

SUPPORTING REPORT (2)

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 IV : SUPPORTING REPORT (2)

ANNEX 5 : ENVIRONMENT

TABLE OF CONTENTS

	Page
CHAPTER 1 PRESENT CONDITIONS ON NATURAL ENVIRONMENT	
1.1 Natural Environment	A5-1
1.1.1 Bellanwila-Attidiya Wildlife Sanctuary	A5-1
1.1.2 Weras Ganga.....	A5-2
1.2 Pollution	A5-2
1.2.1 Water Quality in the Canal System and Conceivable Pollution Sources	A5-2
1.2.2 Bottom Sediment Quality in the Canal System.....	A5-3
1.2.3 Wastewater Management	A5-3
1.2.4 Solid Waste Management	A5-4
CHAPTER 2 ENVIRONMENTAL IMPACT ASSESSMENT	
2.1 Environmental Screening and Scoping on the Proposed Schemes	A5-5
2.2 Environmental Impacts and Mitigation Measures	A5-5
2.2.1 Social Environment.....	A5-5
2.2.2 Natural Environment	A5-7
2.2.3 Pollution.....	A5-8
2.3 Environmental Management and Monitoring Plan.....	A5-10
2.4 Requirements for EIA Approval	A5-11

LIST OF TABLES

	Page
Table 1.2.1	Results of Water Quality Test..... A5-T1
Table 1.2.2	Results of Bottom Sediment Quality Test..... A5-T2
Table 2.1.1	Environmental Screening and Scoping for Weras Ganga Scheme A5-T3
Table 2.1.2	Environmental Screening and Scoping for Bolgoda Canal Scheme..... A5-T4
Table 2.1.3	Environmental Screening and Scoping for Nugegoda-Rattanapitiya Scheme A5-T5
Table 2.1.4	Environmental Screening and Scoping for Ratmalana-Moratuwa Scheme A5-T6
Table 2.1.5	Potential Environmental Impacts by Project Components of the Proposed Schemes A5-T7

LIST OF FIGURES

	Page
Figure 1.2.1	Water Sampling Points and Water Qualities..... A5-F1
Figure 1.2.2	Bottom Sediment Sampling Points and Qualities..... A5-F2
Figure 1.2.3	Existing Solid Waste Dumping Sites..... A5-F3
Figure 2.2.1	Proposed Disposal Sites for Dredged Material and Surplus Soil..... A5-F4

CHAPTER 1 PRESENT CONDITIONS ON NATURAL ENVIRONMENT

1.1 Natural Environment

Non-residential areas in the feasibility study area consist of small marshy lands, active/abandoned agricultural lands and water body including canals and Weras Ganga. The Bellanwila-Attidiya Wildlife Sanctuary is the only place to be mentioned specially in terms of ecologically importance in the feasibility study area. The Weras Ganga is also be mentioned here as the only large river in the feasibility study area.

1.1.1 Bellanwila-Attidiya Wildlife Sanctuary

The Bellanwila-Attidiya marsh area was widely cultivated for rice until the end of the 1970's. However, due to increasing severity of drainage problems with seasonal flooding caused by land-filling and housing construction in the catchment area, siltation of drainage lines and rampant growth of aquatic weeds, the paddy cultivation was abandoned. Since then, intensive use of the marsh has not been undertaken. Consequently, the marsh has been re-colonized by diverse vegetation that provides habitat for a great variety of wildlife¹. After several researches by NGOs on the ecological condition of the marsh, the marsh area, whose total land area is 372 ha, was declared a Sanctuary under the Flora and Fauna Protection Ordinance (FFPO) in 1990.

However, effective management of the marsh has not been conducted by the Department of Wildlife Conservation (DWLC) who has direct management, responsibility due to the following reasons.

- 1) While all wildlife is fully protected within any area of the Sanctuary, plants and habitats are legally protected only on State lands under the FFPO, not private land.
- 2) The greater part of the marshlands are privately owned.
- 3) All who owned land within the Bellanwila-Attidiya marsh prior to its declaration as a Sanctuary, can continue to enjoy the rights and privileges as they did before under the FFPO.

Thus, the legal restriction to the Sanctuary status is too weak to conserve the marsh area appropriately.

Under the condition for the conservation of the Sanctuary, urban pressure from the upper basin and surrounding area of the marsh such as wastewater inflow and solid waste dumping has gradually deteriorated natural environment of the marsh. As a

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

result, it is reported that the precious rich biodiversity in the marsh does not remain anymore. There is no definite management plan at present. Stakeholders related to the marsh have different views as shown below.

Stakeholders and their Concerns to Bellanwila-Attidiya Wildlife Sanctuary

Stakeholders	Concerns on Bellanwila-Attidiya Wildlife Sanctuary
DWLC	Low priority to be conserved compared to other protected areas in the country such as national park.
UDA	Fully conserved by pro-nature use such as water park. The land of the sanctuary to be conserved is acquired.
Local authority	Almost no intention.
Private land owners	Willing to sell by filling land due to high demand of the land under urbanization in the area
Local environmental NGOs, Part of local residents and supporters	Active conservation of the Sanctuary

1.1.2 Weras Ganga

In addition to the water flow from the upper stream of the canals connecting to the Weras Ganga, the Weras Ganga receives runoff from its boundary areas. Based on the water quality data, salinity level is low in the upstream reaches of the Weras Ganga since tidal flow is prevented by fresh water flow from upstream of the canals. According to a local NGO, the fish catch has been virtually depleted in the last decade due to industrial pollution although a wide variety of fish species living in the Weras Ganga is reported.

1.2 Pollution

1.2.1 Water Quality in the Canal System and Conceivable Pollution Sources

To determine water quality in the canal system in the study area under present conditions, water sampling and analysis were conducted at 12 locations in the canals and marshes. The water sampling under storm condition was not conducted due to dry weather season when the EIA study was conducted. The results of water quality test are shown in Table 1.2.1. Water sampling points and summary of water quality are shown in Figure 1.2.1.

The water quality at the sampling point L1 (Kospalana bridge) has a very high conductivity level, which indicates a high salinity level. This may be due to intrusion of seawater from the Panadura Ganga.

Generally, water quality in most of sampling locations has deteriorated. Water quality of the drainage water from the Ratmalana-Moratuwa area at sampling points L3 and L6 show that highly polluted water from the area flows into the Weras Ganga.

1.2.2 Bottom Sediment Quality in the Canal System

To examine appropriate disposal method of the dredged materials from the canals and Weras Ganga, bottom sediment sampling and analysis were conducted at almost the same 12 locations as the water sampling. Bottom sediment sampling points and summary of bottom sediment quality are shown in Table 1.2.2 and Figure 1.2.2.

1.2.3 Wastewater Management

Surface water pollution in the canals and marshes is a most serious problem in the feasibility study area as well as that in other area of the CMR. The main causes of surface water pollution are²:

- 1) Discharge of urban drainage water mixed with industrial and domestic origin to natural streams including runoff from open markets and garbage dumps,
- 2) Direct discharge of industrial wastewater into rivers, canals and lowlands,
- 3) Uncontrolled and illegal dumping of industrial and domestic waste in waterways, embankments and lowlands,
- 4) Discharge of sewerage directly into canal/surface water bodies mainly by shanty settlements along canals,
- 5) Insufficient maintenance and cleaning of watercourses and embankments resulting in siltation, blockage and aquatic weed growth.

