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SRI LANKA

MINISTRY OF TRANSPORT AND HIGHWAYS
MINISTRY OF FINANCE AND PLANING

COLOMBO-KATUNAYAKE EXPRESSWAY PROJECT

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Detailed Hydrological Study of Colombo – Katunayake Expressway

Final Report

Engineering Consultants Limited - May 1999

(Interim Report replaced by Final Report, refer Addendum No. 04)

BETWEEN
ROAD DEVELOPMENT AUTHORITY OF SRI LANKA

AND
DAEWOO – KEANGNAM JOINT VENTURE
REPUBLIC OF SOUTH KOREA

ROAD DEVELOPMENT AUTHORITY

DETAILED HYDROLOGIC STUDY OF THE PROPOSED COLOMBO KATUNAYAKE EXPRESSWAY PROJECT

FINAL REPORT

Submitted By

Engineering Consultants Limited

No. 1098, Sri Jayawardenapura Mawatha,
Welikada,
Rajagiriya.

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FINAL REPORT

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EXECUTIVE SUMMARY

DESCRIPTION OF CKE TRACE AND CATCHMENTS INTERCEPTED

The proposed trace commencing from the left bank of Kelani Ganga, crosses Kelani Ganga and runs in a northerly direction intercepting the catchments of Mudun Ela, Kalu Oya, Uruwal Oya (Ja-Ela), Dadugam Oya and the micro catchments intervening these basins. Of the above, Mudun Ela and Kalu Oya are right bank tributaries of Kelani Ganga, while Dandugam Oya and Ja-Ela drain into the Negombo Lagoon. The micro catchments drain directly into Muthurajawela marsh.

The proposed trace at its furthest point is about 3.5km from the sea and is essentially located within the flood plains extending from Kelani Ganga to the Negombo Lagoon. The catchment areas of these drainage basins are as follows:

	Catchment Area in sq. km	
Basin	At A3	At CKE
Dandugam Oya	587	589
Ja-Ela	183	183
Kalu Oya	54	52.5
Mudun Ela	8.2	5.9
Micro Catchments (6 No.)	-	13.5

Figure 1.1 (in the docket) shows the trace of the CKE, the existing A3 Highway and the catchments intercepted.

Rainfall Analyses

Due to the absence of reliable flow data within these basins, flood hydrographs have to be developed applying Mathematical Models using available rainfall data and other catchment parameters. The daily rainfall records were collected from different sources for ten rainfall stations in and around the project area. (Please sees Fig. 3.1)

The project area is located in the Hydrological Region III, which covers the North Western part of Sri Lanka. Available rainfall intensity studies are based on Katunayake and Colombo rain gauges and therefore more site-specific analysis was carried out for this study. Daily rainfall data at Vincit Estate and Katunayake rain gauges for the most recent 30 years were collected to carry out a fresh intensity analysis and these Depth Duration Curves [DDC] are shown in Figures 3.2 and 3.3. These two DDCc were used in addition to the DDC for Colombo, which is shown in Figure 3.4. Table 3.2 shows the results of this rainfall intensity analysis. For Katunayake and Vincit, analysis was done for a duration of 5 days. For the frequency analysis, Extreme Probability Type I distribution [Gumbel] was adopted.

For Dandugam Oya basin, rainfall intensity analysis of both Vincit and Katunayake were used. For Ja-Ela only Katunayake rainfall was used as the catchment is mostly coastal. For Kalu Oya, rainfall intensity for Colombo was used. For all these stations, rainfall corresponding to 50, 100 and 200 year return periods were used as design storms. 05-day durations for the design storms were considered for both Dandugam Oya and Ja Ela and 04 day storm was considered for Kalu Oya as the catchment is smaller. By extracting the intensities from the DDCc of three rain gauges, 50, 100 and 200 year storms were developed for 03 hour time resolutions. For the design of storms the standard procedure in storm designs by the application of unit hydrographs technique was adopted.

Mathematical models use rainfall information and the catchment characteristics to develop a Flood Hydrograph. There are many mathematical models for river flow simulation but some of these models require very extensive field data, collection of which is time consuming. Considering the time frame of this study, only limited field data could be collected and therefore the consultants decided to use two different models to assure the designer that the results obtained by applying both models are varying within acceptable limits.

Model 1 - SCS Model

This model was used in the Interim Report and was developed by the USDA Soil Conservation Services [SCS] in 1955. It is applicable from small to medium sized watersheds. Figure 5.1 is a Schematic Diagram for Development of Inflow Hydrographs by the SCS Model Method.

Model 2 - HEC 1 Model

This model consists of two modules namely: the rainfall-runoff relationship and reservoir routing. Developed by the US Army Corps of engineers this model is also adopted widely in the United States and other countries. Figure 5.2 is a Schematic Diagram for the development of Inflow Hydrographs by the HEC 1 Model Method.

Flood Routing of Major Catchments

Routed flood hydrographs were developed for Dandugam Oya, Ja Ela and Kalu Oya catchments for Return Periods of 50, 100 and 200 years, using the Storm Rainfalls Computed from Depth-Duration-Frequency Curves and the Catchment Parameters. Figures 5.3 to 5.11 consisting of 09 No. printouts show these flood hydrographs. Each printout indicates the Inflow Hydrograph and the Outflow Hydrograph.

Minor Catchments

In the case of minor catchments an empirical formula was used to estimate flood peaks.

HYDRAULIC CONDITIONS DOWNSTREAM OF A3 AND CKE

The schematic in Fig.2.1 indicates the complex nature of the drainage network in the area traversed by the proposed CKE. Detail inspections and studies revealed that, for the purpose of this study the drainage pattern under storm conditions could be schematically represented as in Fig. 6.1.

Mudun Ela Catchment

CKE traverses mainly through marsh lands within this basin and the drainage system comprises of a network of interconnected channels covered with weeds.
The flood levels in the areas are dependent on the flood stage in Kelani River.
The high flood elevation corresponding to the 1947 flood is 2.5 m-MSL.

Kalu Oya Catchment

CKE intercepts the main Kalu Oya drainage line at three locations and also crosses 2 other tributaries. The terrain is mainly marshy land, the elevation of which is close to mean sea level. The flood elevation is dependent on the flood stage in Kelani Ganga and the observed HFL is about 2.5m - MSL.

Micro Catchments

Micro catchments between the catchments of Kalu Oya and Ja-Ela drain into Muthurajawela marsh. Under storm conditions, the backwaters of Negombo lagoon submerge the Muthurajawela marsh.

Ja-Ela Catchment

Ja Ela flows into Negombo Lagoon. Because of the canal embankments Ja-Ela does not give rise to overland flows in the marsh traversed by it. Water elevations in the canal are directly dependent on the water surface elevations of Negombo lagoon.

Dandugam Oya Catchment

The drainage waters flow into Negombo Lagoon through Dandugam Oya, an extrabutary and through channels taking off Mahadora Ela. Under flood conditions part of Dadugam Oya discharge drains into the lagoon as over land flow. Water elevations in Dandugam Oya are directly dependent on the water surface elevations of the lagoon.

Section of CKE traversing along and through a part of the lagoon

Where the CKE trace runs along the lagoon only minor drainages are intercepted and drainage crossings need be provided to cater to these discharges.

The part of CKE passing through the lagoon will isolate hydraulically two areas of the lagoon. Adequate openings on the roadway are required to provide for interchange of water between these areas and the main lagoon.

HYDRAULIC DESIGN OF DRAINAGE CROSSINGS UNDER PROPOSED CKE

Methodology adopted in the hydraulic design of drainage crossings is set out below:

[a] Estimation of pre-project 100 year and 200 year flood levels at the proposed drainage -crossing site

[b] Estimation of available waterway area

[c] Estimation of flow velocity through the structure with the 100-year peak discharge

[d] Estimation of velocity of approach based on available sectional area of flow, hydraulic gradient and Mannings "n"

[e] Calculation of flood afflux (h) at the structure.

Estimation of Flood Levels

The high flood levels pertaining to Mudun Ela and Kalu Oya were estimated on the basis of historical flood elevations in and around the intersections with CKE. Flood elevations in and around Dandugam Oya, Ja-Ela and Muthurajawela marsh are dependent on Negombo lagoon. In order to estimate lagoon water surface elevations under flood conditions a mathematical model was developed with data obtained from site investigations.

Results Obtained from the Model

The maximum water surface elevations at the southern end of the lagoon caused by the 100-year and 200 year flood inflows are estimated at 0.776 m and1.002 m respectively.

Estimation of Flood Levels along CKE Trace

Methodology for the estimation of flood levels in Dandugam Oya, Ja-ela and the Muthurajawela marsh is presented in Figure 7.2.

Design of Major Drainage Crossings & Other Waterway Openings

The waterway areas required to limit the hundred year return period flood afflux to a maximum of 10 cm were computed using the peak value of flood hydrographs, channel sections, estimated velocities of natural channels. In the case of Ja Ela it is proposed to provide a bridge spanning the existing waterway and roads on either bank. Hence there is no change in pre project conditions. In the case of Dandugam Oya the bridge will span the Oya and the roads on either bank, but the overland flood flows which occurred in pre project conditions had to be routed through 2 No./15 m span bridges and a 10 m span bridge over existing drainage channels. The location, span, required waterways, HFL and other details are given in Table 7.2.

Impact of CKE on Flood Levels Upstream of A3

CKE will have no impact on the flood levels upstream of A3 excepting Mudun Ela where due to inadequate waterway area in the existing culverts along A3 a rise of 14 cm is anticipated in the 100 year flood level.

Validation of Road Embankment Levels

Embankment levels are to be determined on the basis of the following :

Hydraulic Considerations:

[1] 1.1 m above 100 year flood level

[2] 100 year flood level + wave height
[for reach of roadway within Negombo Lagoon and Muthurajawela marsh]

[3] 0.5 m above the 200 year flood level

Clearance and Alignment Considerations

[4] 100 year flood level + clearance for boats or traffic + deck thickness [in the case of bridges]

[5] Elevation to suit vertical alignment

Criteria (2) and (3) were found to be satisfied if criterion (1) is complied with.

Inventory of Drainage Crossings across A3

This is presented in Table 7.4.

IMPROVEMENTS TO DOWNSTREAM DRAINAGE SYSTEM TO MITIGATE THE IMPACT OF HIGH FLOODS

The proposed roadway is mainly confined to the flood plains of the river basins intercepted by it and the flood levels are directly dependent on the flood stages in Kelani Ganga or Negombo Lagoon. As such downstream flood elevations cannot be appreciably reduced using cost effective means. However in the case of Mudun Ela the flood discharge has to cross existing A3 mainly through two openings, one at 1 + 100 and the other at 2 + 150 (culvert no. 3/1). The effective waterway areas at these culverts are grossly inadequate and if the waterway area at culvert no. 3/1 is increased flood levels and flooding times can be reduced appreciably.

FLOODS MAPPED OUT AND FLOOD INUNDATION AREAS

This exercise involved much interaction between Consultant, Licensed Surveyor and the informants. The Consultants also had to ensure that the maximum flood levels indicated by any informant were cross-checked by further independent inquiries. They had also to ensure that the flood was caused by the natural build up of storm conditions and not by any disaster e.g. the May 1991 flood in the Dandugam Oya is always associated with an anicut/dam failure upstream in the Attanagalu Oya Irrigation Scheme. Hence, the flood level was the result of a sudden flood wave travelling downstream and not caused by a natural build up of storm conditions.

The following procedure was followed in mapping out at least one historical flood for each major catchment intercepted by the CKE:

- Field inquiries were made to ascertain the approximate date of a historical flood
- The maximum flood level observed at A3 on the upstream was noted. This flood level was converted to MSL by field levelling using the 25 No. Bench Marks set up along the CKE trace
- This flood contour was then traced on the ground so as to establish the inundated area upto a distance of about 02 km east of A3 [as an environmental requirement]
- Suitable cross sections were taken so that floods of other return periods [higher or lower] can be plotted too
- From the results of the Rainfall Analyses, the return period of the floods mapped out for each major catchment was estimated
- For Return Periods of 50, 100 and 200 years, the rainstorms for each catchment was extracted from the results of the Rainfall Analyses and the corresponding Flood Peak Levels were estimated using hydraulic principles
- The contours corresponding to the Flood Peak Levels for the 50, 100, and 200 year storms for each major catchment was plotted using the cross sections taken along the historical flood contour
- Maps on Scale 1:10,000 were prepared showing the flood contour of the historical flood as well as the flood contour of floods with Return Periods of 50, 100 and 200 year storms.

Basically the study revealed that the construction of the CKE does not increase the flood levels upstream of A3, significantly. Chapters 9 and 10 provide all the details.

ADDITIONAL FLOOD DETENTION AREAS TO MITIGATE THE IMPACT OF FLOODS

Detailed studies have shown that the waterway openings proposed in Section 7.3 will limit the rise in the post-project 100 year flood levels immediately upstream of CKE, to 05 cms excepting Mudun Ela catchment where the estimated rise is 15 cm. Even here the rise in flood levels could be limited to 05 cms with increase in the waterway at culvert No. 3/1 on A3. Therefore additional detention areas or other methods of lowering flood levels would not be required.

MONITORING SYSTEM RECOMMENDED DURING CONSTRUCTION.

The risk of sedimentation of the lagoon is best to be left to the construction stage with prior warning to the Tenderers to device suitable measures to counteract the problem.

We propose that the Madabokka area which is vulnerable in the context of prawn spawning, be sampled on two locations on either sides of the road trace at a distance of 60.0 m from the centre line. The area close to the sea be sampled at 02 locations 60.0 m away from the centre line of the road trace. The time interval for sampling shall be as shown in Table 12.1.

IDENTIFYING AREAS ON VERGES OF NEGOMBO LAGOON FOR EXPANDING ITS AREA

128: m of the proposed expressway will traverse through the lagoon .The area lost due to the construction of the roadway embankment is 45,000 m^2 (0.13% of the area of the lagoon). Compensation area is to be created by the excavation of suitable areas selected on the verges of the lagoon. From preliminary studies and reconnaissance field visits areas were selected for further investigations

Augur Hole Survey

A soil survey of the selected areas was carried out by means of 50 augur holes drilled to a depth of 2 m.

Identification of Areas

Two areas A1 and A2 have been identified as suitable areas for expanding the lagoon area.

Area A1 covers an extent of about 10 ha and Area A2 covers an extent of 9 ha.
The extent required to compensate for the area lost due to the roadway is only 5 ha.
If it is decided to proceed with the expansion of the lagoon area, an environmental impact assessment [EIA] need be carried out as the entire area covered by the survey forms part of mangroves surrounding the southern part of the lagoon.

BASELINE SURVEY OF GROUND WATER LEVELS AND WATER QUALITY PROJECT AREA

48 dug wells and two water holes were selected so as to provide representative samples from the area traversed by the CKE.

