basin area will be reduced instead. Though the water level is estimated to raise some 10 cm at most, resettlement by expansion of the inundated area with high water level will barely occur since there are only a small number of settlements in close proximity to the Weras Ganga and Bolgoda Lake.

Regarding the impact to the Bellanwila-Attidiya Marsh, present environmental encroachment to be urgently resolved is serious in the marsh such as a waste dumping site by the Dehiwala - Mt. Lavinia Municipal Council (DMMC) and residential development in the marsh due to weak legislative status as sanctuary with privately-owned lands occupying large part of the marsh³. Due to these existing conditions, environmental impacts to the habitats for flora and fauna in the Bellanwila-Attidiya Marsh caused by the change of storm water flow to the Weras Ganga are expected to be minimal and last for only a short period during storm rainfall.

Regarding the social environmental impact, some 1,200 houses located in riverside land might be subject to resettlement in connection with the land acquisition and regulation of land use by the proposed measures, especially at the upstream area of the Weras Ganga, which has already been urbanized. In the case of resettlement, necessary assistance should be provided for the households to be resettled such as preparation of a resettlement site and assistance for livelihood recovery in the post-resettlement period. In general, resettlement sites can possibly be secured nearby present residential places except in the upstream area of the Weras Ganga, which has already been urbanized. For the upstream area of the Weras Ganga, new resettlement site development in some areas might be required.

In addition, some 2,000 houses frequently inundated in the storm season will be a part of the potential direct beneficiaries of the proposed measures in relation to improvement of storm water drainage and upgrade of storm water-related infrastructure on-site and off-site. These numbers were preliminary estimates by the Community Inventory Survey.

Potential environmental impacts examined above are summarized as shown below.

³ Wetland Site Report & Conservation Management Report: Bellanwila-Attidiya Marsh. CEA/Euroconsult. 1993

Potential Environmental Impacts Caused by Implementation of the Proposed Measures

Potential Environmental Impacts	Preliminary Assessment
1) Ja Ela Basin Storm Water Drainage Plan	
- water level rise in Muthurajawela Marsh by increasing flow of storm water	-no impact to feeding grounds, but possible impacts to nesting sites for birds in breeding season, - lower contribution by the plan than that of the Kalu Oya Basin Storm Water Drainage Plan
- low quality water inflow into Muthurajawela Marsh due to urbanization along the Negombo road in the future	-low impact by improvement of urban sewerage drainage due to relative lower urbanization -no direct linkage with the proposed measures
- resettlement due to land acquisition and land use regulation	-expected to some extent
2) Kalu Oya Basin Storm Water Drainage Plan	
- water level rise in Muthurajawela Marsh by diversion of storm water	-no impact to feeding grounds, but possible impacts to nesting sites for birds in breeding season
- low quality water inflow into Muthurajawela Marsh	-possible impact due to urbanization in future
- resettlement due to land acquisition and land use regulation	-expected to some extent
3) Greater Colombo Basin Storm Water Drainage Plan	
- resettlement due to land acquisition and land use regulation	-expected to some extent., especially in project sites for restoration of Mutwal Tunnel and construction of New Tunnel
- coastal pollution due to leachate from the CMC dumping site along the canal	-expected to some extent, in case of no mitigation measures implemented for the dumping site
- resettlement due to Madiwela South Diversion Construction	-expected to some extent near the Parliament Lake -low impact in Weras Ganga and Bolgoda Lake due to some 10 cm water level rise at most
4) Bolgoda Basin Storm Water Drainage Plan	
- water level rise in Weras Ganga and Bolgoda Lake by urbanization upstream	-low impact due to some 10 cm water level rise at most
- negative impact to ecosystem in the Bellanwila-Attidiya Marsh by change of water regime in Weras Ganga	- expected to be minimal under present conditions already caused by several existing factors
- resettlement due to land acquisition and land use regulation	-expected to some extent

Necessity of the IEE or EIA for each of the proposed projects was preliminarily checked based on the Gazettes No.772/22 of 24th June 1993 and No.859/14 of 23rd Feb. 1995 on the prescribed projects for the IEE/EIA, though the IEE/EIA were not required in the previous GCFC&EIPs. A checklist on possibility of resettlement and IEE/EIA requirement for the proposed projects is shown in Table 2.1.2.