Regarding the domestic wastewater, only some part of Dehiwala-Mt.Lavinia MC area is served by a piped sewerage system established in early 1900s. The feasibility study area is not covering the sewerage service. Most of the population have no or inadequate facilities in the feasibility study area.

The Ratmalana-Moratuwa industrial area comprises more than 190 industries mainly textile and garments, pharmaceutical, metal finishing, food industry and paint industry. This industrial area does not have a central treatment facility and industrial wastewater is discharged into surface drains, while domestic wastewater is discharged via septic tank into soakage pits. Due to the high water table and sandy soil in the area, the partially treated wastewater from septic tanks enters the ground water³.

² IEE Study on Storm Water Drainage Plan for CMR, LHI. 2002

³ University of Moratuwa. 2001. Feasibility Study Report on the Establishment of a Central Waste Water Treatment Plant (CWWTP) for Ratmalana-Moratuwa Industrial and Residential Areas

1.2.4 Solid Waste Management

Waste disposal is one of main environmental issues and it is closely related to the canal system and storm water drainage in the feasibility study area as well as other built-up area in the CMR.

The waste disposal is undertaken by mainly open dumping method under responsibility of the relevant local authorities in the feasibility study area. Most dumping sites are located in lowlands such as marshy and abandoned paddy fields creating water pollution problem by polluted leachate from dumping site to water bodies including canal system. In general, privately-owned lands are targeted for the dumping sites since those lands are available as a mean of land reclamation.

The waste disposal sites mainly operated by local authorities in the study area are shown below and in Figure 1.2.3. Information about the waste disposal by contracted private companies is not available.

Solid Waste Disposal Sites by Local Authorities

DS Division	Solid Waste Disposal Sites	Remarks
Dehiwala - Mt.Lavinia	Attidiya South	-
Ratmalana	Attidiya South	-
Moratuwa	Dendeniyawatta-Katubedda	About 40 tractor loads per day
Kotte	Athul Kotte	-
Maharagama	Navinna	Adjacent to High Level road
Kesbewa	Mabahatha	About 4 tractor loads per day

Source: IEE Study on Storm Water Drainage Plan for CMR, LHI, 2002

The Dehiwala-Mt.Lavinia MC (DMMC) has disposed of its waste in the Bellanwila-Attidiya marsh on a site bordered by the Weras Ganga to the east and a canal flowing along the western and southern boundaries that falls into the Weras Ganga. However, the dumping site was closed recently because of court order due to opposition by residents to the dumping activity.

The Maharagama PS has initiated a source segregation scheme among 2,300 households and it has been effective in reducing the total quantity of waste collected⁴.

⁴ State of the Environment Report, Sri Lanka- First Draft. Ministry of Environment/NORAD/UNEP/SACEP. 2000

CHAPTER 2 ENVIRONMENTAL IMPACT ASSESSMENT

2.1 Environmental Screening and Scoping on the Proposed Schemes

Based on the project components of each proposed scheme as shown below, environmental screening and scoping were conducted for four proposed schemes as shown in Tables 2.1.1 to 2.1.4. Table 2.1.5 summarizes conceivable negative impacts identified by the environmental screening and scoping.

Components of the Proposed Schemes

Proposed Schemes and Components
<p>1. Weras Ganga Scheme</p> <ul style="list-style-type: none"> (1) Dredging of Weras Ganga riverbed <ul style="list-style-type: none"> - Widening and deepening of the existing earth canal (2) Construction of flood protection wall with flap gate (3) Conservation of retention areas (Weras Ganga swamp and Maha Ela retention areas) <ul style="list-style-type: none"> - Construction of peripheral channel and pathway
<p>2. Bolgoda Canal Scheme</p> <ul style="list-style-type: none"> (1) Dredging and channel improvement of Bolgoda Canal <ul style="list-style-type: none"> - Widening and deepening of the existing earth canal - Embankment and construction of O&M road - Replacement of bridge (2) Conservation of a retention area (Bellanwila-Attidiya retention area) <ul style="list-style-type: none"> - Construction of peripheral channel and pathway
<p>3. Nugegoda-Rattanapitiya Scheme</p> <ul style="list-style-type: none"> (1) Channel improvement of Rattanapitiya Ela, Delkanta Ela and Nugegoda Ela <ul style="list-style-type: none"> - Widening and deepening of the existing canal - Bank protection of the existing earth canal with gabion - Construction of concrete open channel - Embankment and construction of O&M road - Replacement of bridge and cross culvert (2) Conservation of three retention areas <ul style="list-style-type: none"> - Construction of peripheral channel and path way
<p>4. Ratmalana-Moratuwa Scheme</p> <ul style="list-style-type: none"> (1) Improvement of urban drainage system in Ratmalana-Moratuwa area <ul style="list-style-type: none"> - Widening and deepening of the existing canal - Bank protection of the existing earth canal with gabion - Construction of concrete open channel and concrete flume with cover slab - Construction of underground pipes and culverts (2) Construction of retention ponds(Kandawala pond and Telewala pond)

2.2 Environmental Impacts and Mitigation Measures

2.2.1 Social Environment

(1) Resettlement Caused by Land Acquisition

Although minimization of the number of households to be resettled caused by the land acquisition for the proposed schemes was examined as explained in Annex 6, 158 households require resettlement. In addition, two factories and a community hall are subject to relocation by the land acquisition.

For residential households, just compensation and necessary assistance for the resettlement should be made based on the past similar projects, National Involuntary Resettlement Policy (NIRP) and relevant laws and guidelines which will be effect soon. Based on the NIRP, a resettlement action plan should be prepared by SLLRDC to implement land acquisition, compensation and resettlement prior to the project implementation with technical advice from CEA, Ministry of Lands, NHDA, etc.

(2) Storm Water Drainage Improvement and Poverty Reduction

Low-income people tend to reside in the lowlands of the feasibility study area such as marsh and canal reserve with inexpensive or free rent because such lowland has low demand for economic use due to flood prone characteristic. Damages by the storm water such as property damage and sanitary deterioration cause significant negative impacts and a heavy burden to livelihoods of the low-income households much more than that of other upper income households.

The proposed schemes for storm water drainage improvement provide an opportunity for a better residential environment especially for the low-income residents by relieving flooding damage relevant to their livelihood and sanitary conditions. The improvement of residential conditions by the storm water drainage improvement can be considered as an aspect of poverty alleviation. In the feasibility study area, relative large numbers of the low-income households reside along the right bank of the Weras Ganga in the Ratmalana-Moratuwa area. Those low-income households will benefit by implementing the proposed schemes.

In addition, involvement of the low-income people living in the feasibility study area in the construction activity for the proposed channel and resettlement site development by employment in the project and/or through the community contract system will bring about employment opportunity even it is temporary.

(3) Temporary Traffic Disturbance during Construction

The construction work in the densely populated residential area such as channel improvement will cause temporary traffic disturbance due to the need for space for construction machinery, construction material yard, etc. To minimize such impact, efficient use of the limited space should be planned location by location, and appropriate detour routes and guidance should be prepared.