Ground Water Survey

Ground water levels were monitored in 50 wells for a period of five months with 2 observations per month. Chemical analysis was performed on 50 samples and microbiological tests were carried out on 25 samples.

Water Level Observations

Water level observations are presented on Table 14.1

Chemical & Physical Parameters

Results of analysis are presented in Tables 14.2 and 14.3

Microbiological Tests

Results of microbiological tests are presented in Annex 2. The results indicate that the sources of the water samples are highly polluted.

DETAILED HYDROLOGICAL STUDY OF PROPOSED COLOMBO - KATUNAYAKE EXPRESSWAY PROJECT

1. OBJECTIVES OF STUDY

1.1 Preamble

The need for a road link between the International Airport at Katunayake and Colombo was identified by the Road Development Authority [RDA] more than 02 decades ago. Despite being considered a priority project at national and local levels, it is yet to be implemented as a result of being beset by numerous financial administrative and social constraints. The Colombo Katunayake Expressway [CKE], when completed, will be the first expressway and one of the largest investment projects in the highway sector in Sri Lanka.

The CKE, nearly 25 km in length is to be constructed, connecting the International Airport to the city of Colombo. It will be a fully access-controlled four-lane design, expandable to a six-lane divided toll roadway; between the intersection of the new Kelani Bridge and Kandy Road [A1] in Colombo and the Canada Friendship Road and Puttalam Road [A3] in Katunayake. The CKE will be constructed to international standards with a design speed of 100 km/h and four diamond-type grade separated intersections [or interchanges] located at Peliyagoda, Kerawalapitiya [where there is a 400 acre area reclaimed from the Muthurajawela marsh by sandfill], Ja Ela and the final at Katunayake [linking the Sri Lanka Canada Friendship Road].

The expressway commencing at the new Kelani Bridge will proceed northward past the Hunupitiya Railway Station, and then swing leftwards to cross the present A3 road at a point close to Mabole in Wattala. It will then follow a northward trace along the corridor of the old Dutch Canal upto the southern end of the Negombo lagoon. The roadway will then enter the lagoon and proceed for about 1.5 km, at an approximate distance of 30 meters from the eastern shoreline of the lagoon, upto the point where the westward extension of the Canada Friendship Road meets the lagoon. Figure 1.1(in the docket) shows the trace of the proposed CKE.

It must also be stated that this present trace was selected and is referred to as the western trace after an eastern trace was earlier identified between new Kelani Bridge and Katunayake Airport. The eastern trace had to be subsequently abandoned due to many adverse sociological problems which cropped up. But in the case of the presently selected western CKE trace, there will not be much displacement on the CKE as around 75% of the proposed highway will be moving over marshy land or lagoon, where there are no permanent settlements.

A major hurdle that has been cleared in relation to the implementation of CKE proposal is that the Central Environmental Authority [CEA] has granted approval to this proposed venture subject to many conditions and guidelines. One of the major concerns is the

Hydrology and Drainage aspects along the CKE trace and Hydrology and Hydraulics of the Negombo Lagoon. These concerns were highlighted by the Technical Evaluation Committee [TEC] which evaluated the Environmental Impact Assessment Report [EIAR] submitted by the RDA in respect of the proposed CKE.

Engineering Consultants Limited are therefore pleased to submit this Final Report on a "DETAILED HYDROLOGICAL STUDY OF PROPOSED COLOMBO-KATUNAYAKE EXPRESSWAY PROJECT", and the results of the study will not only satisfy a major concern expressed by the CEA, but will also provide relevant information to the Design Engineer to finalize the following design parameters:

* Location of proposed under crossings like culverts and bridges along CKE trace
* Area of Flow needed at each such under crossing
* Approximate Level of Flooding for different return periods
* Minimum Finished Road Level of proposed highway at all critical points like under crossings and bridges

1.2 Terms of Reference [TOR]

The TOR was made available to the Consultants by RDA letter dated 30th June 1998. Preparation and submission of proposals, evaluation of proposals and subsequent negotiations ended in August 1998. The study commenced on 07th October 1998.

The comprehensive TOR was essentially aimed at bringing out the hydrological and hydraulic characteristics of the systems influencing the design of the proposed CKE. This included:

- Studying the hydrological and climatic conditions of the area.
- Selecting suitable rainfall stations within the respective river basins [catchments] influencing the proposed CKE and carrying out rainfall analyses and produce Rainfall Intensity - Duration Curves, for return periods of 10, 25, 100 and 200 years.
- Estimating flood discharges at major drainage crossings for 50, 100 and 200 year return period.
- Examination of lead away conditions of major drainage crossings to ensure the mitigation of water levels during a flood to safer downstream locations.
- Hydraulic design of bridges and culverts at strategic locations along CKE indicating the opening sizes to keep the pre-determined pre-project 100 year flood levels as much closer closer to the post project high flood levels.

- Validation of the post-project 100 year design flood levels with the new road embankment, 1.1 m above the design high flood level [HFL] on the proposed CKE by considering the additional cross drainage due to interference of the embankment with the natural drainage system.

- Inventory of all Drainage Crossings across the existing Colombo-Katunayake [A3] with salient parameters to facilitate the design of drainage structures for the proposed CKE and justification of same.

- Propose any Improvements to Downstream Drainage System to Overcome Any Physical Constraints.

- Carrying out field investigations and necessary surveys, so as to establish details of maximum observed historical floods in the area including water spread areas. An attempt to be made to establish the return period of these floods by studying the rain storm causing those floods.

- Predicting probable areas inundated and duration of flooding, caused by these storms of 50, 100 and 200 year return period.

- Inundated areas corresponding to 50, 100 and 200 year storms to be mapped out.

- Propose any retention area which is necessary to mitigate the impact of post-project 100 year flood, in case these levels are significantly higher than the pre-project high flood levels.

- Prepare a suitable monitoring system during the construction of the proposed road to ensure the control of excessive turbidity and sediment loads to Negombo Lagoon during construction.

- Identify suitable land areas along the lagoon verges for expanding the water area of the lagoon to compensate [or if possible over compensate] for the loss of water area due to the construction of the Expressway.

- Carry out a baseline survey of the ground water levels and water quality in the project area.

1.3 Reports Submitted To Date

In keeping with the TOR and as confirmed in the Technical Proposal submitted, the following reports have been submitted prior to the submission of this Final Report:

* An Inception Report within 3 weeks of commencement of study
* Monthly Progress Report No. 1 covering the period 07.10.98 to 06.11.98
* Monthly Progress Report No. 2 covering the period 07.11.98 to 06.12.98
* Monthly Progress Report No. 3 covering the period 07.12.98 to 06.01.99

- Monthly Progress Report No. 4 covering the period 07.01.99 to 06.02.99
- Monthly Progress Report No. 5 covering the period 07.02.98 to 06.03.99
- Interim Report after completion of 03 months of the study, which incorporated results obtained in respect of:
  - Rainfall Data collected and development of Rainfall - Intensity - Duration Curves
  - Estimation of flood discharges for return periods of 50, 100 and 200 years
  - Inventory of Drainage Crossings on existing A3
  - Hydraulic Design of Bridges and Culverts at strategic locations indicating opening sizes for proposed CKE
  - Validation of the post-project 100 year design flood levels with the new road embankment, allowing a minimum free board of 1.1 m.
- *Draft Final Report after completion of 6 months of the study.*

1.4 Special Comments

1.4.1 Additional Surveys

In order to assist in the hydrological and hydraulic studies the following additional surveys, not envisaged at the proposal stage, were carried out:

- Depth measurement along sea outfall canals and Negombo Lagoon
- Cross sections of sea outfall canals at the bridges
- Water surface profiles of Dandugam Oya, Ja Ela and Kalu Oya downstream of A3
- Cross sections of Dandugam Oya, Kalu Oya and Mahadora Ela

1.4.2 Booklet with Bench Mark Details

Based on the setting up of T.B.M.M., approximately 1 km apart, along the CKE trace, a booklet giving the following details was submitted.

- A serial number for each BM commencing from the southern end; which included already existing BMM too
- The elevation in MSL
- A descriptive location of the 32 No. BMM
- Some relevant remarks where possible
- Location of the 32 No. BMM shown on a 1:50,000 scale map
- Location sketches for each BM so that each BM can be identified/located by any technically qualified officer

1.4.3 *Meanders of the Right Bank Tributary of the Kalu Oya Basin*

The proposed CKE trace cuts through the meanders in the RB tributary 3 times thereby necessitating 3 No. bridges over the same river. By acquiring an additional strip of private property it is possible to straighten out 2 of the

meanders by cutting a wide trench, the dimensions of which meet the geometry of the tributary and eliminate the need for 2 out of the 3 No. bridges. This may be a cost effective alternative which deserves further study.

1.4.4 Road Intersections

04 No. road intersections have been identified along the CKE trace. In order to assess the hydraulic requirements of these intersections, it is necessary to have a flat plan showing each intersection in full. The computations done and some parameters determined during the hydrological study for the CKE trace can then be effectively used.

1.4.5 Perimeter Survey of Flooded Areas

Flood levels were ascertained by means of local enquiries and the flood contours shown are for the average value obtained from a number of "observed flood levels" as shown by local residents. The high flood levels shown correspond to a flood peak in that particular catchment and may not be related to the storms causing the flood peaks in adjoining catchments. Also it is to be noted that high flood levels in Kalu Oya and Mudun Ela are dependent on water levels in Kelani Ganga and therefore the observed high flood levels may not correspond to flood peaks in these catchments. In other words the high flood levels in these basins are the result of a combination of high stages of Kelani along with catchment inflows. The probability of a 100 year flood peak coinciding with a 100 year flood stage in lower Kelani are extremely low.

2. IDENTIFICATION OF CATCHMENTS AND SUB-CATCHMENTS

2.1 Drainage Pattern

The proposed CKE trace can be said to traverse approximately in a northerly trace from Colombo to Katunayake and running parallel to the western coast and at a distance of about 3-4 km from it. This trace intercepts a number of cross drainages consisting of minor steams, major streams and rivers during its course. All these cross drainages flow from East to West ultimately draining into the sea along the western coast. The existing A3 highway between Colombo and Katunayake, similarly travels in a northerly direction and also intercepts most of the cross drainages intercepted by the CKE. Hence an identification of all the catchments and sub-catchments and their main drainage courses, which cross the proposed CKE and discharge into the sea, is absolutely essential. Moreover a study of the hydraulics of the drainage system upstream of CKE as well as downstream is also necessary to enable quantifying peak flows for different return periods that could occur at each identified drainage crossing under the proposed CKE.

2.2 Major Catchments

2.2.1 Attanagalu Oya

Attanagalu Oya is located between Kelani Ganga and Maha Oya river basins and has a catchment area of 761 sq.kms. The upper catchment is approximately 250 sq.kms., consisting of rubber and coconut estates and the highest elevation is 300 m MSL. at Galapitamada. The lower catchment is predominantly cultivated with paddy and there are 3870 ha. of paddy irrigated, under Attanagalu Oya Irrigation Scheme (AOS), the largest irrigation project in the basin. The river flows westward and meets Diya Ella Oya near the Gampaha town. At its lower reaches it joins with Uruwala Oya and at this point the river name changes to Dandugan Oya. The AOS itself consists of 10 major diversion schemes for irrigation with 34 minor diversion weirs in the lower reaches. There are also numerous other rainfed, minor and medium irrigation projects within the basin.

The Attanagalu Oya rises in low hills situated at the eastern boundary of the basin and flows from East to West up to Kotugoda, where it turns towards the North and gradually flows to the South, till it reaches the Seeduwa bridge, across Colombo-Negombo road. From the bridge it again flows westwards to the Negombo lagoon. Above Kotugoda, a man made canal called the Ja Ela, directly drains a part of the catchment flow. Hence the runoff from the Attanagalu Oya basin is shared between, the flow through Ja Ela and that through Dandugan Oya. The Ja Ela crosses the Colombo-Negombo road at Ja Ela and also flows in a westerly direction (south of the Dandugan Oya), into the Negombo Lagoon. The longest length of the river course is about 57 km at the A3 crossing.

For the purpose of the study, it is very necessary to apportion definite sectors of the catchment for Dandugan Oya which cross the A3 at Seeduwa and Ja-Ela which crosses at Ja- Ela. Accordingly detail studies of the available topographical maps of the river basin and detail field inspections were carried out with a view to establishing these 2 catchments. Accordingly the following break up has been determined:

	At A3	At CKE
Dandugam Oya (also called Attanagalu Oya)	587 sq.km	589 sq.km
Ja Ela.....	183 sq.km	183 sq.km

These 2 sub catchments have been shown in the catchment map in the docket (Fig, 1.1).

2.2.2 Kalu Oya

This catchment of 52.5 Sq.km is one of the lowest sub catchments of the large Kelani Ganga basin and is intercepted by the CKE upstream of the existing A3. This catchment, due to its proximity to Colombo city, is characterised by its large urban population, and its lower reaches consists of marsh which too has been partly reclaimed. The flooding pattern of this catchment is greatly influenced by river levels prevailing in the Kelani Ganga caused by storm conditions occurring in the large 2292 sq.km. Kelani ganga basin with its source in the Adams peak range at elevations exceeding 2000 m MSL, experiencing rainfalls which can be considered to be among the highest in the island.

2.3 Minor Catchments

2.3.1 Mudun Ela

This is another minor basin of 8.2 sq.km at A3 and 5.9 sq.km at CKE within the Kelani Ganga Basin, but closest to the city of Colombo and is highly industrialised. Due to the low lying nature of the land, drainage of this basin cannot be adequately effected by gravity and a pumping scheme is necessary (minor flood protection scheme). The SLLR&DC is in the process of implementing such a major pumping scheme in order to assure the safety of the large industrial complex that is envisaged within this catchment. Under gravity conditions the Mudun Ela drains into Kelani Ganga mainly through 2 No. drainage crossings under A3. The other culverts are either insignificant or are malfunctioning.

2.3.2 Micro Catchments

There are 6 No. such micro catchments identified between the southern end of the Ja Ela catchment and the northern end of the Kalu Oya catchment. All these catchments are intercepted by the CKE along its trace which lies west of the existing A3. Some of them even have the major part of their micro catchments between the existing A3 and the proposed CKE. They originate in the highland urban areas around A3 and drain towards Muthurajawela through stretches of marsh, and paddy tracts.