In general for all proposed plans, negative environmental impacts during construction stage might be caused by noise and vibration, dust, offensive odor from dredged canal sediment, storage and dumping of construction waste, and temporary traffic obstruction. Regarding the excavated materials from lowlands or other potential acid sulphate soils, disposal to sensitive ecosystems or productive agricultural lands should be avoided so as not to cause vegetation damage or low agricultural productivity in such lands. Environmental mitigation measures during construction stage should be undertaken for environmental impact items as stated above.

2.2 Environmental Issues Relevant to the Canal System

2.2.1 Waste Water Management

It can be observed that water quality in the canals of the study area, especially along the densely populated areas, is heavily deteriorated in many places. It is because inflow into the canals in the non-flooding period is almost only wastewater from domestic and industrial/commercial origins, sewers directly connecting to the canals, leachate from waste dumping sites and direct waste disposal into the canal, while the steady inflow of better quality water from outside of the canal system is negligible. In addition, stagnation of the pollutants in the canals accelerates the water quality deterioration process and causes high concentrations of the pollutants. Extraordinary growth of the aquatic weeds caused by the water quality deterioration in the canal blocks storm water passage in many places.

In the proposed storm water drainage plans, storm water retention areas are planned in the lowlands such as marshes and abandoned paddy fields. The retention area will temporarily receive some amount of polluted water from the canals during and after storm rainfall, though the polluted water from the canals are much diluted with storm water before entering the retention area. Therefore, the inflow of the polluted water might cause a negative impact, to some extent, to the ecological and/or sanitary conditions of the lowlands designated as retention areas, especially in the environmental protected areas such as Bellanwila-Attidiya Marsh and Muthurajawela Marsh. Improvement of water quality of the canals is to be considered in relation to storm water drainage improvement as well as hygienic conditions and urban landscape improvement in the study area.

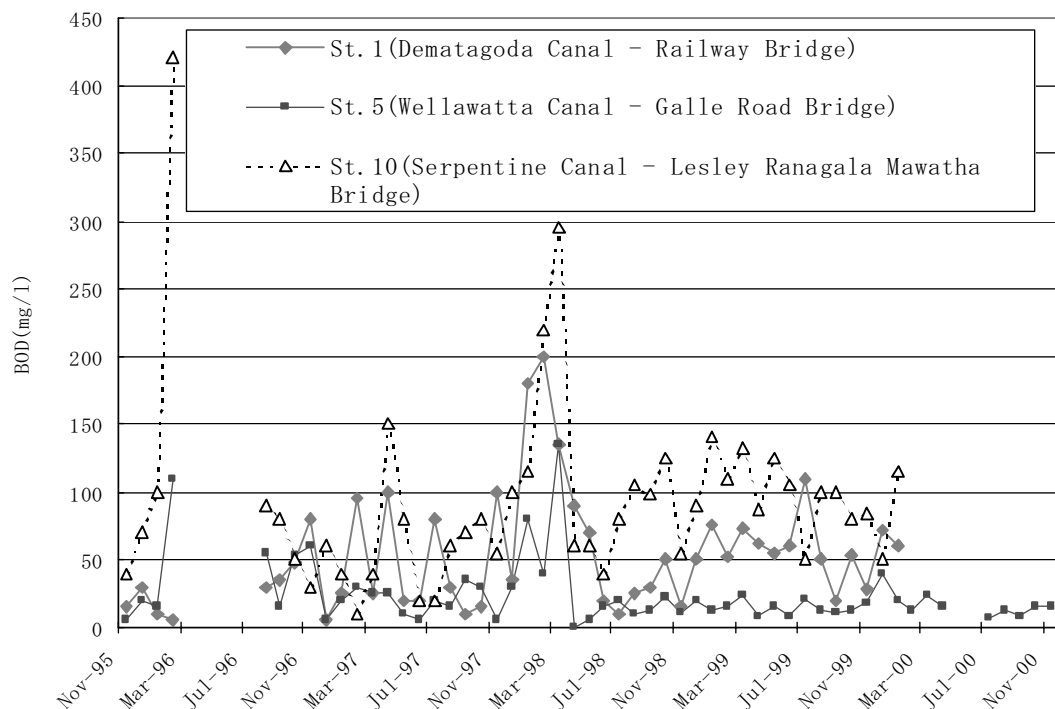
In the GCFC&EIP Phase II, water quality monitoring in the canals in the Greater Colombo area has been conducted from 1995 to 2000 as well as water level measurements. Ten water quality parameters are monitored: ammonia, nitrate, temperature, phosphate, turbidity, pH, conductivity, DO, BOD, and COD. Locations of 17 sampling points are shown below. In addition to the water quality monitoring, a survey on discharge points of wastewater along the canals was conducted by type of pollution sources such as sewerage pipes and direct discharge of domestic and industrial wastewater. The water quality monitoring is continuing in the GCFC&EIP Phase III.