(4) Breeding of Mosquitoes in the Proposed Retention Ponds

The proposed retention ponds in the Ratmalana-Moratuwa scheme store water in non-flooding period to some extent. The stagnant water in the ponds would provide breeding sites for mosquitoes. To prevent the breeding of mosquitoes, biological control measures such as introducing fish species that feed on mosquito larvae should

be taken rather than the use of insecticide that may cause water pollution. In addition, water quality in the pond should be kept at appropriate level for the fish for the mosquito control by preventing both industrial and domestic wastewater from inflowing.

(5) Other Social Issues related to the Project

There are no other social issues to be expected related to the implementation of the proposed schemes such as any loss of production opportunity, losses and decreases in value of ruins and cultural assets, deterioration of sanitary conditions, or disturbance of regional society.

2.2.2 Natural Environment

(1) Bellanwila-Attidiya Wildlife Sanctuary

Under the proposed Weras Ganga and Bolgoda Canal Schemes, Bellanwila-Attidiya marsh area is designated as a storm water retention area. To secure the retention area, it is recommended that all lands for the retention area be acquired. The delineation of the retention area is conducted under real situation of the area because some of the marsh area is already used as residential area and some is already reclaimed for use even within the Sanctuary area. By delineating the retention area, the majority of the Sanctuary will be secured except for the area at the right bank of Bolgoda Canal and Weras Ganga from the Elawella road to downstream including the proposed runway expansion project site of the Ratmalana airport.

Specific measures will not be undertaken in the retention area except for the construction of the peripheral channel and pathway along the boundary of the retention area. This should prevent any development pressure although there is a possibility of a change of water regime of the canal passing through the retention area by implementation of the proposed schemes affecting natural conditions in the Sanctuary area.

Water level of the canal in the sanctuary in non-flood period by implementation of the proposed schemes will not be changed from present conditions of the water level. However, salinity level may be slightly increased by salt intrusion through the Weras Ganga due to dredging of the Weras Ganga and demolition of the gate on the Bolgoda Canal. It is highly probable that it will cause vegetation change mainly along the Weras Ganga and Bolgoda Canal. However, most of the vegetation in the Sanctuary would not be affected widely and drastically because most of the terrestrial vegetation area is not submerged in non-flood period. In addition, the dredging of the Weras Ganga and demolition of the salt intrusion gate should restore the sanctuary area to the natural condition that existed in the past.

Considering the present situation where appropriate management of the Sanctuary area is not initiated, it can be considered that acquisition of the land for use of retention area is one of best ways to conserve the area.

(2) Weras Ganga

The dredging work of the Weras Ganga would change the natural condition of the Weras Ganga to some extent by increasing the salinity level and removing the bottom sediment. These changes are not significant as compared to the case of the Bellanwila-Attidiya Wildlife Sanctuary. However, the change of natural conditions might affect fishery activity from midstream to downstream of the Weras Ganga though intensive fishery activity does not seem to be conducted at present.

2.2.3 Pollution

(1) Noise and Vibration during Construction

Existing canals and other structures subject to improvement by the proposed schemes mostly pass through residential area. Therefore, noise and vibration caused by construction machinery and equipment during construction would affect residents to some extent. To mitigate the impacts by noise and vibration, low-noise and low-vibration type generators and machinery should be used for the construction work. In addition, construction time should be limited to daytime in the residential area. Affected workers should be provided with appropriate protective equipment such as ear plugs.

(2) Emission Gas and Dust during Construction

Likewise, dust caused by construction machinery and equipment during construction would affect residents in some extent. Emission gas from construction machinery will be negligible in the local atmospheric condition. To mitigate the impacts by dust, sprinkling water in and around the construction site should be conducted during construction. In addition, affected workers should be provided with appropriate protective equipment such as dust-resistant masks.

(3) Wastewater Pertain to the Construction Activities

No specific construction method or machinery discharging wastewater is used during construction. However, temporary toilets should be installed for construction workers at construction sites.

(4) Disposal of Construction Wastes

Dredging of the Bolgoda canal and Weras Ganga is conducted under the proposed schemes at around 140,000 m³ under estimation. In addition, bottom sediment will be excavated at channel improvement section in some volume. The dredged/excavated

bottom sediment contains organic matter and water. Offensive odor is expected if the dredged material is disposed of by open dumping without any measures. Therefore, as soon as bottom sediment is dredged, it should be transported to designated temporary dumping site or final disposal site located a certain distance from residential area.

Two disposal sites for the dredged materials are proposed in the feasibility study area from viewpoints of minimization of impact to residential areas by offensive odor as shown in Figure 2.2.1. One disposal site is located in the proposed land filling site for the airport runway expansion at the right bank of the Weras Ganga near the airport. Land area for the disposal site will be 36 ha at maximum. It is planned that 80,000m³ of the dredged materials and 280,000 m³ of the surplus soil from the construction can be deposited. The disposal site is located at least 100 m away from nearest residential area to minimize impact by offensive odor. Another disposal site is located at the lowest reach of the Maha Ela. Land area for the disposal site will be 6 ha at maximum with 60,000 m³ capacity for the dredged material. This site is located in part of proposed retention area. Therefore, shallow filling at most 1 m is planned.

For surplus soil apart from the dredged bottom sediment, there is probably demand for use to fill lowland developed area. There is no other waste for which special disposal measure is required. Most of construction waste such as cement bag would be disposed as general waste.

(5) Removal and Utilization of the Aquatic Weed

In many places in the canals, especially those within the marshland such as the Bolgoda canal, floating, submerged and bottom-rooted vegetation exists. The majority of free-floating plants are Water Hyacinth *Eichornia crassipes* (Japan-jabara), *Saleinia molesta*, and *Monochoria vaginalis*. The submerged and bottom-rooted plants include *Cabomba* sp., *Hydrilla verticillata* and *Nymphaea lotus* (Olu) as the common vegetation profiles to be found. Extraordinary growth of these aquatic weeds caused by the water quality deterioration in the canal blocks storm water passage in many places of the canals.

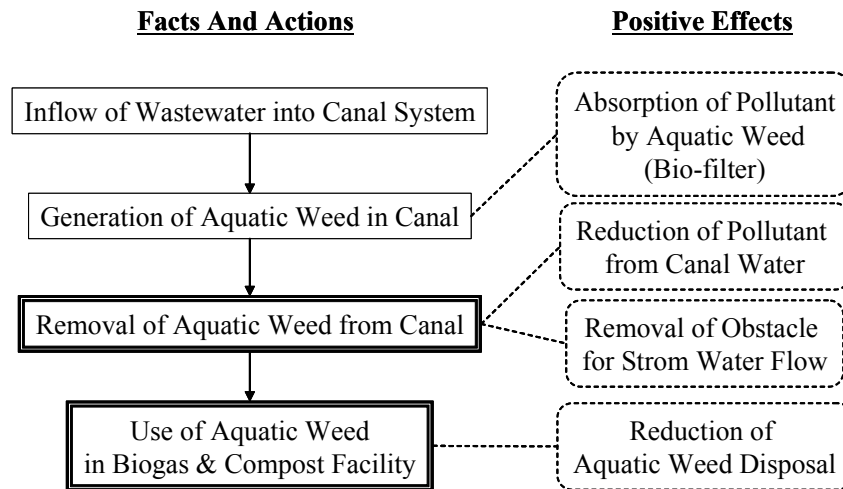
However, there is a positive effect of the aquatic weed existing in the canal system attributed to bio-filter function of the aquatic weed that absorbs nutrient salts in the canal water with nitrogen and phosphorus. To use this function effectively, regular removal activity and appropriate disposal of the aquatic weed are important.