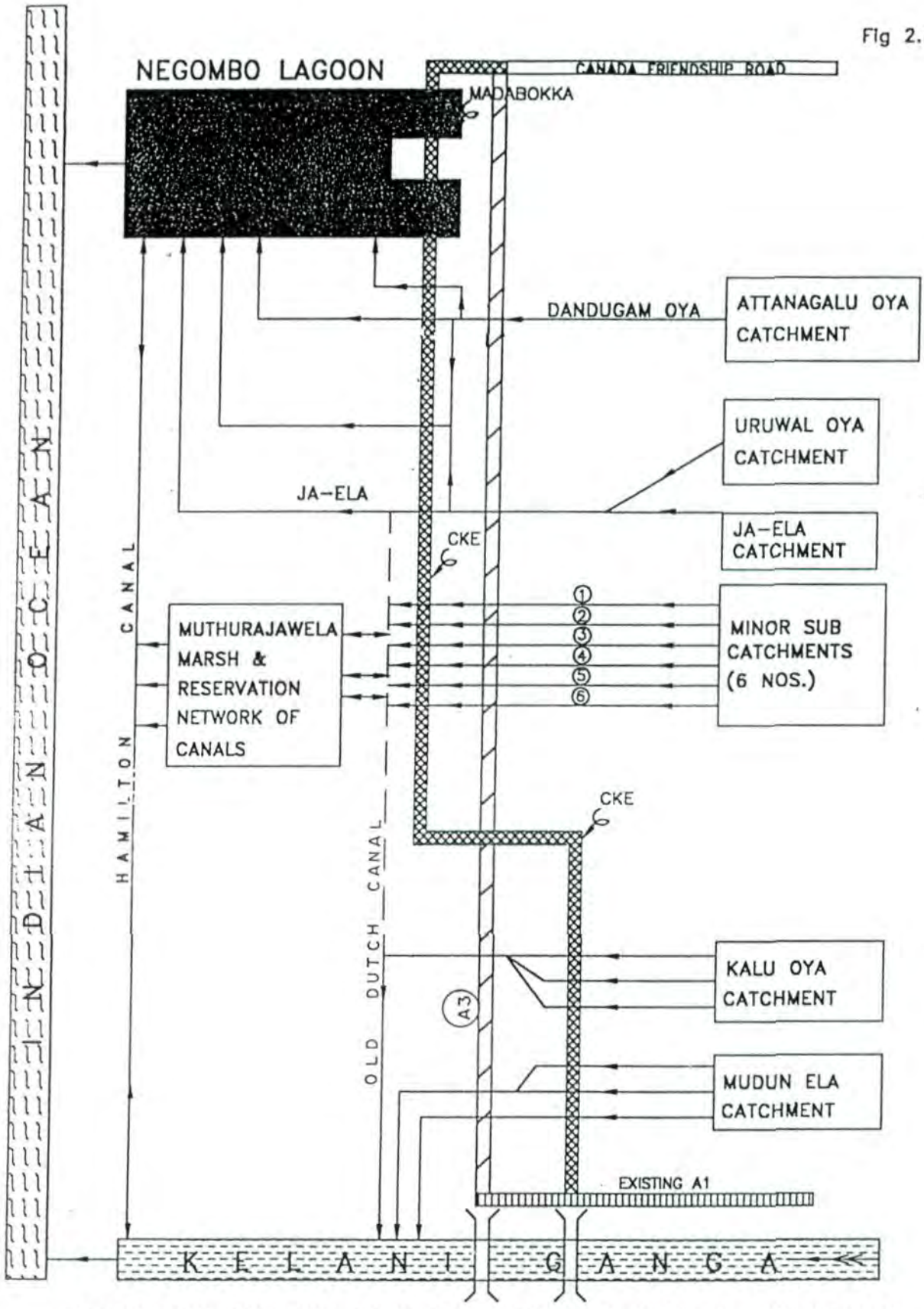
These micro catchments are detailed below:

	Location	Estimated catchment Area at CKE (Sq.km)
1.	Between Ja-ela and Nadurupitiya	2.5
2.	Between Nadurupitiya and Nagoda	3.99
3.	South of Nagoda	1.79
4.	South of Nagoda to Mahabage	3.48
5.	Mahabage to Mathumagala	0.77
6.	Mathumagala to Mabole	0.95

Fig. 2.1 gives in schematic form the relative positions of the respective catchments and sub-catchments and the drainage conditions which prevail during storm conditions.

Figure 1.1 (scale - 1:63,360) in the docket shows the different catchments, the river networks and their drainage in relation to A3, the proposed CKE, the Negombo Lagoon, Muthurajawela, the Dutch Canal and Kelani Ganga.

Fig 2.1



SCHEMATIC SKETCH SHOWING HYDROLOGICAL & HYDRAULIC CHARACTERISTICS AFFECTING PROPOSED CKE DURING STORM CONDITIONS

3. RAINFALL ANALYSIS

3.1 Available Run-off Data

Flow data within the catchments intercepted by CKE have been systematically recorded only at one upper tributary of the Attanagalu Oya. at Karasnagala. Flow measurements for this station are available for a period of 25 years from 1971 to 1995. The catchment area at the gauging station is 53.4 sq.km., which is only 7% of the entire Attanagalu Oya and Ja Ela Catchments. Furthermore, the catchment characteristics at Karasnagala differ significantly from those of the entire 770 sq.km. catchment, especially in terms of gradient, land use, and flood detention. Hence it is not possible to use this data to simulate run-off characteristics of Attanagalu Oya and Ja Ela at A3 or proposed CKE. Relevant Hydrographs have therefore been developed applying Mathematical Models using available rainfall data and other catchment parameters and have been described in Chapters 4 and 5.

3.2 Available Rainfall Data

The daily rainfall records were collected from different sources for ten rainfall stations in and around the project area.(Please see Fig. 3.1)

No.	Rainfall Station	Period of Record for the Study
1	Ambepussa Govt Farm	1967 – 1997
2	Chester Ford Estate	1967 – 1997
3	Kirillawala Group	1987 – 1997
4	Halgahapitiya Group	1967 - 1997 *
5	Colombo	1967 - 1997 *
6	Katunayake	1967 - 1997 *
7	Henarathgoda Bot. Gardens	1967 - 1997 *
8	Vincit Estate	1967 - 1997 *
9	Pasyala	1967 - 1997 *
10	Walpita	1967 - 1997 *

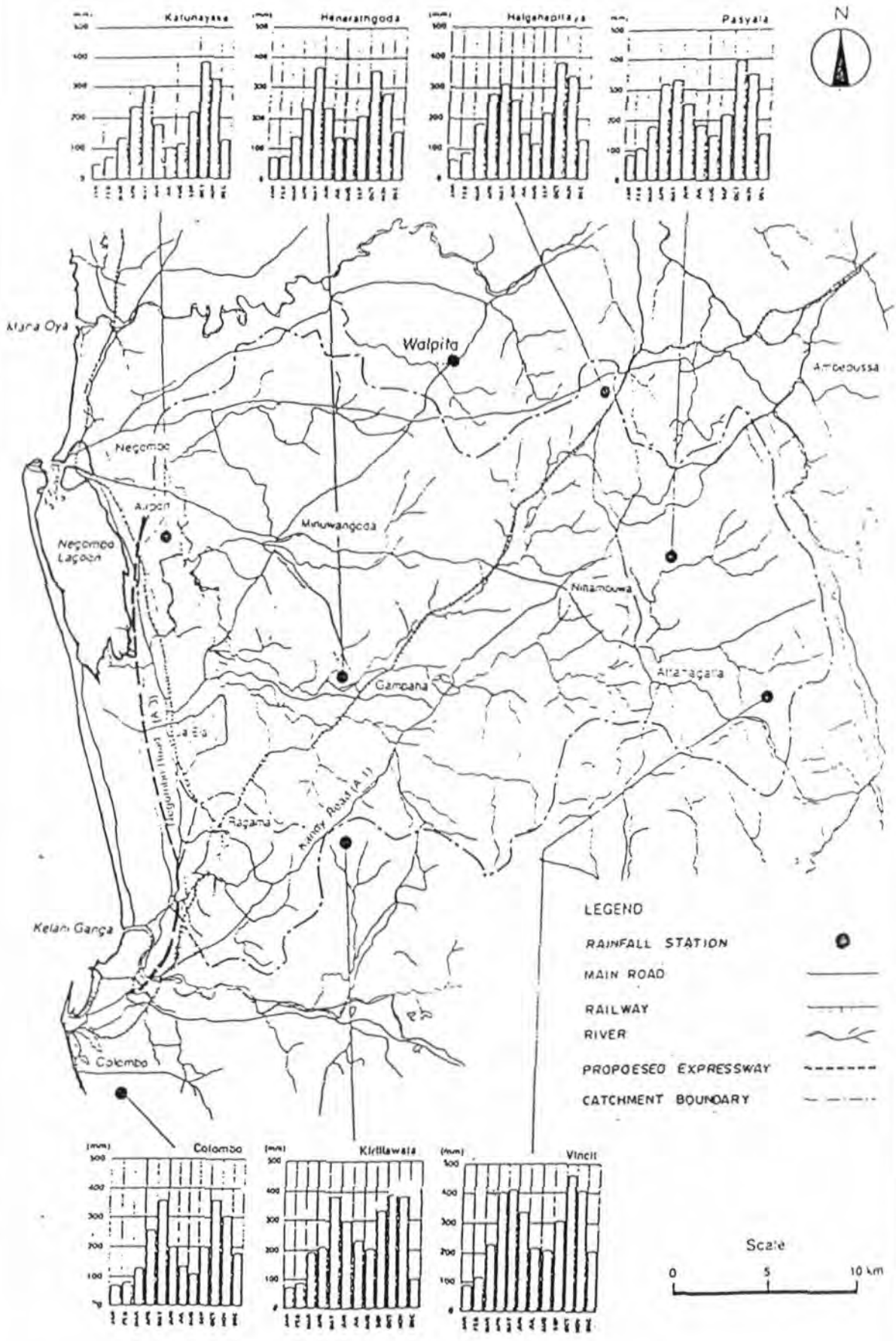
* These Rainfall Stations are more relevant to the study area. (Please see Annex 1.)

Table 3.1 : List of Rainfall Stations

3.3 Rainfall Intensity Studies

A Rainfall intensity study in Sri Lanka has been carried out by V R Baghirathan and E M Shaw in 1978. This original work was up dated by the Hydrology Division of the Irrigation Department in 1990 [Ref: Dharmasena G T, Engineer, Quarterly Journal of IESL Vol. 18 Dec 1990]. The project area is located in the Hydrological Region III, which covers the North Western part of Sri Lanka. However, the rainfall intensity study already carried out is based on Katunayake and Colombo rain gauges and therefore it was

FIGURE 3·1



LOCATION OF RAINFALL STATIONS

decided to up date and carry out more site specific analysis for this study as stipulated in the TOR. Therefore, daily rainfall data at Vincit Estate and Katunayake rain gauges for the most recent 30 years were collected to carry out a fresh intensity analysis and these Depth Duration Curves [DDC] are shown in Figure 3.2 and Figure 3.3. These two DDCc were used in addition to the DDC for Colombo and is shown in Figure 3.4. Table 3.2 shows the results of this rainfall intensity analysis. For Katunayake and Vincit, analysis was done for a duration of 5 days. For the frequency analysis, Extreme Probability Type 1 distribution [Gumbel] was adopted.

3.4 Catchment Rainfall

The major catchments considered for this study are listed below with the catchment areas at the intersection of the A3 road.

Dandugam Oya	-	587 sq km
Ja Ela	-	183 sq km
Kalu Oya	-	051 sq km

For Dandugam Oya basin, rainfall intensity analysis of both Vincit and Katunayake were used. For Ja Ela only Katunayake rainfall was used as the catchment is mostly coastal. For Kalu Oya, rainfall intensity for Colombo was used. For all these stations, rainfall corresponding to 50, 100 and 200 year return periods were used as design storms.

Regarding the duration of the design storms 05 day were considered for both Dandugam Oya and Ja Ela and 04 day storm was considered for Kalu Oya as the catchment is smaller.

By extracting the intensities from the DDCc of three rain gauges, 50, 100 and 200 year storms were developed for 03 hour time resolutions. For the design of storms the standard procedure in storm designs by the application of unit hydrographs technique was adopted.

3.5 Flood Experienced in Colombo City in June 1992

Dharmasena has analyzed this flood in his study "An Act of God - The Great Flood in Colombo on 05th June 1992; and is attached at Annex A. The essential features that can be observed from this study are:

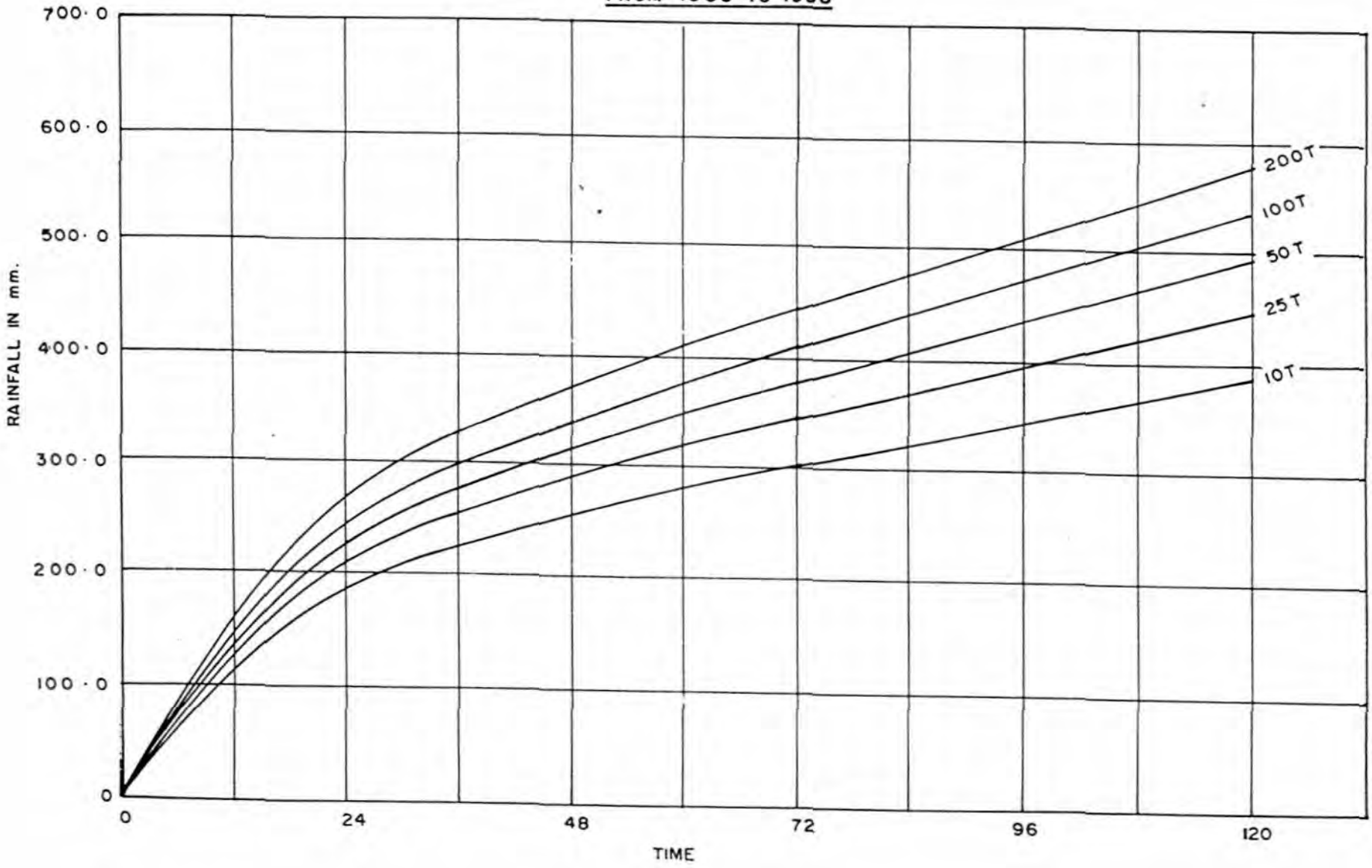
The rainfall was intense and occurred over a period of approximately 12 hours