Locations of Water Sampling Points

Name of Canal/Lake	Sampling Points	Monitoring Period
1) Dematagoda Canal	Railway bridge	Nov. 1995 - Jan. 2000
2) St. Sebastian South Canal	Most upstream point	Nov. 1995 - Nov. 2000 [KM1]
3) Kotte North Canal	Sri Jayawardenapura Mawatha bridge	
4) Torrington Canal	Railway bridge	
5) Wellawatta Canal	Galle Road bridge	
6) Dehiwala Canal	Galle Road bridge	
7) Lunawa Lake Outfall	Railway bridge	
8) Bolgoda Canal	Attidiya Road bridge	
9) Weras Ganga	Borupana ferry site	
10) Serpentine Canal	Lesley Ranagala Mawatha bridge	Nov. 1995 - Jan. 2000
11) St. Sebastian North Canal	Bridge near Inguru Kade junction	Dec. 1999 - Jan. 2000
12) Dematagoda Canal	Kolonnawa bridge	
13) Mahawatta Canal	Cotta Road bridge	
14) Kirillapone Canal	Open University bridge	
15) Lunawa Lake	Station 05	
16) Lunawa Lake	Station 06	
17) Lunawa Lake	Station 07	

Source: Water Quality and Water Level Monitoring Program in the Greater Colombo Canal System (June 1995 - December 1999), GCFC&EIP Phase II, January 2000

In general, values of some water quality parameters such as phosphate, DO, BOD and COD have not satisfied the environmental standards of Sri Lanka in the monitored canals. In almost all canals, improvement of the quality has not been seen for those parameters. Monitoring results of the BOD in three canals are shown below for example.



Water Quality in 3 Canals (BOD)

Source: Water Quality and Water Level Monitoring Program in the Greater Colombo Canal System (June 1995 - December 1999), GCFC&EIP Phase II, January 2000

The most efficient and essential resolution to improve water quality in the canal system is to thoroughly eliminate pollutants that undesirably flow into the canal system from pollution sources such as domestic/industrial wastewater and sewerage. However, it is not realistic that all mitigation measures can be implemented in the whole area in a short period due to limited financial resources and other issues to be solved in advance.

It is proposed that the water quality improvement measures be implemented in phases in order to enhance public awareness on water quality improvement from public hygienic and urban landscape improvement viewpoints.

2.2.2 Solid Waste Management

Dumping of solid waste into the canals is observed as a common activity in many places of the CMR as well as illegal waste dumping in proximity to the canal due to lack of solid waste collection service and lack of public concern. This practice has caused blocking of the storm water passage in the canals as well as water quality deterioration.

Local Authorities (LAs) are responsible for the collection and disposal of solid waste arising from the following sources:

- 1) Residential and commercial wastes including market waste;
- 2) Hospital waste, clinical and non-clinical waste;
- 3) Industrial waste;
- 4) Slaughter house waste;
- 5) Drain cleaning and street sweepings.

The collection service provided by any LAs to the respective areas is one or a combination of door-to-door service, primary and secondary collection services.

In many areas, particularly in rural areas, a significant amount of the waste generated does not enter the waste stream and is not collected for final disposal. Over the last 3 years, a few LAs have privatized waste collection and disposal. This has shown a marked increase in street cleaning and door-to-door waste collection.