As an alternative to the removal of aquatic weed instead of the direct disposal in the construction and operational stages, anaerobic digestion of waste for energy recovery in the form of methane (biogas) and production of digested organic residue for

compost has been initiated by the National Engineering Research Development Center (NERD) using a dry batch reactor system. Feedstock is the source separated green and market waste. On average, 1m³ of methane is produced per ton of waste per day over the 4-month digestion cycle in the experimental plant of NERD.

Ja Ela PS is now constructing a biogas & composting facility with 16 biogas generators of 40 tons capacity per generator in 42 perches land¹ along the Hamilton Canal under supervision of NERD. Feedstock for the facility is mainly market waste and green waste including aquatic weed from canals which will be collected from Ja Ela PS and surrounding municipalities. The facility starts its operation from this middle of November. After NERD operates the facility for the first year, Ja Ela PS will take over its operation and maintenance work as primal management organization. The facility might be useful example for application to this project.

Under the present condition that canal water quality has deteriorated, removal of the aquatic weeds would be a more positive solution for water quality improvement as well as storm water drainage improvement. Positive effects related to the aquatic weeds with necessary actions is summarized as shown below.



Concept Flow of Aquatic Weed Management

2.3 Environmental Management and Monitoring Plan

In the construction and operational stages of the proposed schemes, environmental mitigation measures mentioned above should be appropriately implemented. A prime responsible agency for the environmental management is SLLRDC though the environmental mitigation measures are implemented by contractors, local authorities,

¹ 42 perches equal approximately 1,050 m².

and/or relevant agencies. To confirm the effectiveness of the mitigation measures, compliance of the environmental requirement and any environmental incidentals, environmental monitoring should be conducted by relevant agencies and SLLRDC.

Monitoring methods on conceivable environmental impacts discussed above are shown in the following table.

Environmental Monitoring and Methods

Impact Items	Monitoring Items	Monitoring Method	Project Period/Frequency
1. Resettlement	- Payment of compensation - Implementation of resettlement assistance - Livelihood recovery - Living condition - Sanitary condition - Grievance	- Household survey	Before resettlement: 1 time After resettlement: once a year for three years
2. Temporary traffic disturbance during construction	- Implementation of planned mitigation measure - Grievance	- Inquiry survey to residents living near construction site	Once during construction in each construction site
3. Breeding place for mosquitoes in the proposed retention ponds	- Breeding of the mosquito larvae	- Periodical observation in the ponds	One a month after operation start
4. Flora & fauna in the Bellanwila-Attidiya Sanctuary	- Existing species - Distributions of the species	- Field survey	Before construction: 1 time After operation: to be discussed based on the first survey
5. Emission gas & dust during construction	- Implementation of planned mitigation measure - Grievance	- Inquiry survey to residents living near construction site	Once during construction in each construction site
6. Noise & vibration during construction	- Implementation of planned mitigation measure - Grievance	- Inquiry survey to residents living near construction site	Once during construction in each construction site
7. Offensive odor by disposal dredged materials	- Implementation of planned mitigation measure - Grievance	- Field inspection - Inquiry survey to residents living near disposal site	After operation of the disposal site starts: once half a year for three years

2.4 Requirements for EIA Approval

The proposed project will be subject to the EIA approval under the Gazettes No.772/22 of 24th June 1993 and No.859/14 of 23rd February 1995 since more than 100 households have to be relocated by the project. As the first step of the EIA procedure, preliminary information on the project should be submitted by SLLRDC to CEA. The form of project preliminary information would be fulfilled based on this F/S report.

After the project preliminary information is reviewed by CEA within 6 days after the submission, CEA decides whether the project is subject to the IEE or EIA. Then a Terms of Reference for the IEE or EIA is set by CEA in 14 days or 30 days respectively.

Tables

Table 1.2.1 Results of Water Quality Test

Sampling Location	Water Quality Parameter												
	Water Temperature (°C)	Approximate Water Flow (m ³ /s)	pH	Color (Hazen Units)	Dissolved Oxygen (mg/l)	Conductivity (µs/cm)	Total Suspended Solids (mg/l)	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	NH ₄ -N (mg/l)	Total Nitrogen (mg/l)	Total Phosphorus (mg/l)	Total Coliform (MPN/100ml)
L1	29.8	13.7	7.4	10	5.0	35,800	15.5	20.0	33.3	0.33	3.8	<0.010	130
	29.5	15.0	7.9	10	5.6	50,300	12.8	29.5	220.0	0.25	5.0	0.015	170
L2	27.7	S/G	6.4	20	0.9	1,234	6.2	22.0	33.3	*4.00	6.7	0.004	170
	30.7	S/G	6.4	30	1.2	7,000	7.2	27.5	67.2	*2.67	7.6	0.200	340
L3	30.4	S/G	11.7	-	-	25,700	59.6	200.0	615.7	-	6.3	0.166	40
	31.4	S/G	11.2	-	-	1,401	35.8	110.0	460.0	-	6.2	0.723	300
L4	29.6	2.3	6.7	20	4.9	3,900	2.9	16.5	58.8	0.17	4.1	0.002	220
	32.5	2.0	6.7	10	5.2	2,200	2.5	43.0	106.4	0.17	3.8	0.018	800
L5	22.0	S/G	5.9	120	2.1	2,900	2.4	11.5	16.3	0.17	3.8	0.001	300
	34.0	S/G	6.8	100	3.1	14,500	2.7	58.0	121.6	0.25	3.6	0.010	800
L6	28.5	S/G	4.6	70	0.4	885	23.4	610.0	1,159.2	0.84	8.3	0.011	24,000
	32.0	S/G	5.5	90	0.9	794	19.6	74.0	326.4	1.00	8.2	0.026	35,000
L7	31.2	S/G	6.5	20	0.8	1,710	8.7	145.0	407.7	*>5.0	5.9	0.011	17,000
	34.8	S/G	6.6	20	1.6	1,420	9.9	215.0	258.4	*>5.0	8.2	0.063	90,000
L8	28.5	S/G	6.6	15	1.1	3,300	2.7	85.0	141.4	*2.2	6.5	0.028	220
	35.2	S/G	6.5	20	4.2	3,400	3.1	95.0	281.2	*2.0	11.5	0.027	500
L9	28.1	S/G	6.5	50	0.8	964	12.3	64.5	109.2	*4.3	9.3	0.030	800
	33.2	S/G	6.5	60	1.3	1,094	13.8	23.0	28.8	*4.3	8.0	0.012	800
L10	24.3	S/G	7.1	40	2.9	1,821	9.0	42.5	57.1	*3.7	3.2	0.016	10,000
	33.9	S/G	7.7	40	1.1	1,618	6.2	90.0	182.4	*3.3	5.6	0.020	900
L11	30.7	0.5	6.3	100	1.9	1,497	13.5	90.0	158.1	*3.3	7.0	0.071	130
	31.9	0.5	6.5	70	2.3	1,325	11.3	105.0	136.8	*3.3	4.7	0.015	800
L12	29.7	0.4	6.6	15	0.8	1,234	3.8	71.5	117.6	*3.0	5.0	0.085	10,000
	32.4	0.5	6.6	20	4.8	902	19.8	95.0	136.8	*3.0	4.4	0.020	14,000

Note: Values in the upper and lower row are data sampled on 15 August 2002 (except for sampling Nos.L5 and L10 on 21 August 2002) in dry weather and 6 September 2002 in the day rained on previous day, respectively.