The centre of the storm was Colombo City and depleted in areas around it in the Kelani and Bolgoda Catchments

In relation to the proposed CKE, while Colombo experienced a 24 hour rainfall of about 494 mm Katunayake experienced only 72 mm

DEPTH–DURATION CURVE FOR ST. VINCIT

FROM 1965 TO 1998



DEPTH–DURATION CURVE FOR KATUNAYAKA

FROM 1965 TO 1998

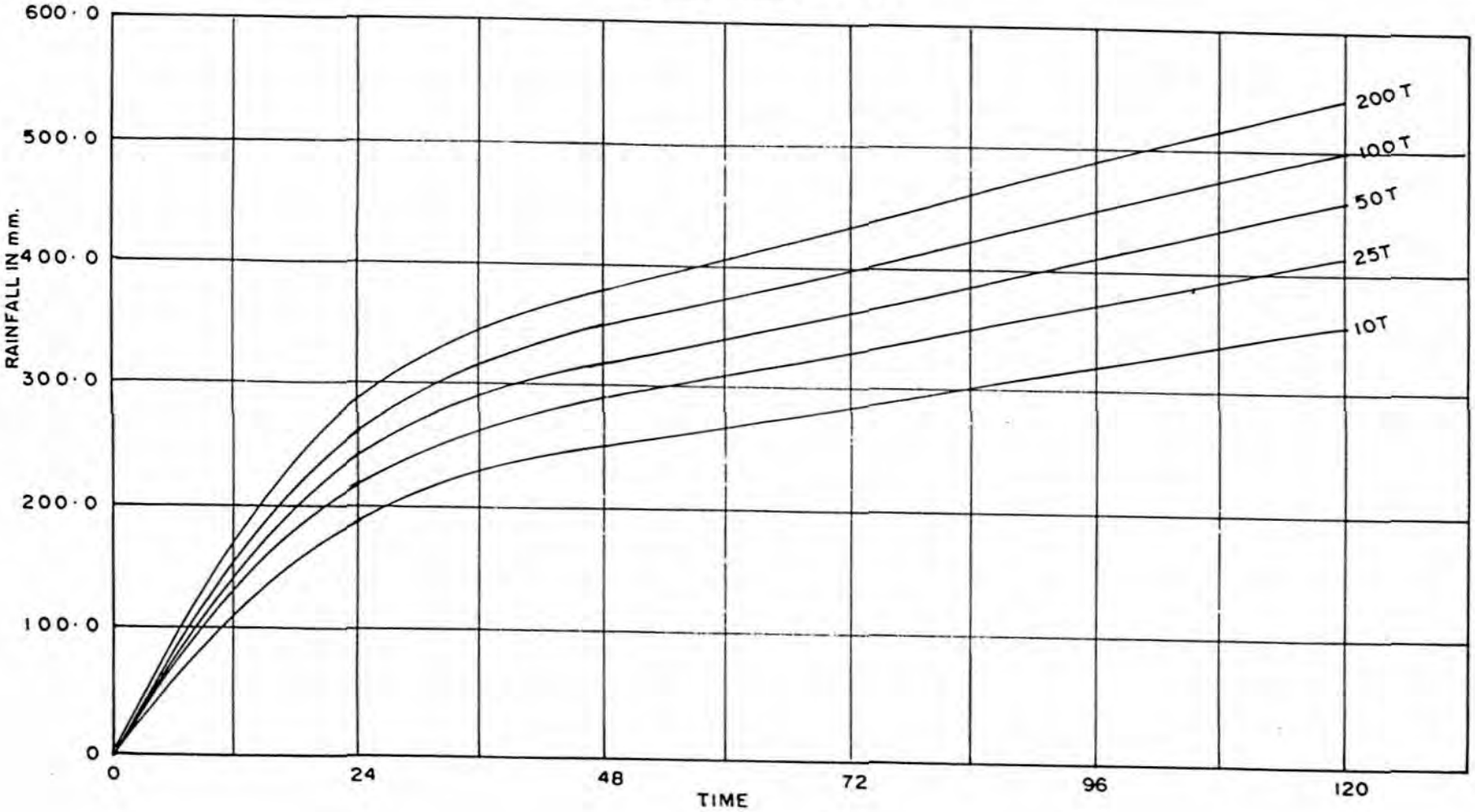
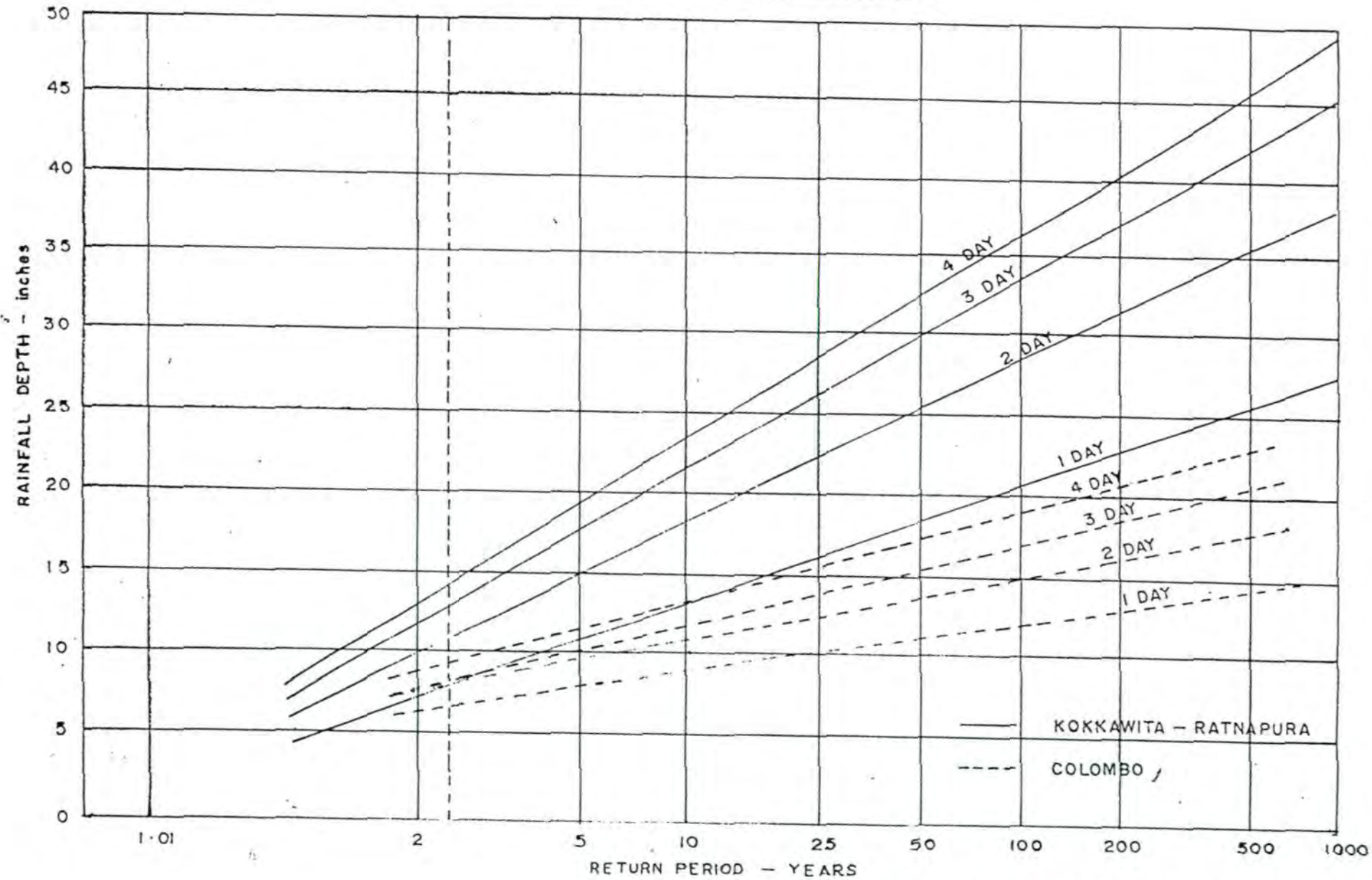


Fig.3.3

DEPTH – DURATION – FREQUENCY



SOURCE - HYDROLOGY DIVISION - IRRIGATION DEPARTM

RAINFALL INTENSITIES IN (mm)

Stations	Day	Return Period (years) 10year	25year	50year	100year	200year
Colombo	1	215	254	274	300	323
	2	272	307	335	381	400
	3	296	343	289	424	462
	4	338	396	434	472	523
St.vincit	1	183	213	283	250	275
	2	253	288	315	340	370
	3	305	350	385	415	445
	4	345	395	435	470	508
	5	393	448	495	540	580
Katunayaka	1	193	222	245	270	292
	2	252	290	320	350	380
	3	285	332	365	400	435
	4	320	375	415	450	493
	5	355	415	460	498	545

Table 3.2

Rainfall Frequency Analysis by different methods, of this recorded storm, revealed that the Return Period of this storm was in excess of 500 years for a 01 day storm

Hence, considering these aspects, it is concluded that his storm has no significance to the design return periods required in the CKE study.

4. CATCHMENT PARAMETERS

Since long terms flow data recorded in Ja Ela and Dandugam Oya is not available, Mathematical Models have to be utilized. These models use rainfall information and the catchment characteristics in order to develop a Flood Hydrograph of any known return period. Different models use different catchment characteristics in order to develop a hydrograph which simulates actual flooding patterns both in magnitude of flow as well as time. Some important catchment parameters of the 03 major basins in the study area are given in Table 4.1:

River Basin	Dandugam Oya	Ja Ela	Kalu Oya
Catchment Area at A3 [sq km]	587.0	183.0	51.00
Catchment Area at CKE [sq km]	589.0	183.0	52.50
Stream Length at A3 [km]	057.0	030.0	13.20
Stream Length at CKE [km]	057.0	031.0	11.70
Stream Slope [%]	000.1	000.3	00.15
Detention Area at A3 [Ha]	9,550	2,970	533
Detention Area at CKE [Ha]	9,750	2,970	521

Table 4.1 : Catchment Parameters

5. DEVELOPMENT OF FLOOD HYDROGRAPHS

5.1 Available Data

There are many mathematical models for river flow simulation but some of these models require very extensive field data. Collection of this necessary field data is time consuming and considering the time frame of this study, only limited field data could be collected. Hence, the consultants decided to use different mathematical models to develop the required flood hydrographs.

5.2 Available Alternatives for Development of Flood Hydrographs

5.2.1 Model 1 - SCS Model

Salient features of the model are given below:

* This model was described in "The National Engineering Handbook No. 4 – Hydrology by the USDA Soil Conservation Services [SCS] published in 1955, which presented a method for Synthetic Unit Hydrograph development.
* It is applicable to small to medium sized water sheds.
* This method uses a dimensionless unit hydrograph to provide a standard unit hydrograph shape.
* An average velocity method is used to calculate lag time.
* In this method the ratio of time to peak to hydrograph duration is fixed at 05.
* This method assumes that the main portion of the unit hydrograph has the approximate shape of a triangle.
* Catchment characteristics are used to develop a SCS run-off curve number.

Figure 5.1 is a "Schematic Diagram for Development of Inflow Hydrographs "by the SCS Model Method".

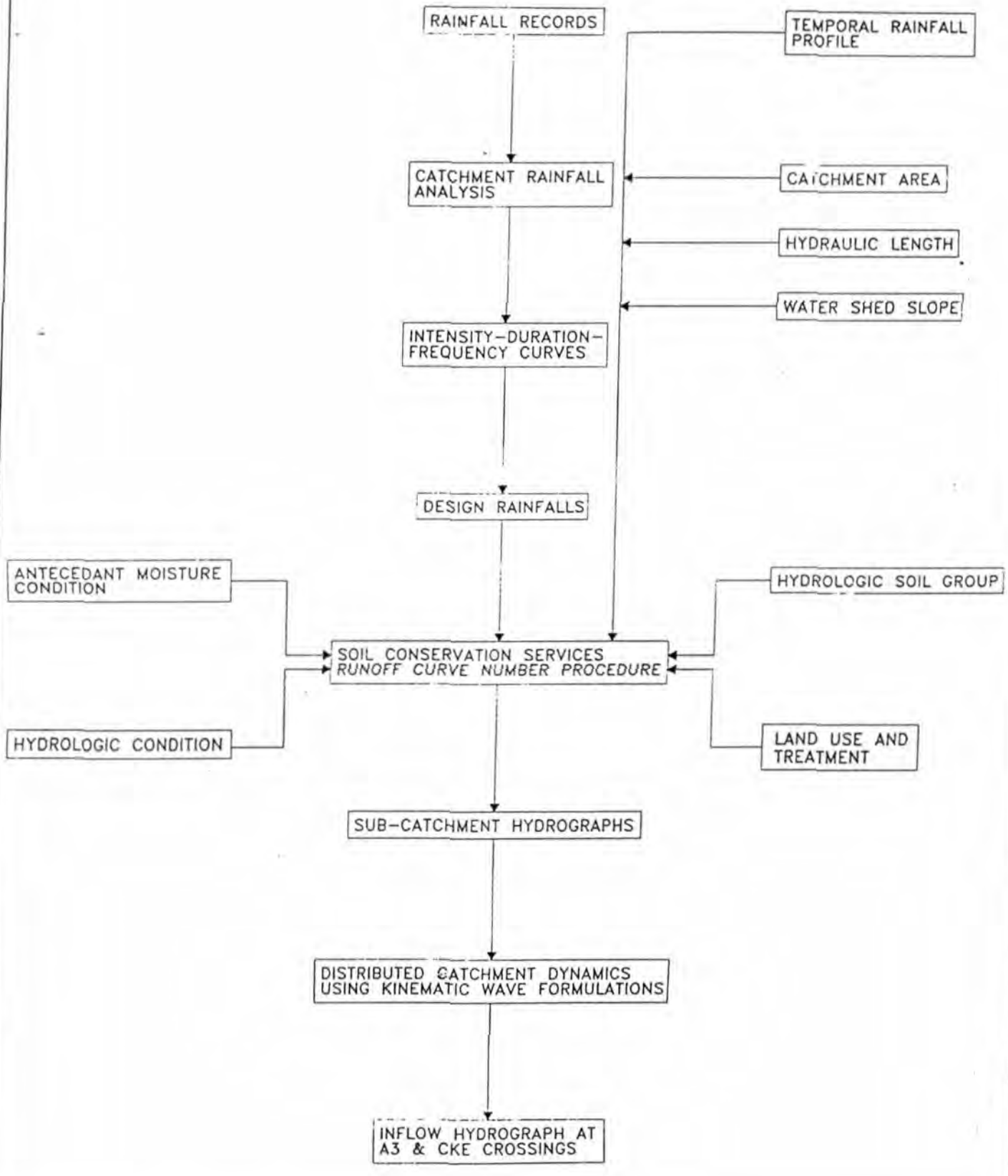
5.2.2 Model 2 - HEC 1 Model

This model consists of two modules namely: the rainfall-runoff relationship and reservoir routing. For the rainfall-runoff module, the synthetic unit hydrograph developed by Snyder is used and flood routing through a reservoir is based on the normal step by step method of water balance applicable to reservoir routing.