The most prevalent method of waste disposal is open dumping. The majority of such open dumping areas are in lowlands such as marshy lands and abandoned paddy fields. Due to various factors like urban sprawl development and severe public opposition, locating disposal sites in urban areas has become difficult. The present disposal sites of many MCs in urban areas have almost reached full capacity.

None of the open dumping sites are engineered to minimize or control pollutants released from decomposition of waste. There exist little or no basic operations such

as leveling and covering of waste due to financial constraints. Soil cover is applied only at the final stage after using or due to public pressure. In addition to the dumping sites operated by the relevant authorities, haphazard dumping takes place along streets, marshes, abandoned paddy fields and stream banks by private parties without any control. Most of such sites border water bodies such as canals or rivers with waste spilling over and blocking the passage of water, in addition to discharge of leachate.

DMMC has disposed of its waste in the Bellanwila-Attidiya marsh and the dumping site is bordered by the Weras Ganga to the east and a canal flowing along the western and southern boundaries that falls into the Weras Ganga although the dumping site was closed due to a court order in response to opposition by residents nearby. As reported in the ERM study⁴, the canal was blocked with waste. The Kolonnawa Ela forms the northern boundary of the Sri Jayawardenepura Kotte MC disposal site. The Moratuwa MC dumping site is bounded by the Depa Ela to the north, Maha Ela to the south and Weras Ganga to the east. With many other sites located adjacent to water bodies it is apparent that with no engineering controls in place, leachate generated will seep through to the water bodies and canals will be clogged with waste.

The fundamental problems and issues associated with waste disposal could be identified as:

- 1) Lack of coherent planning at national, provincial and local levels;
- 2) Lack of suitable waste treatment technologies and disposal facilities;
- 3) Shortage of suitable lands and public opposition to disposal facilities in their neighborhood;
- 4) Lack of resources in Local Authorities;
- 5) Insufficient public awareness on the health, social and environmental impacts of open dumping

⁴ Review of Current Municipal Solid Waste Dump Sites in the Greater Colombo Area, Western Province, Sri Lanka. Colombo Environment Improvement Project and Presidential Task Force on Solid Waste Management, ERM, 2000.

Tables

Table 2.1.1 Environmental Legislations in Sri Lanka (1/2)

<p>1. Cross-Sectoral Issues - National Environmental Act, No.47 of 1980, Amendment Act No.56 of 1988</p>
<p>2. Natural Resources A. Property rights in natural resources: Wildlife & Nature Protection Society Act No.29 of 1968 B. Use of natural resources of public domain: Industrial Development Act, No.36 of 1969</p>
<p>3. Fresh Waters A. Water resource management: Water Resources Board Act, No.29 of 1964 B. Regime of public/private waters - National Water Supply and Drainage Board Law, No.02 of 1974, Amendment Act No.13 of 1992 C. Water administration - Municipal Council Ordinance, No.16 of 1949, No. 48 of 1983 - Pradeshiya Sabhas Act, No.15 of 1987, Amendment No.34 of 1993 - Urban Council Ordinances, No.61 of 1993, No.48 of 1984 D. Water Uses: Mahaweli Authority of Sri Lanka No.23 of 1979, Amendment Act No.59 of 1993 E. Water quality standards - Sri Lanka Standards SLS 652: 1984 - Tolerance limits for industrial waste water discharged into Inland Surface Waters - Sri Lanka Standards SLS 722: 1985 - Tolerance limits for Inland surface waters for use as raw water for public water supply - Sri Lanka Standards SLS 721: 1985 - Tolerance limits for industrial waste water discharged into Marine coastal waters - Sri Lanka Standards SLS 614: 1983/84 - Sri Lanka standard specification for potable water - Tolerance limits for industrial waste water discharged into public (common) sewer for further treatment (Interim standard) F. Water pollution: control and monitoring - Marine Pollution Prevention Act, No.59 of 1981 - Sri Lanka Ports Authority Act, No.51 of 1979, No.2 of 1992 G Water works - Colombo Water Works Ordinance No.18 of 1907, No. 29 of 1947 - Irrigation Ordinance No.32 of 1946, No.3 of 1994</p>
<p>4. Flora A. Flora: Protection of species - Felling of Trees (control) Act, No.9 of 1951, Amendment Act No.30 of 1953 - Fauna and Flora Protection Ordinance, No.2 of 1937, Amendment Act No.49 of 1993 - Plant Protection Ordinance, No.10 of 1924, Amendment Act No.20 of 1986 - Water Hyacinth Ordinance, No.4 of 1909</p>
<p>5. Fauna A. Protected areas for sustainable management of faunal resources: National Heritage Wildness Areas Act, No.3 of 1988 B. Management of resources: Fauna and Flora Protection Ordinance, No.2 of 1937, Amendment Act No.49 of 1993 C. Regulation of activities with impact on conservation objectives - Fauna and Flora Protection Ordinance, No.2 of 1937, Amendment Act No.49 of 1993 - Wildlife & Nature Protection Society Act No.29 of 1968 - National Heritage Wildness Areas Act, No.3 of 1988</p>
<p>6. Places of Natural and Architectural Beauty: Historical and Archaeological Sites and Monuments A. Protection of landscapes formed by natural or cultivated resources - Irrigation Ordinance No.32 of 1946, No.3 of 1994 - National Heritage Wildness Areas Act, No.3 of 1988 B. Protection of architectural landscapes - Town and Country Planning Ordinance, No.13 of 1946, Amendment Act No.57 of 1981 - Urban Development Authority Law, No.41 of 1978, No.41 of 1988 C. Protection of historic and archaeological sites and monuments: Antiquities Ordinance No.9 of 1940, No.22 of 1955</p>