S/G – Stagnant flow

* - Determined after dilution (maximum measurable NH₄⁺ value (without dilution): 1.67 mg/l)

Table 1.2.2 Results of Bottom Sediment Quality Test

(Unit: mg/kg dry weight)

Sampling Location	Sediment Quality Parameter															
	Cr	Cd	Cu	Ni	Pb	Fe	Co	Ag	Al	Mn	Mg	Na	K	Sulphates (% of dry weight)	Chlorides (% of dry weight)	Organic Content (% of dry weight)
L1	32.9	3.8	38.4	<u>63.6</u>	48.0	>40,000	24.9	7.7	33,030	231.8	8,352	3,954	2,608	0.27	0.35	10.7
L2	27.0	3.4	77.3	32.7	54.7	35,764	9.1	8.7	7,656	72.9	75,276	3,030	2,248	0.28	0.06	5.1
L3	41.5	2.3	11.5	19.8	41.7	14,936	2.8	6.9	1,704	59.9	36,408	882	756	0.04	0.04	0.5
L4	33.4	3.9	36.7	<u>82.9</u>	50.6	>40,000	16.7	5.7	12,884	66.1	78,148	1,756	2,796	0.13	0.07	10.9
L5	22.1	3.7	26.3	<u>75.3</u>	53.6	38,620	14.3	5.7	1,974	81.6	5,452	2,100	2,820	0.50	0.09	15.3
L6	15.2	3.3	11.7	34.2	36.5	14,252	N/D	5.8	48,736	80.9	25,728	492	1,420	0.02	0.02	3.8
L7	42.1	3.4	40.8	<u>78.6</u>	29.5	40,000	N/D	7.7	111,836	202.7	46,348	848	2,264	0.06	0.06	4.9
L8	41.7	3.1	42.2	<u>57.7</u>	53.9	40,000	10.6	6.6	106,296	299.6	49,868	1,696	2,648	0.08	0.09	7.2
L9	44.4	3.6	44.1	<u>61.3</u>	46.4	34,656	13.9	7.3	13,772	191.5	47,804	868	2,384	0.04	0.05	7.5
L10	35.7	3.6	22.8	<u>55.7</u>	60.1	13,880	9.8	7.7	1,578	125.9	47,264	568	2,940	0.01	0.09	1.7
L11	67.0	4.2	25.8	33.4	61.4	>40,000	6.7	5.8	987	288.9	76,412	532	2,804	0.03	0.05	5.0
L12	41.9	4.2	35.2	40.2	90.7	36,372	8.3	6.1	-	149.5	49,272	1,540	2,228	0.09	0.31	11.4
N*	380.0	7.5	90.0	45.0	530.0	-	-	-	-	-	-	-	-	-	-	-

Note: N/D- Below the detection limit.

Underlined values mean exceeding the sediment quality limit as test level which is the practical limit below which the sediment is considered to be mildly polluted under the sediment quality classification system of the Port of Rotterdam in Netherlands.

*: Test level in the Netherlands standard mentioned above.

Table 2.1.1 Environmental Screening and Scoping for Weras Ganga Scheme

Environmental Items		Screening	Scoping		
		Possibility of Impacts	Extent of Impacts	Reasons	
Social Environment	1	Resettlement	Yes	A	Land acquisition for construction of flood protection wall is necessary.
	2	Economic activity	Yes	E	Reduction of flood damage bring about positive impact to economic activity in the project area.
	3	Transportation and public facilities	Yes	B	Temporary traffic disturbance may occur during construction.
	4	Region dividing into parts	No	D	There is no such structure to be developed
	5	Ruins and cultural asset	No	D	There is no relevant factor.
	6	Water use right and commonage	No	D	There is no such water user.
	7	Sanitation	Yes	B	Retention area can be breeding place for mosquitoes.
	8	Waste	Yes	B	Dredged material and construction residue are disposed.
	9	Disaster (risk)	Yes	E	Main purpose of project is reduction of disaster by storm water drainage improvement.
Natural Environment	10	Topography and geology	No	D	There is no important topographical and geological sites to be protected.
	11	Soil erosion	No	D	There is no relevant factor.
	12	Ground water	No	D	There is no relevant factor.
	13	Lakes and marshes, and river regime	Yes	B	River regime will be changed at Weras Ganga.
	14	Coastal and sea area	No	D	There is no relevant factor.
	15	Flora and fauna	Yes	B	Part of the project site is located in Bellanwila-Attidiya Wildlife Sanctuary.
	16	Meteorology	No	D	There is no relevant factor.
17	Landscape	Yes	D	There is no precious landscape to be protected in the project area.	
Pollution	18	Air pollution	Yes	B	Local air pollution by emission gas from construction vehicle and equipment and dust occur during construction.
	19	Water pollution	Yes	B	Temporary degradation of water quality occurs during dredging work.
	20	Soil pollution	No	D	There is no relevant factor.
	21	Noise and vibration	Yes	B	Noise and vibration by construction vehicle and equipment occurs during construction.
	22	Subsidence	No	D	There is no relevant factor.
	23	Offensive odor	Yes	B	Dredged material and construction residue are disposed.
Overall Evaluation: - Necessity of IEE or EIA		Necessary	-	-	-

Note: This checklist was prepared based on the JICA Environment Guidelines for Development Study.

Extent of Impacts:

- A: Significant negative impact is expected. B: Negative impact is expected in some extent.
 C: Impact is unknown. Study is necessary. D: Little negative impact is expected.
 E: Positive impact is expected.