Engineers in Sri Lanka are very familiar with the Snyder Technique for the development of a unit hydrograph. This model -developed by the US Army Corps of engineers - is also adopted widely in the United States and other countries.

FIG. 5·1

SCHEMATIC DIAGRAM FOR DEVELOPMENT OF INFLOW HYDROGRAPHS



The salient features of this model are:

- An initial loss is applied to the storm rainfall and a constant rate of loss thereafter is adopted.
- A coefficient Cp is computed under the Snyder Technique and is indicative of the catchment slope
- The time to peak tp of the unit hydrograph is estimated using the catchment parameters
- The outflow hydrograph is computed by considering the catchment as a reservoir with a known width of spill, through which the inflow hydrograph is routed. Many catchment parameters are used in simulating the reservoir which is a major component of the model.
- The Snyder Technique is used to develop the unit hydrograph, which also uses many catchment parameters.

Figure 5.2 is a "Schematic Diagram for the development of Inflow Hydrographs by the HEC 1 model method.

5.3 Model Selected for the Study

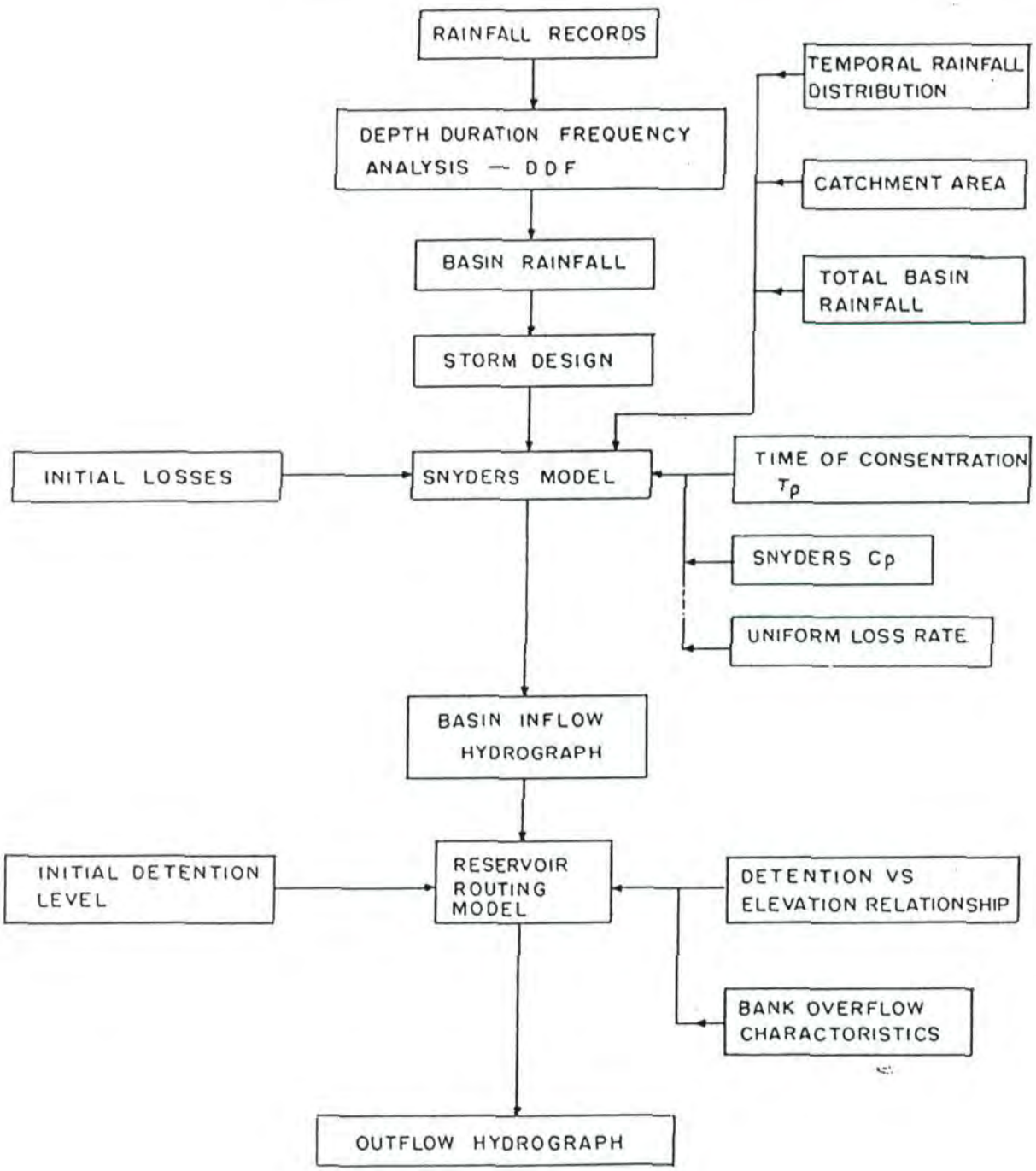
In the absence of long term stream flow data for the major river basins in the study area, the use of mathematical models to develop flood hydrographs is very necessary. Although mathematical models are developed and tested, no such model can be said to be applicable to any catchment. Every model therefore endeavours to simulate actual behaviour of the catchment by using catchment parameters as well as formulae and assumptions which characterize each model. Hence it is preferable to do a flood study of a catchment using more than one catchment model. Although the developed hydrographs using the 02 models may not be identical, the results can serve to assure the designer that the results obtained by applying both models are varying within acceptable limits say 10 to 20%. It is with this intention that the Consultants have selected the HEC 1 model to develop the flood hydrographs presented in this Draft Final Report, as the SCS model was used in developing the preliminary flood hydrographs indicated in the Interim Report.

5.4 Flood Hydrographs Developed for Pre-Project Conditions

5.4.1 Model Parameters Used

For flat catchments, the Snyder's Coefficient Cp = 0.3 has been used for all catchments.

SCHEMATIC DIAGRAM FOR DEVELOPMENT OF INFLOW AND OUTFLOW HYDROGRAPHS



Applying catchment parameters, Time to Peak [Tp] has been computed to be as follows:

Dandugam Oya	-	12.0 Hrs
Ja Ela	-	06.0 Hrs
Kalu Oya	-	05.0 Hrs

Catchment Losses for all catchments has been applied as follows:

First Hour of Storm	-	0.25 mm
Thereafter	-	1.25 mm/hr

Flood plain width, needed for the model as estimated from field data is:

Dandugam Oya	-	400 m
Ja Ela	-	500 m
Kalu Oya	-	300 m

5.4.2 Flood Routing of Major Catchments

Dandugam Oya, Ja Ela and Kalu Oya using the Storm Rainfalls Computed from Depth- Duration-Frequency Curves [Figure 3.2, 3 3 and 3.4], the Catchment Parameters and the computed model parameters, routed flood hydrographs were developed for Dandugam Oya, Ja Ela and Kalu Oya catchments for Return Periods of 50, 100 and 200 years. Figures 5.3 to 5.11 consisting of 09 No. printouts show these flood hydrographs. Each printout indicates the Inflow Hydrograph and the Outflow Hydrographs.

Dandugam Oya Hydrographs

The Inflow and Outflow hydrographs represent the flood at A3. The outflow hydrograph together with the Ja Ela outflow hydrograph and the hydraulics of the system downstream of A3 is then used to estimate the flood flow pattern at the CKE crossing and to estimate the flood levels in the marsh and lagoon for the different return periods.

Ja Ela Hydrographs

The Inflow and Outflow hydrographs represent the flood at A3 as well as at CKE, since the Ja Ela is confined between flood bunds in the reach from A3 to CKE. This outflow hydrograph is then used together with that of Dandugam Oya to estimate the flood levels in the marsh and lagoon for the different return periods.

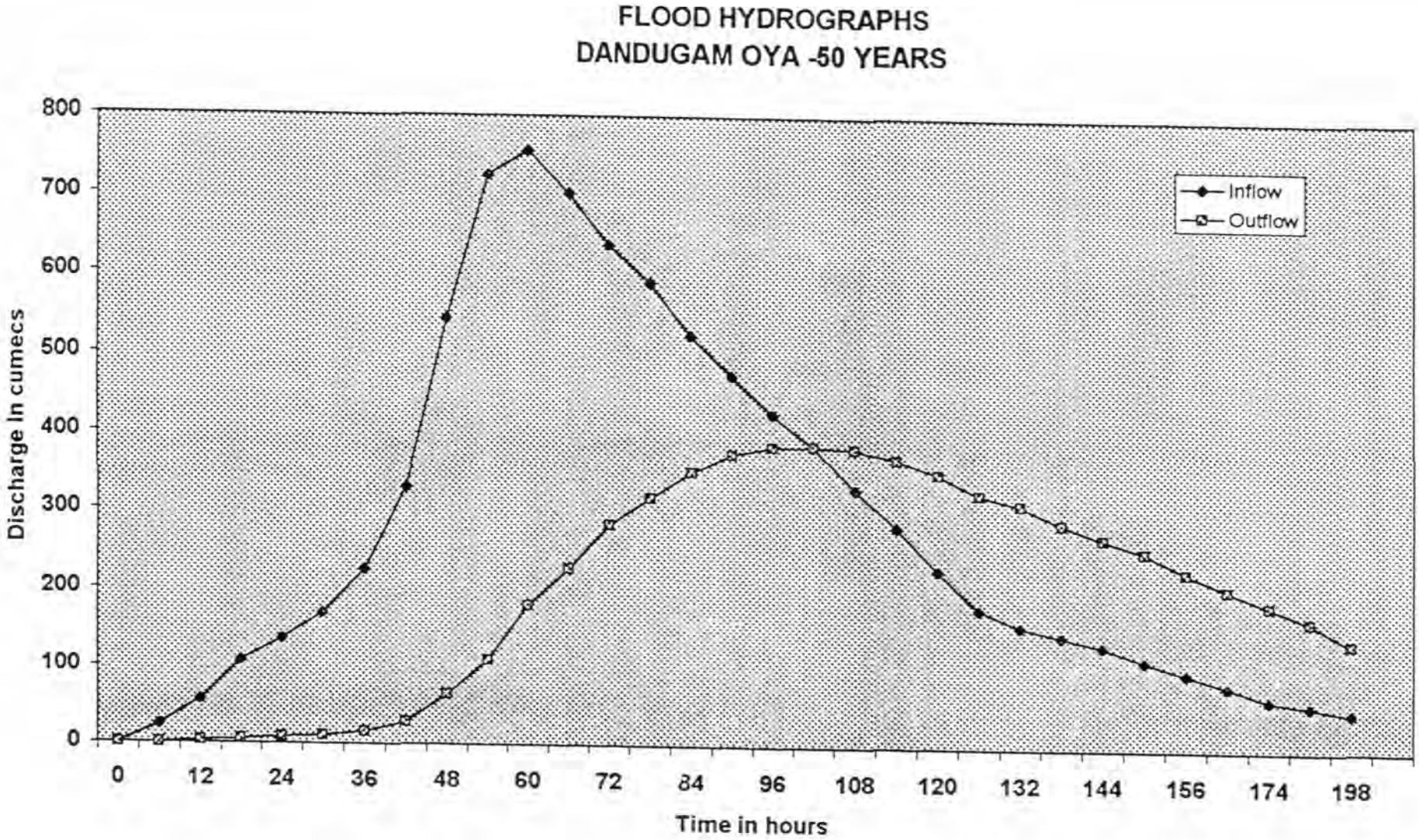

FLOOD HYDROGRAPHS
DANDUGAM OYA -50 YEARS
Discharge in cumecs
800
700
600
500
400
300
200
100
0
Inflow
Outflow
0
12
24
36
48
60
72
84
96
108
120
132
144
156
174
198
Time in hours