Table 2.1.1 Environmental Legislations in Sri Lanka (2/2)

<p>7. Noise, Vibrations and Odors</p> <p>A. Standards on noise, vibrations and odors: Typical Noise Level Criteria - Interim Standards</p> <p>B. Prevention and control of noise, vibrations and odors</p> <ul style="list-style-type: none"> - Municipal Council Ordinance, No.16 of 1949, No. 48 of 1983 - Predeshiya Sabhas Act, No.15 of 1987, Amendment No.34 of 1993 - Urban Council Ordinances, No.61 of 1993, No.48 of 1984
<p>8. Hazardous and Solid Wastes</p> <p>A. Hazardous and solid wastes policy/management</p> <ul style="list-style-type: none"> - Industrial Products Act, No.18 of 1949, Amendment Act No.69 of 1961 - Factories Ordinance No.45 of 1942, Amendment Act No.32 of 1984 - Predeshiya Sabhas Act, No.15 of 1987, Amendment No.34 of 1993 <p>B. Recovery treatment and disposal operations</p> <ul style="list-style-type: none"> - Industrial Dispute Act, No.43 of 1950, Law No.53 of 1973 - Industrial Promotion Act, No.46 of 1990 - Industrial Products Act, No.18 of 1949, Amendment Act No.69 of 1961 - Predeshiya Sabhas Act, No.15 of 1987, Amendment No.34 of 1993
<p>9. Prevention and Control of the Environmental Effects of Public Works</p> <ul style="list-style-type: none"> - National Dangerous Drugs (Control) Board Act, No.11 of 1984, Amendment Act No.21 of 1990 - Nuisances Ordinance, No.15 of 1862, No.57 of 1946 - Wells and Pits Ordinance, No.27 of 1884, No.3 of 1946 - Municipal Council Ordinance, No.16 of 1949, No. 48 of 1983 - Predeshiya Sabhas Act, No.15 of 1987, Amendment No.34 of 1993 - Urban Council Ordinances, No.61 of 1993, No.48 of 1984
<p>10. Settlement of Disputes</p> <p>A. Ombudsman: Ombudsman Act, No.17 of 1981</p> <p>B. Arbitration: Arbitration Ordinance, No.15 of 1866, Amendment Ordinance No.2 of 1889</p>
<p>11. Environmental Impact Assessment System</p> <ul style="list-style-type: none"> - National Environmental Act, No.47 of 1980, Amendment Act No.56 of 1988 - Government gazettes (Extra-ordinary) No. 772/22 of 24th June 1993 and No. 859/14 23rd Feb. 1995 - A Guide for Implementing the EIA Process, No.1, 1998 - A Guide for Implementing the EIA Process, No.2, 1995 - Guidelines for conducting environmental scoping