Table 2.1.2 Environmental Screening and Scoping for Bolgoda Canal Scheme

Environmental Items		Screening	Scoping		
		Possibility of Impacts	Extent of Impacts	Reasons	
Social Environment	1	Resettlement	Yes	A	Land acquisition for channel improvement is necessary.
	2	Economic activity	Yes	E	Reduction of flood damage bring about positive impact to economic activity in the project area.
	3	Transportation and public facilities	Yes	B	Temporary traffic disturbance may occur during construction.
	4	Region dividing into parts	No	D	There is no such structure to be developed
	5	Ruins and cultural asset	No	D	There is no such assets in the project area.
	6	Water use right and commonage	No	D	There is no such water user.
	7	Sanitation	Yes	B	Retention area can be breeding place for mosquitoes.
	8	Waste	Yes	B	Dredged material and construction residue are disposed.
	9	Disaster (risk)	Yes	E	Main purpose of project is reduction of disaster by storm water drainage improvement.
Natural Environment	10	Topography and geology	No	D	There is no important topographical and geological sites to be protected.
	11	Soil erosion	No	D	There is no relevant factor.
	12	Ground water	No	D	There is no relevant factor.
	13	Lakes and marshes, and river regime	Yes	B	River regime will be changed at Weras Ganga.
	14	Coastal and sea area	No	D	There is no relevant factor.
	15	Flora and fauna	Yes	B	Bellanwila-Attidiya Wildlife Sanctuary is utilized as retention area.
	16	Meteorology	No	D	There is no relevant factor.
17	Landscape	Yes	D	There is no precious landscape to be protected in the project area.	
Pollution	18	Air pollution	Yes	B	Local air pollution by emission gas from construction vehicle and equipment and dust occur during construction.
	19	Water pollution	Yes	B	Temporary degradation of water quality occurs during dredging work. Seawater intrusion occur by dredging work as past
	20	Soil pollution	No	D	There is no relevant factor.
	21	Noise and vibration	Yes	B	Noise and vibration by construction vehicle and equipment occurs during construction.
	22	Subsidence	No	D	There is no relevant factor.
	23	Offensive odor	Yes	B	Dredged material and construction residue are disposed.
Overall Evaluation: - Necessity of IEE or EIA		Necessary	-	-	

Note: This checklist was prepared based on the JICA Environment Guidelines for Development Study.

Extent of Impacts:

- A: Significant negative impact is expected. B: Negative impact is expected in some extent.
 C: Impact is unknown. Study is necessary. D: Little negative impact is expected.
 E: Positive impact is expected.

Table 2.1.3 Environmental Screening and Scoping for Nugegoda-Rattapitiya Scheme

Environmental Items		Screening	Scoping		
		Possibility of Impacts	Extent of Impacts	Reasons	
Social Environment	1	Resettlement	Yes	A	Land acquisition for channel improvement is necessary.
	2	Economic activity	Yes	E	Reduction of flood damage bring about positive impact to economic activity in the project area.
	3	Transportation and public facilities	Yes	B	Temporary traffic disturbance may occur during construction. There is a community hall to be relocated for land acquisition
	4	Region dividing into parts	No	D	There is no such structure to be developed
	5	Ruins and cultural asset	No	D	There is no relevant factor.
	6	Water use right and commonage	No	D	There is no such water user.
	7	Sanitation	No	D	There is no relevant factor.
	8	Waste	Yes	B	Dredged material and construction residue are disposed.
	9	Disaster (risk)	Yes	E	Main purpose of project is reduction of disaster by storm water drainage improvement.
Natural Environment	10	Topography and geology	No	D	There is no important topographical and geological sites to be protected.
	11	Soil erosion	No	D	There is no relevant factor.
	12	Ground water	No	D	There is no relevant factor.
	13	Lakes and marshes, and river regime	Yes	B	River regime will be changed at Weras Ganga.
	14	Coastal and sea area	No	D	There is no relevant factor.
	15	Flora and fauna	No	D	There is no protected area for flora and fauna.
	16	Meteorology	No	D	There is no relevant factor.
	17	Landscape	Yes	D	There is no precious landscape to be protected in the project area.
Pollution	18	Air pollution	Yes	B	Local air pollution by emission gas from construction vehicle and equipment and dust occur during construction.
	19	Water pollution	No	D	There is no factor causing water pollution.
	20	Soil pollution	No	D	There is no relevant factor.
	21	Noise and vibration	Yes	B	Noise and vibration by construction vehicle and equipment occurs during construction.
	22	Subsidence	No	D	There is no relevant factor.
	23	Offensive odor	Yes	B	Dredged material and construction residue are disposed.
Overall Evaluation: - Necessity of IEE or EIA		Necessary	-	-	

Note: This checklist was prepared based on the JICA Environment Guidelines for Development Study.

Extent of Impacts:

- A: Significant negative impact is expected. B: Negative impact is expected in some extent.
 C: Impact is unknown. Study is necessary. D: Little negative impact is expected.
 E: Positive impact is expected.

Table 2.1.4 Environmental Screening and Scoping for Ratmalana-Moratuwa Scheme

Environmental Items		Screening	Scoping		
		Possibility of Impacts	Extent of Impacts	Reasons	
Social Environment	1	Resettlement	Yes	A	Land acquisition for channel improvement is necessary.
	2	Economic activity	Yes	E	Reduction of flood damage bring about positive impact to economic activity in the project area.
	3	Transportation and public facilities	Yes	B	Temporary traffic disturbance may occur during construction.
	4	Region dividing into parts	No	D	There is no such structure to be developed
	5	Ruins and cultural asset	No	D	There is no such assets in the project area.
	6	Water use right and commonage	No	D	There is no such water user.
	7	Sanitation	Yes	B	Retention ponds can be breeding place for mosquitoes.
	8	Waste	Yes	B	Dredged material and construction residue are disposed.
	9	Disaster (risk)	Yes	E	Main purpose of project is reduction of disaster by storm water drainage improvement.
Natural Environment	10	Topography and geology	No	D	There is no important topographical and geological sites to be protected.
	11	Soil erosion	No	D	There is no relevant factor.
	12	Ground water	No	D	There is no relevant factor.
	13	Lakes and marshes, and river regime	Yes	B	River regime will be changed at Weras Ganga.
	14	Coastal and sea area	No	D	There is no relevant factor.
	15	Flora and fauna	No	D	There is no protected area for flora and fauna.
	16	Meteorology	No	D	There is no relevant factor.
	17	Landscape	Yes	D	There is no precious landscape to be protected in the project area.
Pollution	18	Air pollution	Yes	B	Local air pollution by emission gas from construction vehicle and equipment and dust occur during construction.
	19	Water pollution	No	D	There is no factor causing water pollution.
	20	Soil pollution	No	D	There is no relevant factor.
	21	Noise and vibration	Yes	B	Noise and vibration by construction vehicle and equipment occurs during construction.
	22	Subsidence	No	D	There is no relevant factor.
	23	Offensive odor	Yes	B	Dredged material and construction residue are disposed.
Overall Evaluation: - Necessity of IEE or EIA		Necessary	-	-	

Note: This checklist was prepared based on the JICA Environment Guidelines for Development Study.