Fig.5.3

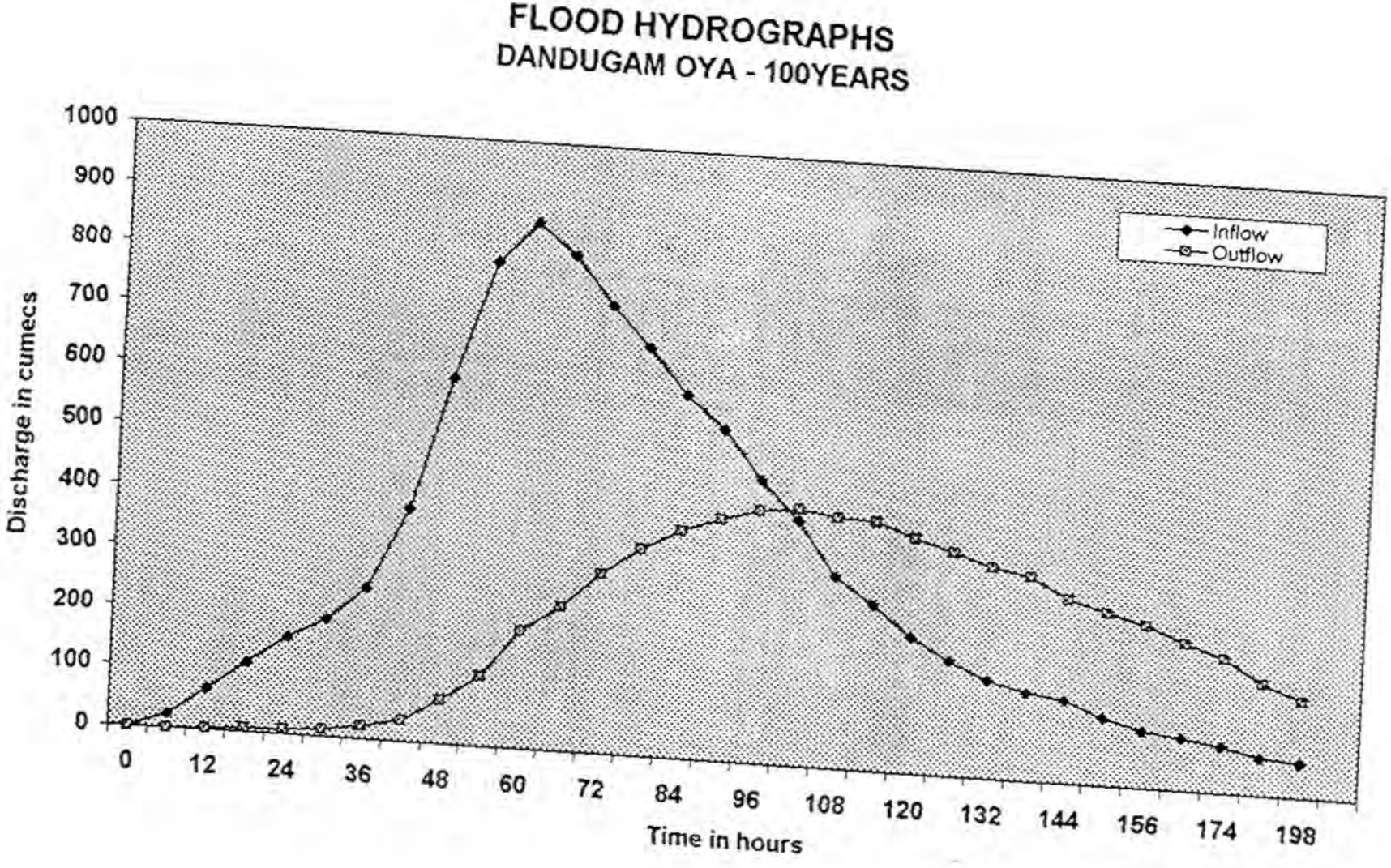

FLOOD HYDROGRAPHS
DANDUGAM OYA - 100YEARS
Discharge in cumecs
1000
900
800
700
600
500
400
300
200
100
0
Inflow
Outflow
0
12
24
36
48
60
72
84
96
108
120
132
144
156
174
198
Time in hours

Fig.5.4

FLOOD HYDROGRAPHS
DANDUGAMOYA - 200 YEARS

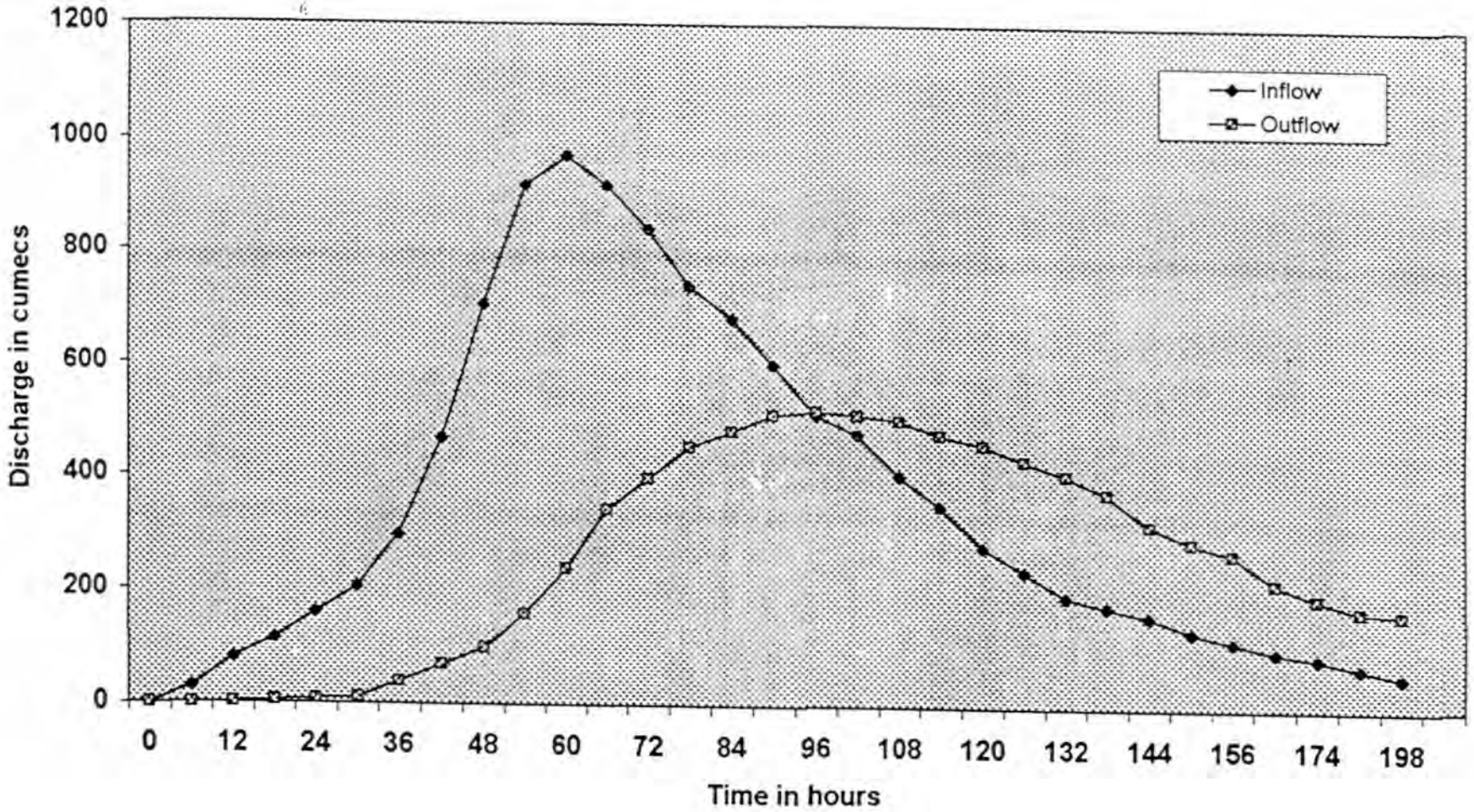


Fig.5.5

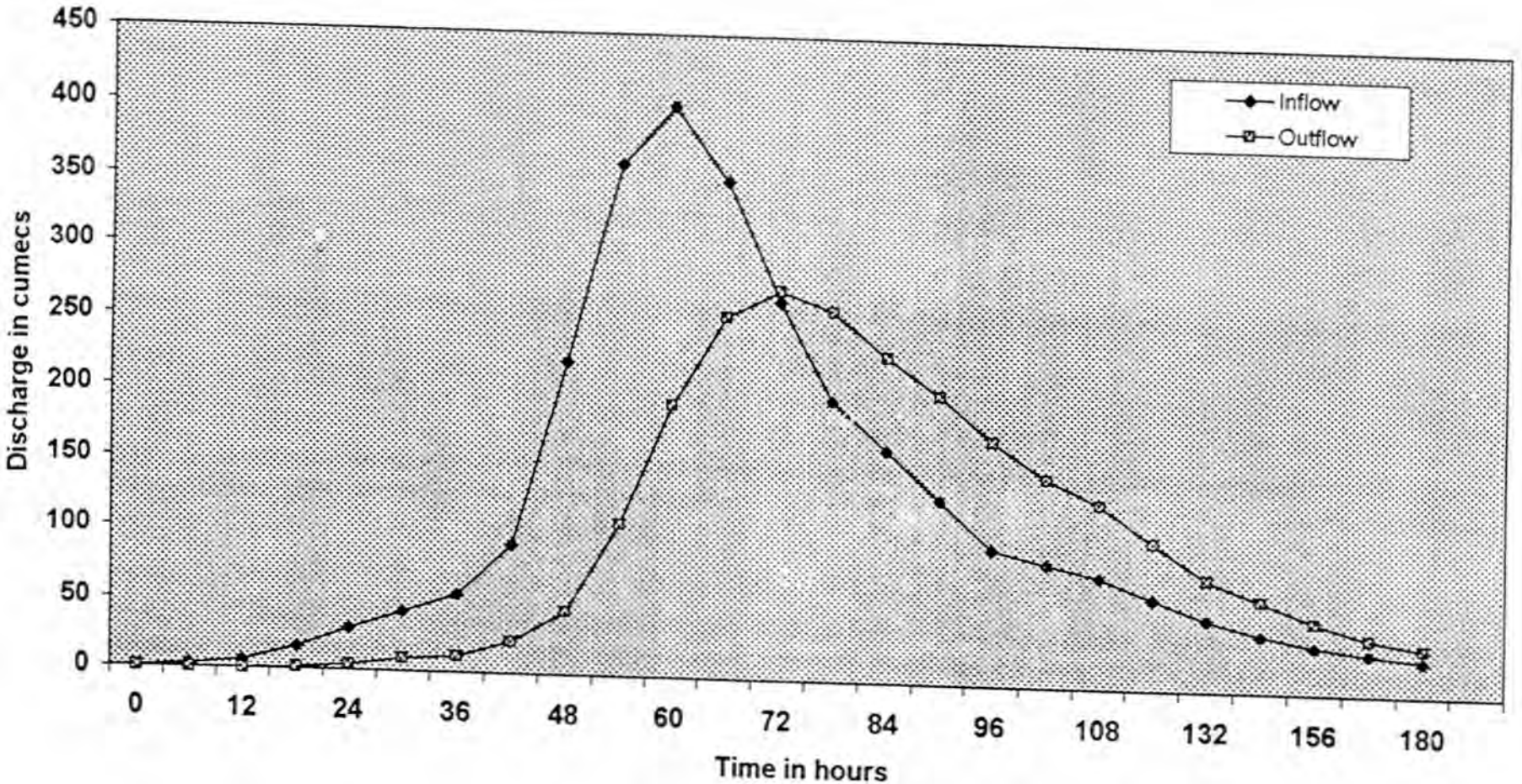

FLOOD HYDROGRAPHS
JAELA - 50 YEARS
Discharge in cumecs
450
400
350
300
250
200
150
100
50
0
0
12
24
36
48
60
72
84
96
108
132
156
180
Time in hours
Inflow
Outflow