Source: Index to Environmental Legislations in Sri Lanka, 1995 and A Guide for Implementing the EIA Process, No.1, 1998

Table 2.1.2 Check List of Resettlement and Prescribed Undertakings on the Proposed Plans

Proposed Measures	Items	Possibility of Resettlement	Possible Project Type Prescribed for IEE/EIA*
1. Ja Ela Basin Storm Water Drainage Plan			
1) Ja Ela Channel Improvement		○	A, B, C, D, F
2) Dandugam Oya Channel Improvement		△	A, B, C, D, F
3) Ja Ela Retention Area Conservation		△	A, B, C, D, F
4) Muthurajawela Marsh Flood Plain Conservation		△	A, B, C, D, F
2. Kalu Oya Basin Storm Water Drainage Plan			
1) Kalu Oya Channel Improvement		○	A, B, C, D, F
2) Old Negombo Canal Improvement		△	A, B, C, D, F
3) Urbanized Area Storm Water Retention Facilities Construction		×	A, B, C, F
4) Kalu Oya Retention Area Conservation		△	A, B, C, D, F
5) Muthurajawela Marsh Buffer Zone Conservation		△	A, B, C, D, F
3. Greater Colombo Basin Storm Water Drainage Plan			
1) Madiwela South Diversion Construction		△	A, B, C, D, F
2) Mutwal Tunnel (Existing) Restoration		○	A, D, E, F
3) New Mutwal Tunnel Construction Project		○	A, D, E, F
4) Urbanized Area Storm Water Retention Facilities Construction		×	A, B, C, F
5) Kolonnawa Marsh Retention Area Conservation		△	A, B, C, D, F
6) Kotte Marsh Retention Area Conservation		△	A, B, C, D, F
7) Heen Marsh Retention Area Conservation		△	A, B, C, D, F
4. Bolgoda Basin Storm Water Drainage Plan			
1) Weras Ganga Improvement		△	A, B, C, D, F
2) Urbanized Area Storm Water Retention Facilities Construction		×	A, B, C, F
3) Bolgoda Lake North Retention Area Conservation		△	A, B, C, D, F
4) Bolgoda Lake South Retention Area Conservation		△	A, B, C, D, F