Extent of Impacts:

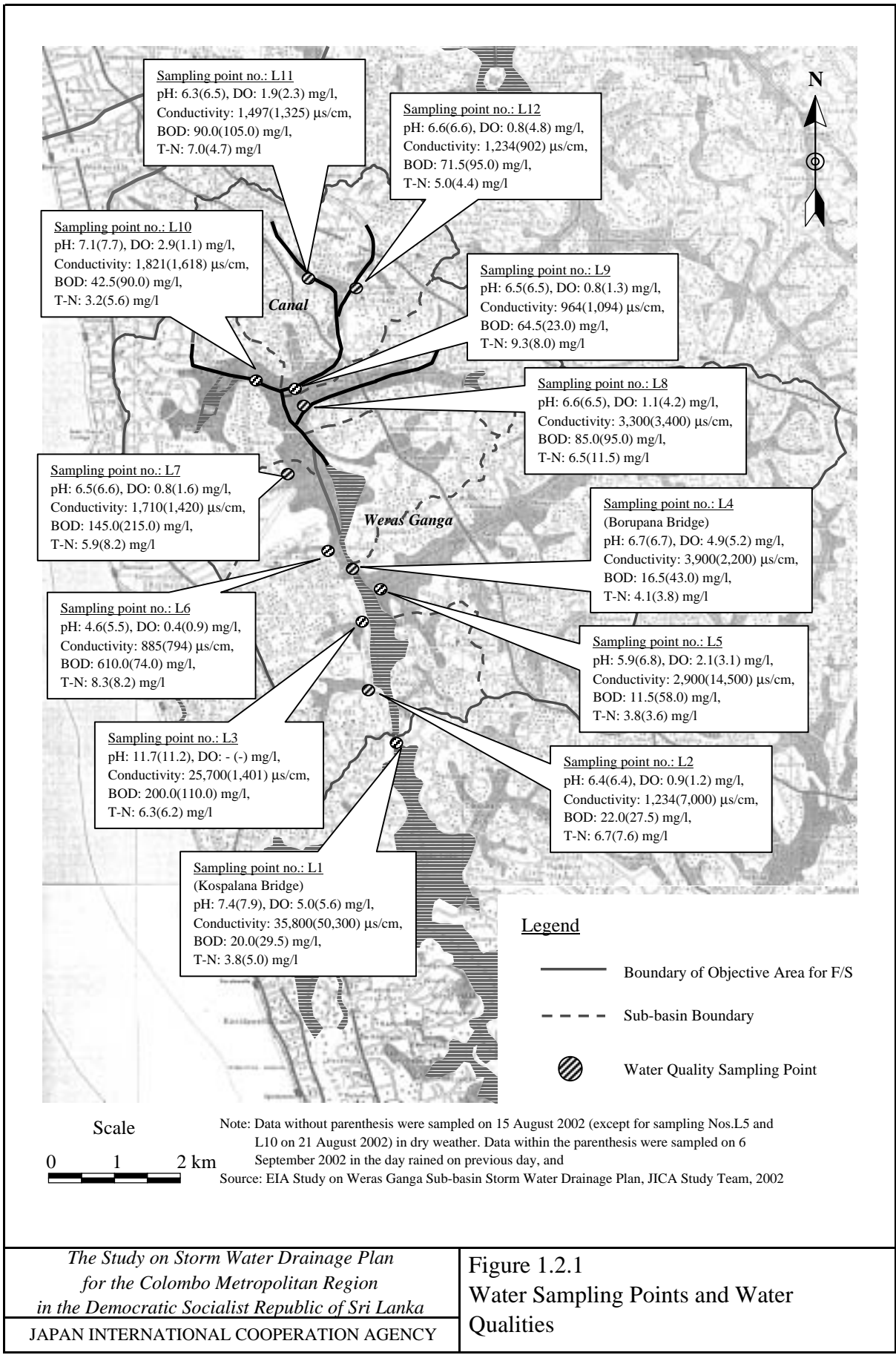
- A: Significant negative impact is expected. B: Negative impact is expected in some extent.
 C: Impact is unknown. Study is necessary. D: Little negative impact is expected.
 E: Positive impact is expected.

Table 2.1.5 Potential Environmental Impacts by Project Components of the Proposed Schemes

Potential Environmental Impacts	Resettlement by land acquisition	Relocation of public facilities	Temporary traffic disturbance during construction	Breeding places for mosquitoes	Flora & fauna in the protected area	Emission gas and dust during construction	Noise and vibration during construction	Offensive odor by disposal of dredged material
1. Weras Ganga Scheme								
(1)Dredging of Weras Ganga riverbed - Widening and deepening of the existing earth canal - Replacement of the Borupana bridge	-	-	X	-	X	X	X	X
(2)Construction of flood protection wall with flap gate	XX	X	X	-	-	X	X	-
(3)Conservation of retention areas(Weras Ganga swamp and Maha Ela retention areas) - Construction of peripheral channel and path way	-	-	-	X	X	X	X	-
2. Bolgoda Canal Scheme								
(1) Dredging and channel improvement of Bolgoda Canal - Widening and deepening of the existing earth canal - Embankment and construction of O&M road - Replacement of bridge	XX	-	X	-	X	X	X	X
(2)Conservation of a retention area (Bellanwila-Attidiya retention area) - Construction of peripheral channel and path way	-	-	-	X	X	X	X	-
3. Nugegoda-Rattanaipitiya Scheme								
(1)Channel improvement of Rattanaipitiya Ela, Delkanta Ela and Nugegoda Ela - Widening and deepening of the existing canal - Bank protection of the existing earth canal with gabion - Construction of concrete open channel - Embankment and construction of O&M road - Replacement of bridge and cross culvert	XX	X	X	-	-	X	X	X
(2) Conservation of three retention areas - Construction of peripheral channel and path way	-	-	-	X	X	X	X	-
4. Ratmalana-Moratuwa Scheme								
(1)Improvement of urban drainage system in Ratmalana-Moratuwa area - Widening and deepening of the existing canal - Bank protection of the existing earth canal with gabion - Construction of concrete open channel and concrete flume with cover slab - Construction of underground pipes and culverts	-	-	X	-	-	X	X	X
(2) Construction of retention ponds(Kandawala pond and Telewala pond)	XX	-	-	X	-	X	X	-