Fig.5.6

FLOOD HYDROGRAPHS
JAELA - 100 YEARS

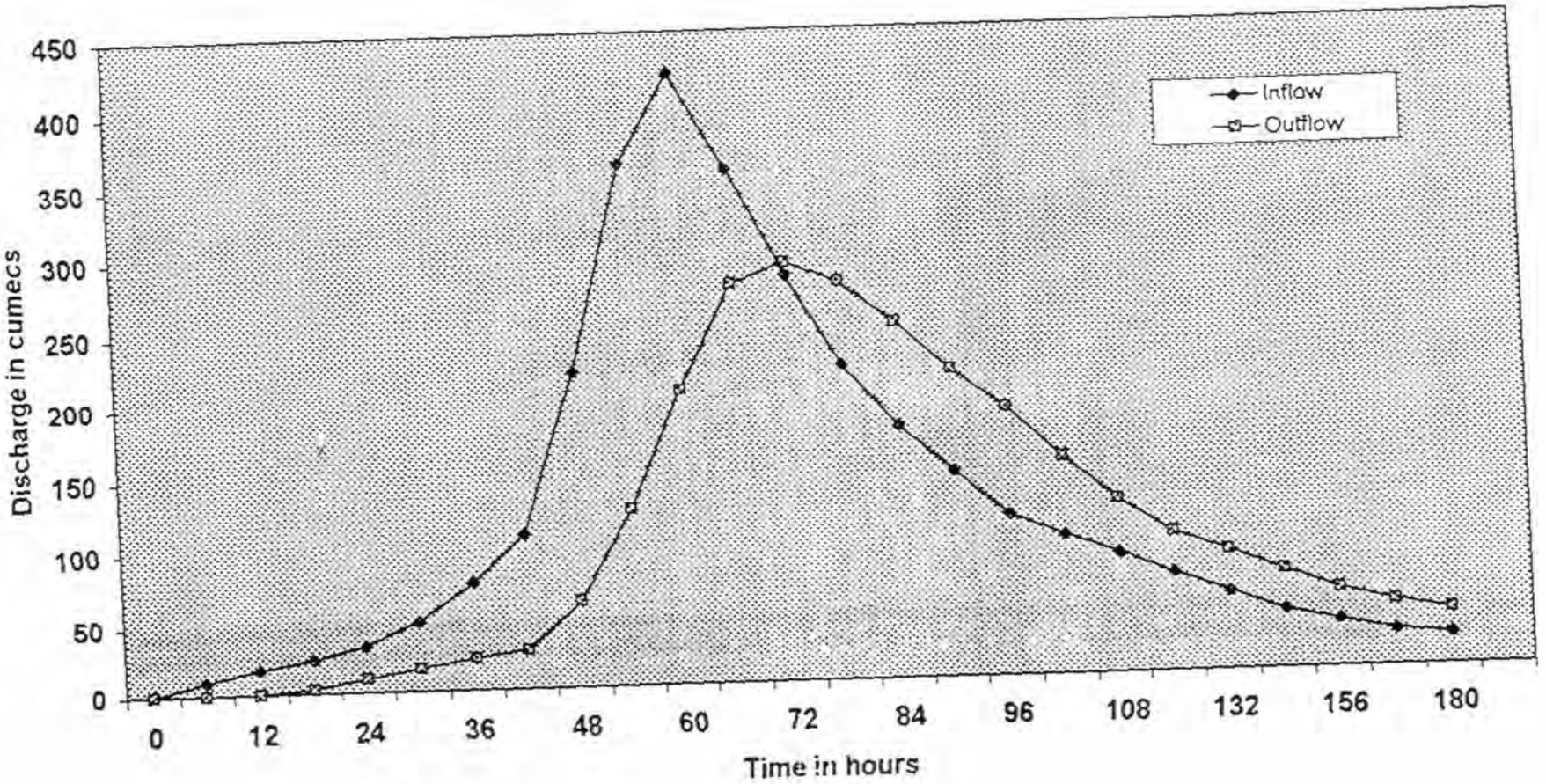


Fig.5.7

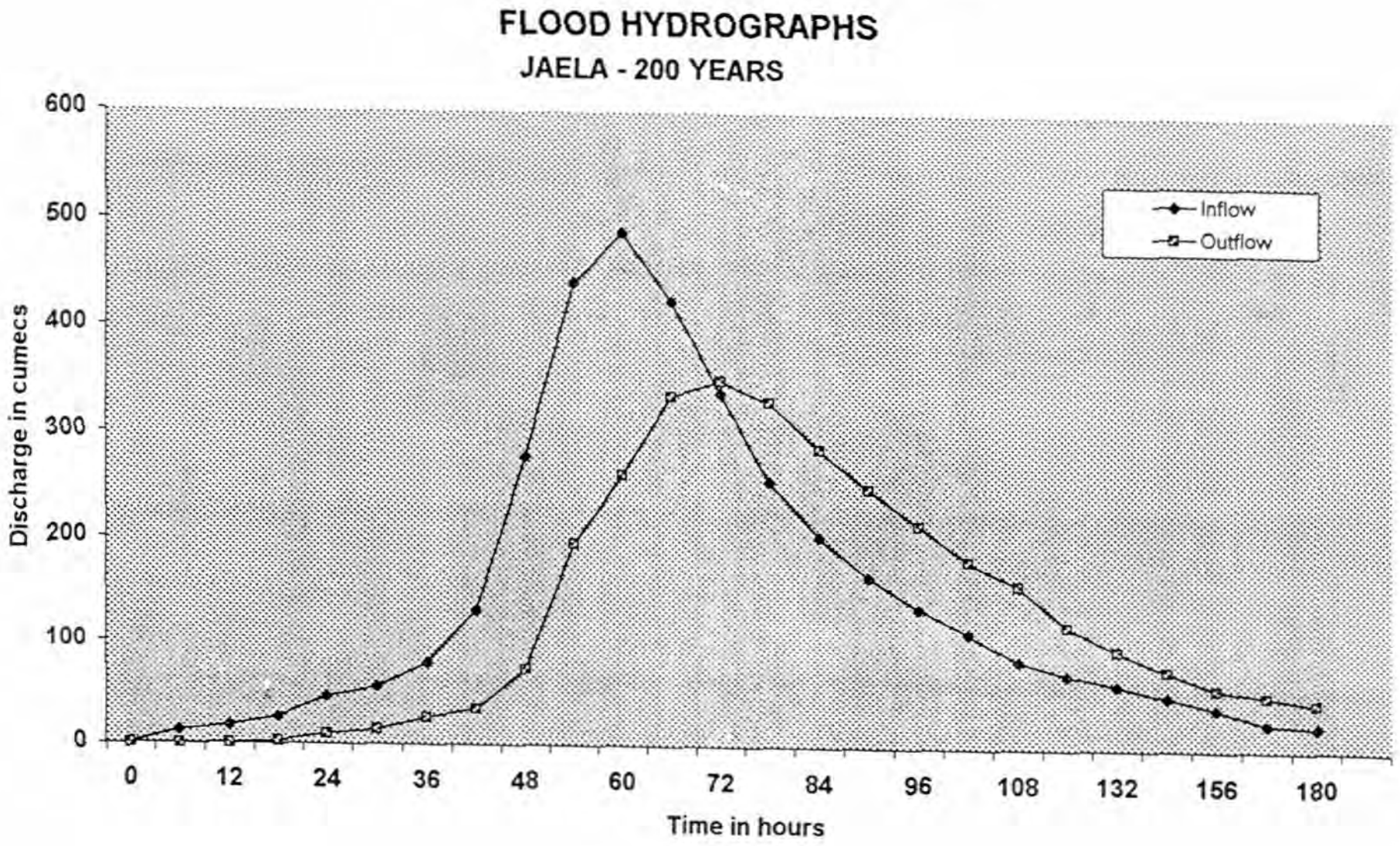

FLOOD HYDROGRAPHS
JAELA - 200 YEARS
Discharge in cumecs
600
500
400
300
200
100
0
0
12
24
36
48
60
72
84
96
108
132
156
180
Time in hours
Inflow
Outflow

Fig.5.8

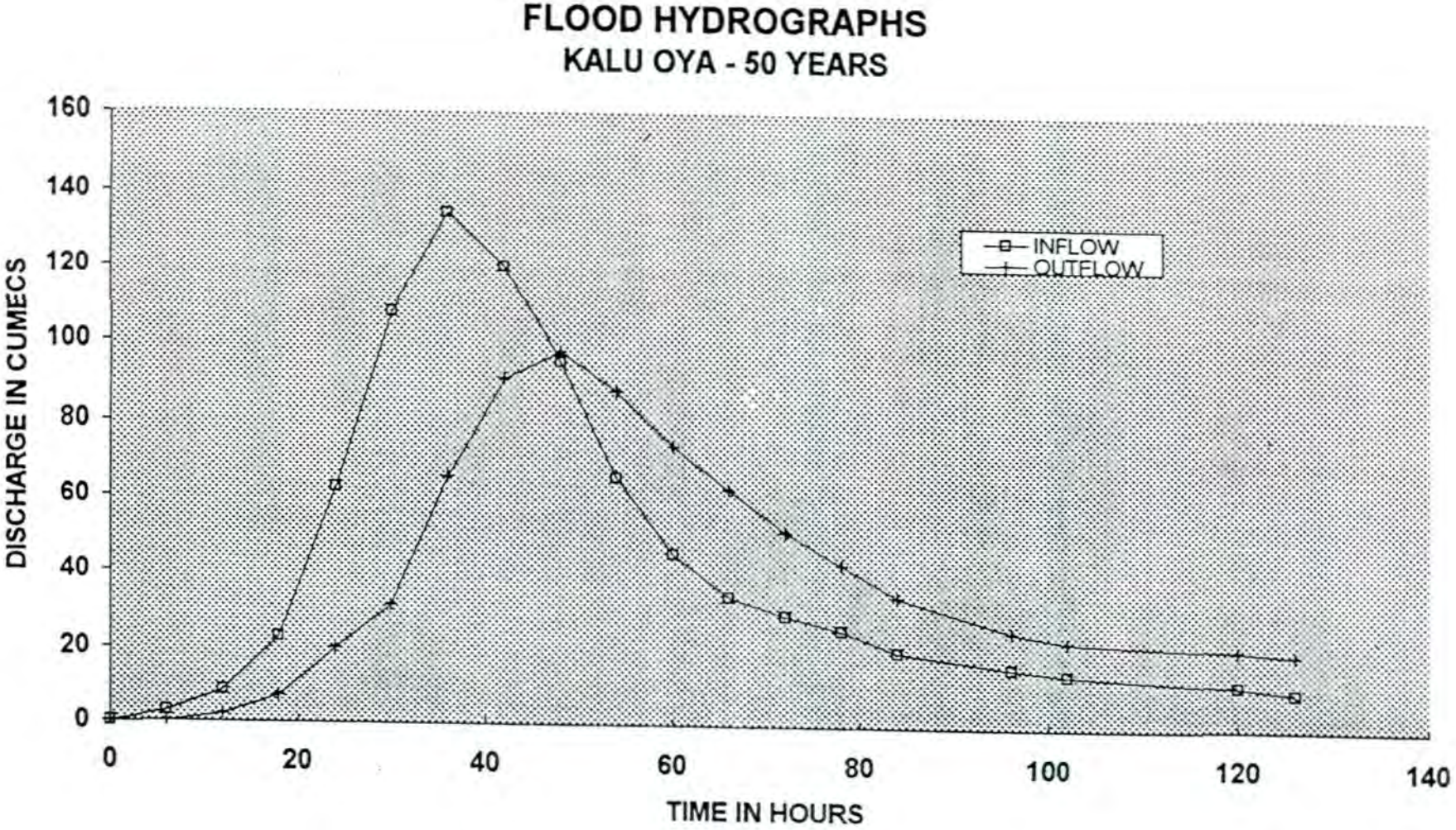

FLOOD HYDROGRAPHS
KALU OYA - 50 YEARS
DISCHARGE IN CUMECS
TIME IN HOURS
INFLOW
OUTFLOW
0
20
40
60
80
100
120
140
160

Fig.5.9

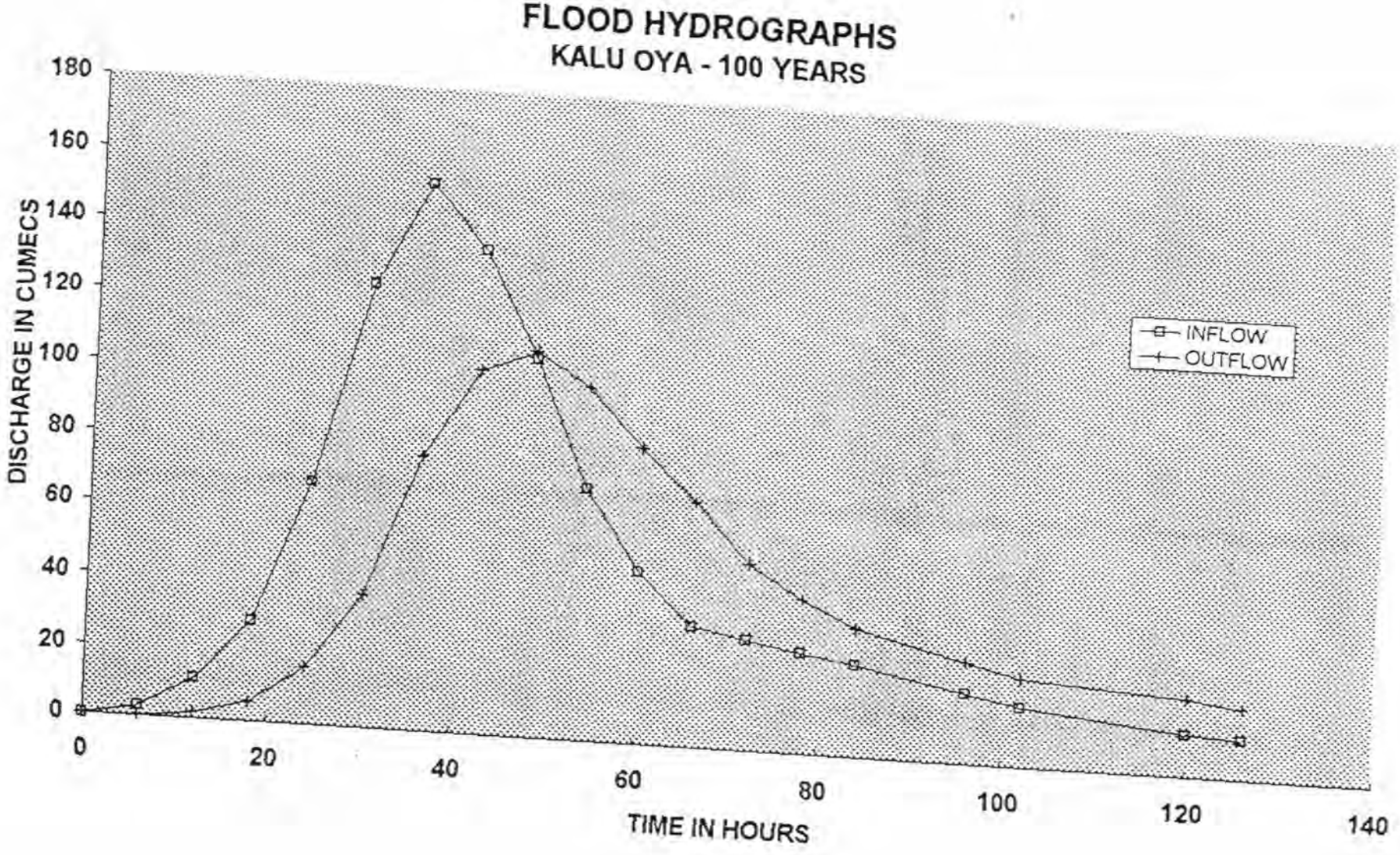

FLOOD HYDROGRAPHS
KALU OYA - 100 YEARS
DISCHARGE IN CUMECS
180
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
120
140
TIME IN HOURS
INFLOW
OUTFLOW

Fig.5.10

FLOOD HYDROGRAPHS
KALU OYA - 200 YEARS

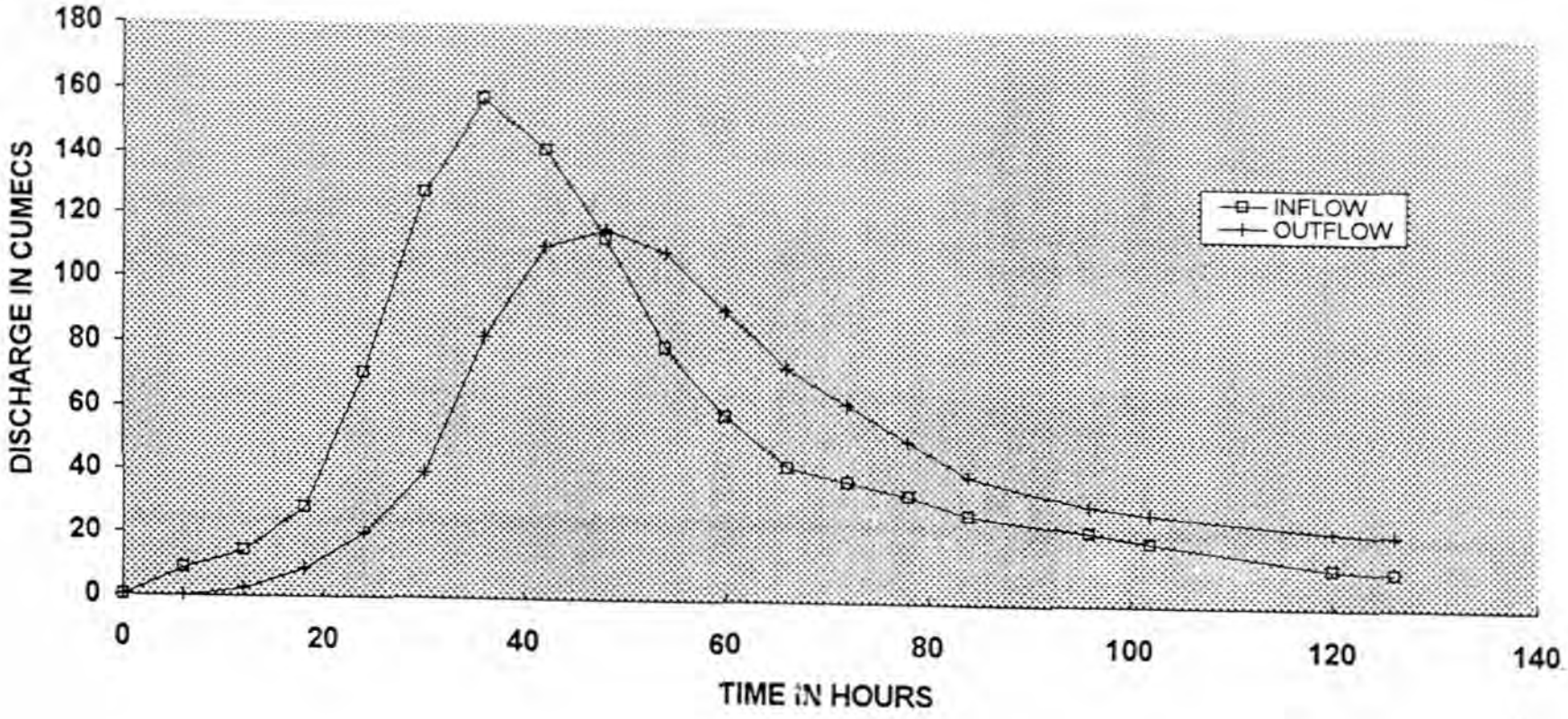


Fig.5.11

Kalu Oya Hydrographs

Since the CKE runs East of the A3, the inflow and outflow hydrographs have been directly computed for the CKE crossings. These outflow hydrographs together with the hydraulic parameters downstream of CKE have been used to estimate the flood levels at CKE and A3 for 50, 100 and 200 year Return Periods. Table 5.1 shows the ordinates of outflow hydrographs for 50, 100 and 200 year Return Periods for the 03 No. catchments.