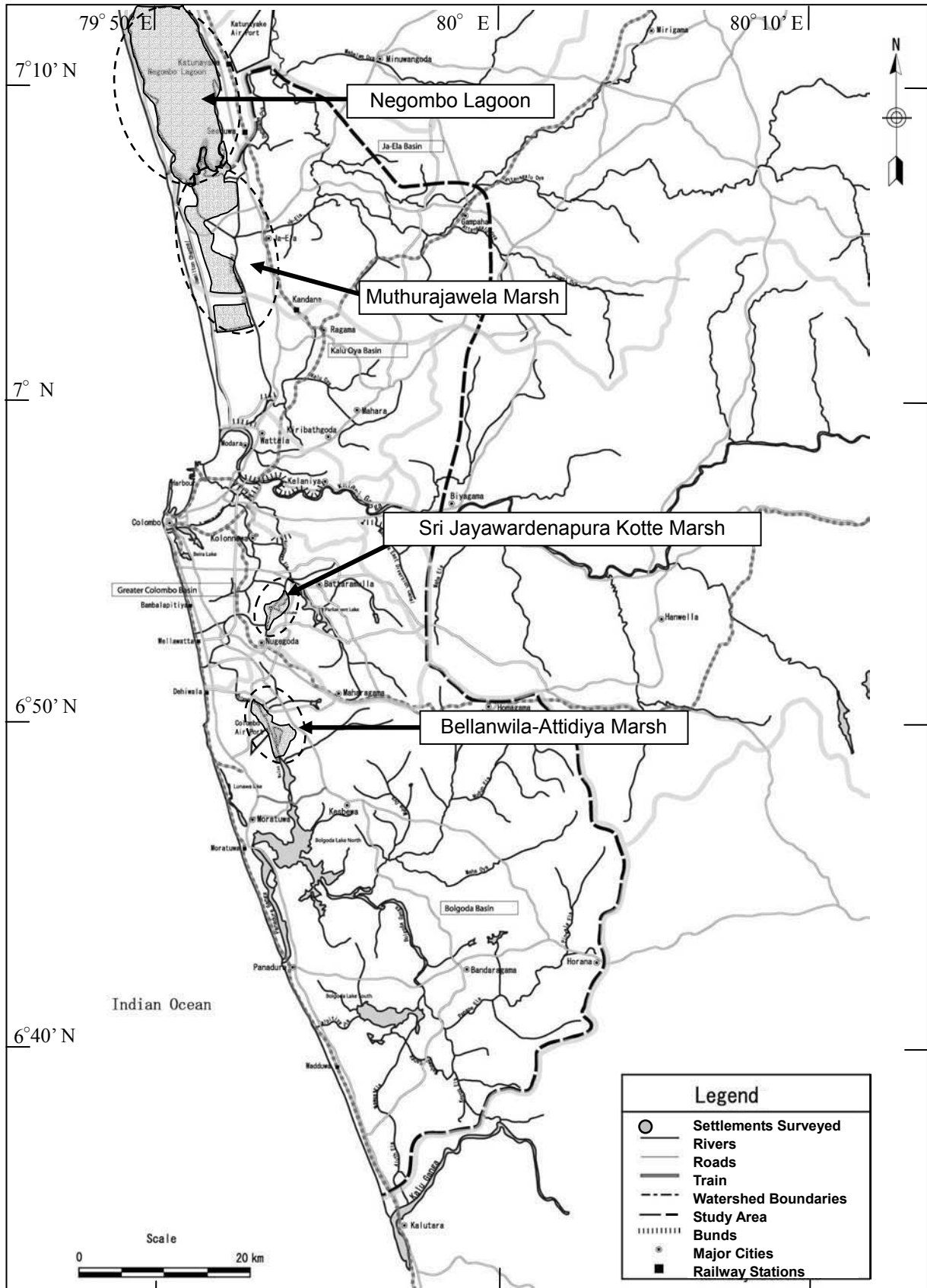
Note: Possibility of Resettlement - ○: high possibility due to existence of settlements in the proposed site,
 △: low possibility
 ×: no resettlement occur.

*: Government gazettes No.772/22 of 24th June 1993 and No.859/14 of 23rd Feb.1995

Prescribed project types and locations relevant to the proposed plans based on the above gazettes