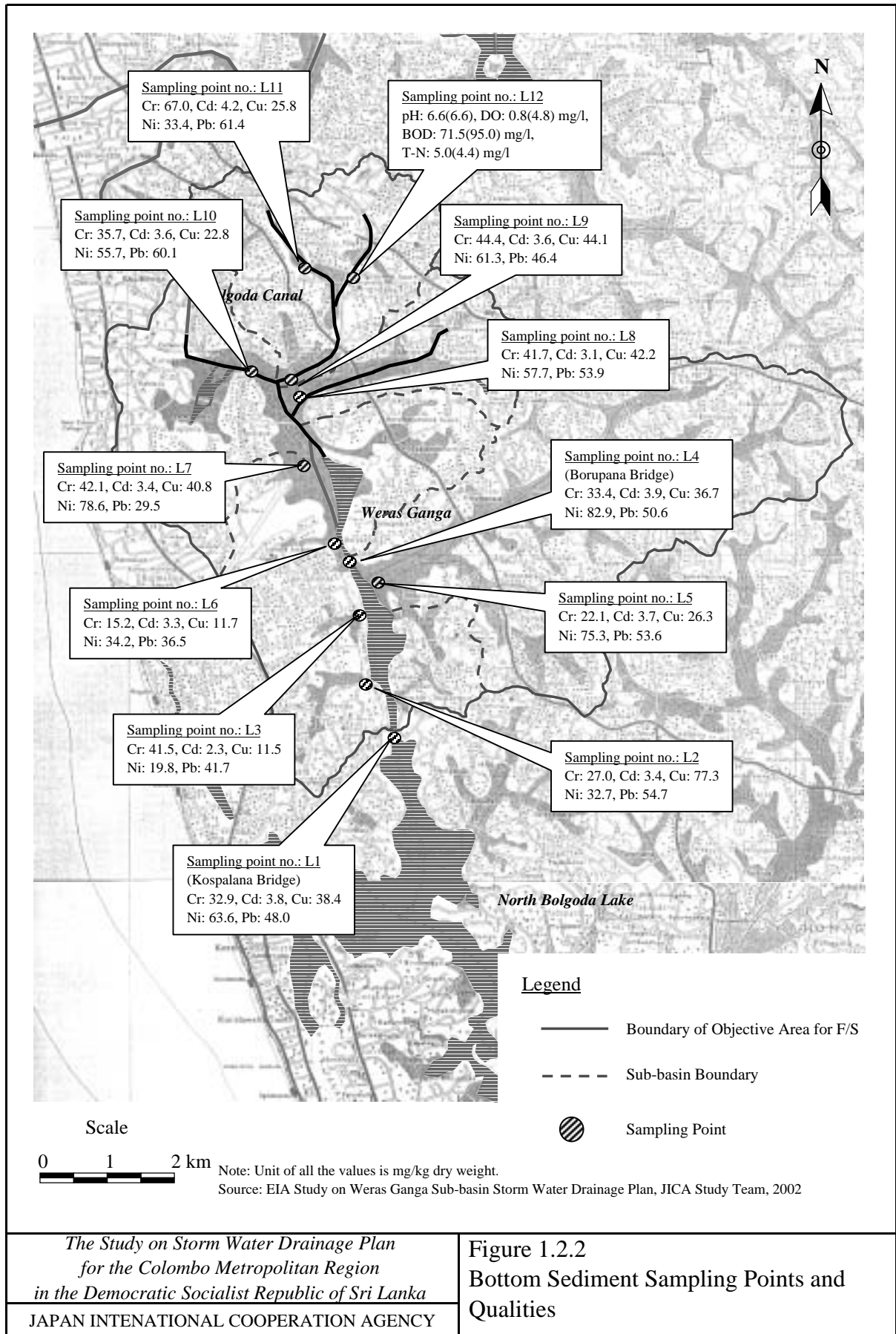
Note: XX: Potential negative impact with significance, X: Potential negative impact in some extent, -: no impact

Figures



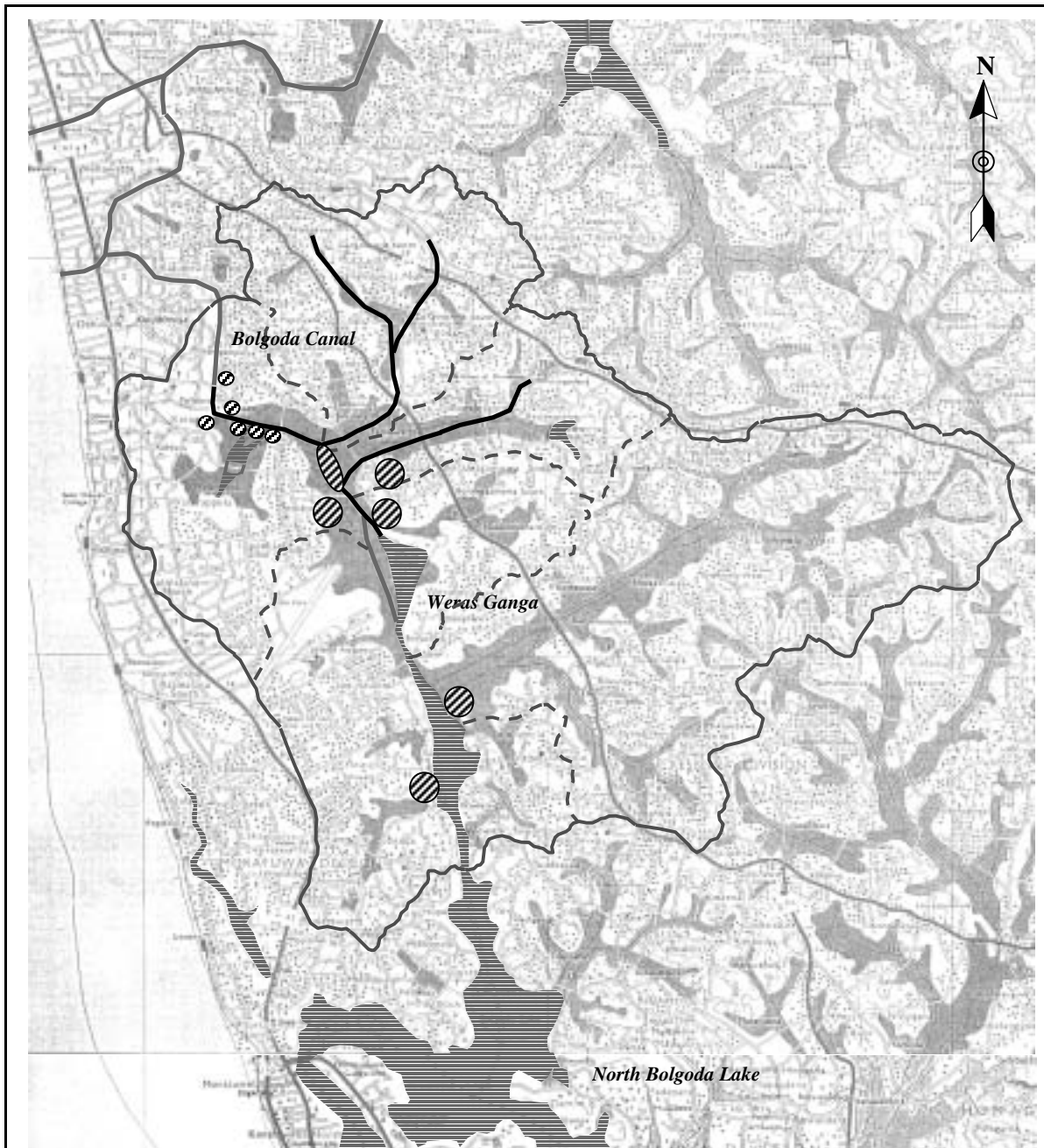
The Study on Storm Water Drainage Plan
 for the Colombo Metropolitan Region
 in the Democratic Socialist Republic of Sri Lanka
 JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 1.2.1
 Water Sampling Points and Water
 Qualities



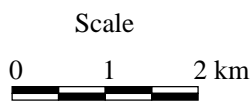
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Figure 1.2.2
Bottom Sediment Sampling Points and Qualities



Legend

- Boundary of Objective Area for F/S
- - - - Sub-basin Boundary
- ⊗ Existing Solid Waste Dumping Site



Source: EIA Study on Weras Ganga Sub-basin Storm Water Drainage Plan, JICA Study Team, 2002

<p><i>The Study on Storm Water Drainage Plan for the Colombo Metropolitan Region in the Democratic Socialist Republic of Sri Lanka</i></p>	<p>Figure 1.2.3 Existing Solid Waste Dumping Sites</p>
<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	