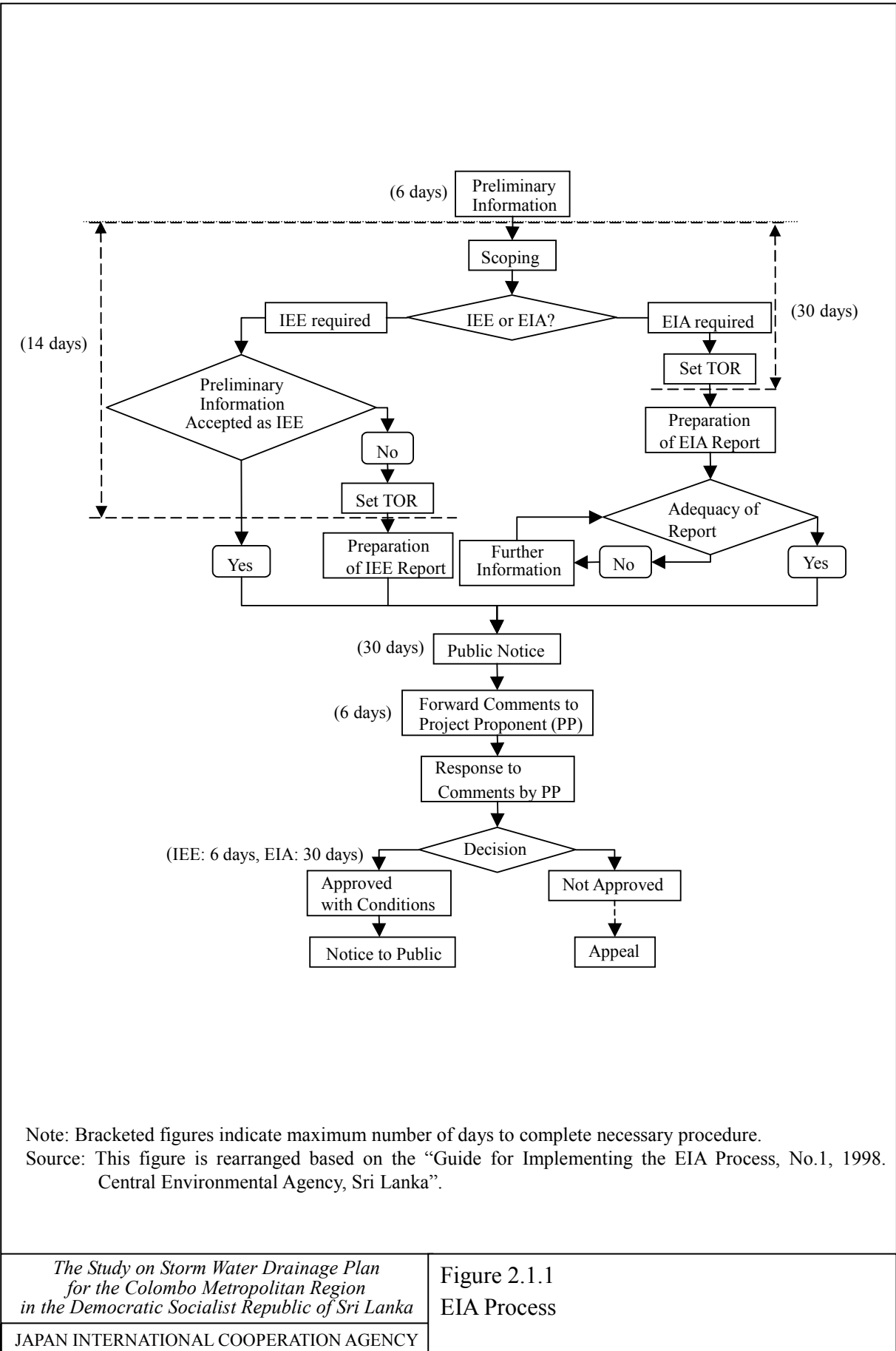
- A: All river basin development and irrigation projects excluding minor irrigation works
- B: Conversion of forests covering an area exceeding 1 hectare into non-forest uses
- C: Clearing of land areas exceeding 50 hectares
- D: Resettlement
- E: All tunneling projects
- F: Following areas
 - a. Within 100m from the boundaries of or within any area declared under
 - the National Heritage Wilderness Act No.3 of 1988;
 - the Forest Ordinance;
 - b. Within the following areas whether or not the areas are wholly or partly within the Coastal Zone:
 - i. any erodible area declared under the Soil Conservation Act.
 - ii. any Flood Area declared under the Flood Protection Ordinance and any flood protection area declared under the Sri Lanka Land Reclamation and Development Corporation Act, 15 of 1968 as amended by Act, No.52 of 1982.
 - iii. 60 meters from the bank of a public stream as defined in the Crown Lands Ordinance and having a width of more than 25 meters at any point of its course.
 - iv. any reservation beyond the full supply level of a reservoir.
 - v. any archaeological reserve, ancient or protected monument as defined or declared under the Antiquities Ordinance.
 - vi. any area declared under the Botanic Gardens Ordinance.
 - vii. within 100 meters from the boundaries of, or within, any area declared as a Sanctuary under the Fauna and Flora Protection Ordinance.
 - viii. within 100 meters from the high flood level contour of, or within, a public lake as defined in the Crown Lands Ordinance including those declared under section 71 of the said Ordinance.

Figures



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Figure 1.2.1
Locations of Environmental Protected Areas



Note: Bracketed figures indicate maximum number of days to complete necessary procedure.
 Source: This figure is rearranged based on the “Guide for Implementing the EIA Process, No.1, 1998. Central Environmental Agency, Sri Lanka”.

Figure 2.1.1
 EIA Process