5.4.3 Flood Routing of Minor Catchments

An empirical formula has been developed for small catchments relating a flood peak and the catchment area as:

$$Q = CM^{3/4}$$

Where M = Catchment Area in Square Miles

Q = Flood Peak in Cusecs

C = A Coefficient representing catchment characteristics and rainfall

Since Kalu Oya is a comparatively small catchment and the flood peak is known, it is possible to compute the coefficient C for Kalu Oya for the different return periods and apply this to the Minor catchments encountered by the CKE; as these micro catchments are hydrologically similar to that of the Kalu Oya. On this basis the flood peaks for Mudun Ela and the 06 No. Micro Catchments for the different return periods has been estimated.

For Kalu Oya

Applying $Q = CM^{3/4}$

Return Period [Yrs]	Coefficient [C]
50	365
100	404
200	434

ORDINATES OF HYDROGRAPHS

KALU OYA				JA-ELA				DANDUGAM OYA			
TIME IN HOURS	DISCHARGE IN CUMECS			TIME IN HOURS	DISCHARGE IN CUMECS			TIME IN HOURS	DISCHARGE IN CUMECS		
	50 YEAR	100 YEAR	200 YEAR		50 YEAR	100 YEAR	200 YEAR		50 YEAR	100 YEAR	200 YEAR
0	0.00	0.00	0.00	0	0.00	0.00	0.00	6	0.00	0.00	0.00
6	0.00	0.00	0.00	6	0.00	0.00	0.00	12	2.80	3.00	2.00
12	2.00	1.50	2.30	12	0.00	0.00	0.00	18	5.50	6.50	5.00
18	7.00	5.40	8.50	18	1.50	3.00	2.00	24	7.80	8.50	8.00
24	20.00	16.00	20.00	24	3.50	10.00	9.00	30	10.20	11.40	11.33
30	31.15	37.10	39.64	30	8.90	16.00	14.00	36	16.00	21.00	39.00
36	65.13	77.10	82.12	36	11.33	22.65	25.00	42	28.32	34.30	67.96
42	90.61	102.20	110.43	42	22.65	28.32	33.98	48	65.00	71.00	98.00
48	97.58	108.20	116.01	48	45.31	62.30	73.62	54	110.50	114.30	158.57
54	87.78	99.00	109.00	54	107.60	124.59	195.00	60	181.23	194.30	237.86
60	73.62	82.90	90.61	60	192.55	205.54	260.51	66	228.53	240.00	342.00
66	62.30	68.60	73.62	66	254.85	277.50	334.14	72	283.17	297.10	396.43
72	50.97	52.00	62.30	72	273.74	291.18	348.72	78	317.15	342.80	453.07
78	42.47	43.00	50.97	78	260.51	277.50	328.47	84	351.13	377.10	481.38
84	34.00	36.00	40.00	84	229.36	249.19	286.00	90	373.78	400.00	509.70
96	25.48	28.60	31.15	90	203.88	215.21	249.19	96	384.40	417.10	516.86
102	23.00	25.00	29.00	96	172.73	186.89	215.21	102	384.51	423.20	509.70
120	21.00	22.00	24.00	102	147.25	152.00	181.23	108	382.27	414.30	500.30
126	19.82	20.00	22.65	108	130.26	122.00	158.57	114	368.12	411.40	475.72
				120	104.00	98.00	120.00	120	351.13	388.60	458.75
				132	79.29	84.95	96.28	126	325.20	370.00	430.41
				144	65.00	70.00	76.00	132	312.00	350.00	405.00
				156	50.97	56.63	59.46	138	290.00	338.00	373.78
				168	40.00	47.00	52.00	144	272.00	305.00	318.00
				180	33.98	39.64	45.31	150	254.86	286.70	288.00
								156	230.00	270.00	270.00
								168	210.00	245.00	220.00
								174	190.00	224.00	195.00
								192	170.00	185.00	175.00
								198	141.58	160.00	169.90

Table 5.1

Mudun Ela

Catchment Area = 5.9 sq km at CKE

Return Period [Yrs]	Peak Flow [Cumecs]
50	19.3
100	21.4
200	23.0

Micro Catchments [06 No.]

Total Catchment Area = 13.48 sq km

Return Period [Yrs]	Peak Flow [Cumecs]
50	35.5
100	39.8
200	42.7

6. HYDRAULIC CONDITIONS DOWNSTREAM OF A3 AND CKE

6.1 General

The proposed trace commencing from the left bank of Kelani Ganga, crosses Kelani Ganga and runs in a northerly direction intercepting the catchments of Mudun Ela, Kalu Oya, Uruwal Oya (Ja-Ela), Dadugam Oya and the micro catchments intervening these basins. Of the above, Mudun Ela and Kalu Oya are right bank tributaries of Kelani Ganga, while Dandugam Oya and Ja-Ela drain into the Negombo Lagoon. The micro catchments drain directly into Muthurajawela marsh.

The proposed trace at its furthest point is about 3.5km from the sea and is essentially located within the flood plains extending from Kelani Ganga to the Negombo Lagoon.

The schematic in Fig. 2.1 indicates the complex nature of the drainage network in the area traversed by the proposed CKE. Detail inspections and studies revealed that, for the purpose of this study the drainage pattern under storm conditions could be schematically represented as in Fig. 6.1 in view of (a) the section of old Dutch Canal between Kalu Oya confluence and Ja-Ela is clogged up with weeds and does not play any significant part in the drainage of flood flows, (b) minor catchments discharge directly into Muthurajawela marsh ,(c) the? marsh, because of its proximity and low elevation can be considered as an extension of the lagoon under flood conditions and (d)Ja-ela because it is canalised discharges directly in to Negombo Lagoon.

6.2 Mudun Ela Catchment

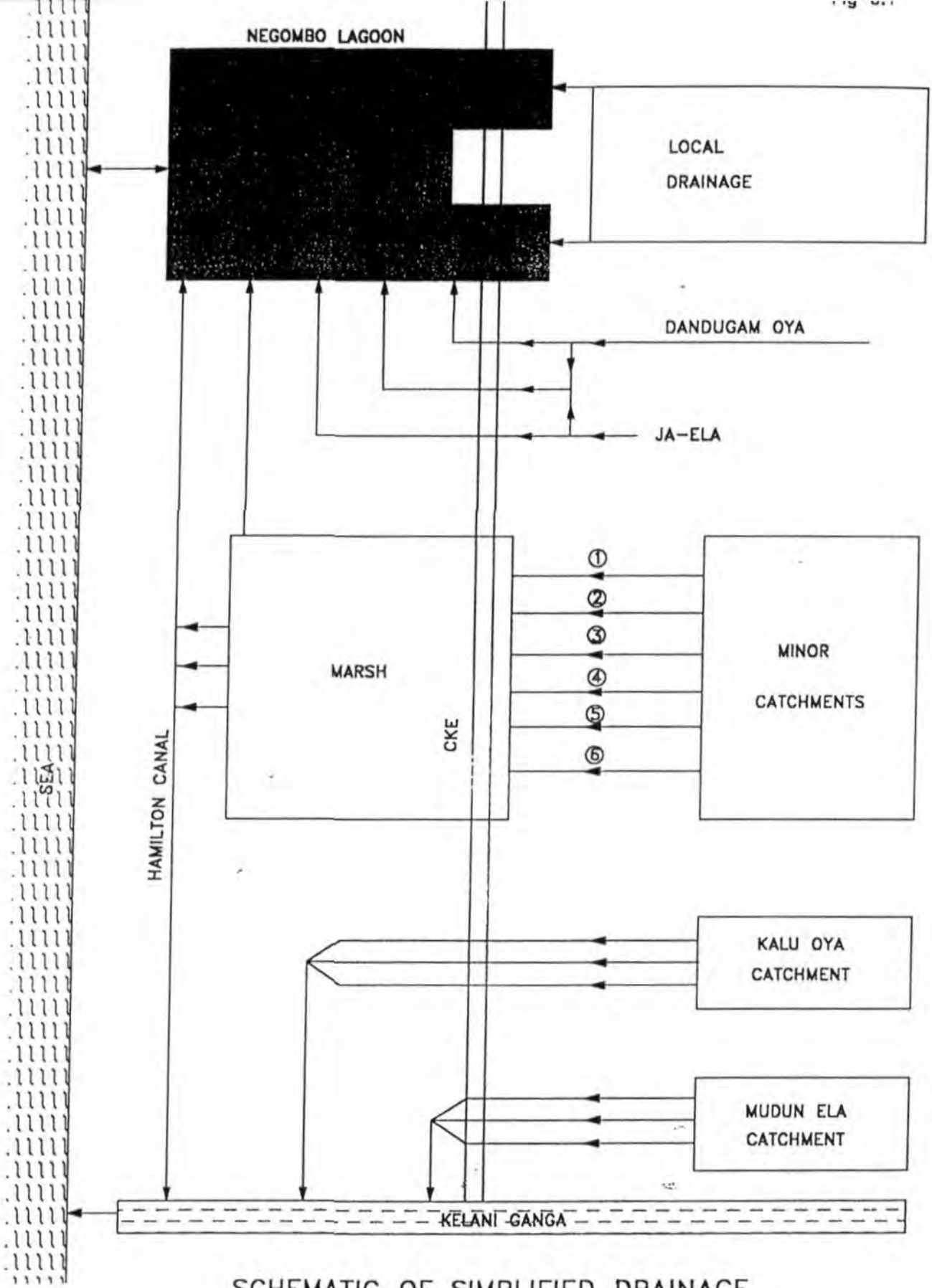
CKE traverses mainly through marsh lands within this basin and the drainage system comprises a network of interconnected channels covered with weeds.
The flood levels in the areas are dependent on the flood stage in Kelani River.
The high flood elevation corresponding to the 1947 flood is 2.5 m-MSL.

6.3 Kalu Oya Catchment

CKE intercepts Kalu Oya drainage at three locations crossing its three tributaries. Further the trace crosses and re-crosses the right bank tributary thrice. Right bank tributary area mainly comprises marshy land, the elevation of which is close to mean sea level. The flood elevation is dependent on the flood stage in Kelani Ganga and the observed HFL is about 2.5m - MSL.

6.4 Micro Catchments

Micro catchments between the catchments of Kalu Oya and Ja-Ela drain into Muthurajawela marsh which is hydraulically interconnected with the Negombo Lagoon. Under storm conditions Muthurajawela marsh is submerged by the back waters of Negombo lagoon.



SCHEMATIC OF SIMPLIFIED DRAINAGE SYSTEM (UNDER STORM CONDITIONS)

Discharges from the micro catchments into the marsh on the eastern side of CKE need be passed on to the western side of the marsh through suitable openings.

6.5 Ja-Ela Catchment

Drainage from this basin flows along the Ja-Ela canal and drains into Negombo lagoon. Because of the canal embankments Ja-Ela does not give rise to overland flows in the marsh traversed by it. Overland flow is limited to spill overs from low sections of the earthen embankments. Water elevations in the canal are directly dependent on the water surface elevations of Negombo lagoon. CKE intercepts Ja-Ela about 4600 m upstream of the lagoon and about 1460 m downstream of A3.

6.6 Dandugam Oya Catchment

Drainage from this basin flows into Negombo lagoon through Dandugamoya, an extrabutary and through channels taking off Mahadora Ela. Under flood conditions part of Dadugam Oya discharge drains into the lagoon as over land flow. Water elevations in Dandugam Oya are directly dependent on the water surface elevations of the lagoon. CKE intercepts Dandugam Oya 4250 m upstream of its confluence with the lagoon and 750m downstream of A3. With the construction of CKE overland flows need be routed through adequate openings on either side of Dandugam Oya.

6.7 Section of CKE traversing along and through a part of the lagoon.

Where the CKE trace runs along the lagoon minor drainages are intercepted and drainage crossings need be provided to cater to these discharges

The part of CKE passing through the lagoon will isolate hydraulically two areas of the lagoon. Adequate openings on the roadway are required to provide for interchange of water between these areas and the main lagoon.

7. HYDRAULIC DESIGN OF DRAINAGE CROSSINGS UNDER PROPOSED CKE

7.1 Methodology

Methodology adopted in the hydraulic design of drainage crossings is set out below:

a) Estimation of pre-project 100 year and 200 year flood levels at the proposed drainage crossing site.

b) Estimation of available waterway area (up to 100 year HFL estimated in (a) with assumed bridge span and stream bed levels. In the case of pipe culverts a minimum diameter of 900 mm was adopted in view of the length of the structure (over 35 m). The Inventory of Drainage Crossings Across A3 presented in paragraph 7.6 was used as a guide in arriving at the waterway area.

c) Estimation of flow velocity through the structure with the 100 year peak discharge arrived at in Chapter 5.

d) Estimation of velocity of approach (and get away) based on available sectional area of flow, hydraulic gradient and Manning's 'n".

e) Calculation of flood afflux (h) at the structure using the relationship

H = contraction loss + expansion loss
$= V_2^2 * C/2g + (V_2 - V_1)^2/2g$

where V_2 = velocity through structure
V_1 = velocity of approach

C = coefficient dependent on the ratio of V_1 / V_2

V_1/V_2	0.1	0.2	0.3	0.4	0.5	0.6	0.7
C	0.36	0.34	0.31	0.28	0.22	0.16	0.1

Reference: Indian Practical Civil Engineers Handbook by P.N Khanna.

7.2 Estimation of Flood Levels

The high flood levels pertaining to Mudun Ela and Kalu Oya were estimated on the basis of historical flood elevations in and around the intersections with CKE. Due to the lack of reliable data on historic flood stages of Kelani Ganga at the confluences of Mudun Ela and Kalu Oya (old Dutch canal), flood levels at CKE intersections could not be correlated with available flood records on Kelani (at Nagalagam street).

Flood elevations in and around Dandugam Oya, Ja-Ela and Muthurajawela marsh are dependent on Negombo lagoon. In order to estimate lagoon water surface elevations under flood conditions a mathematical model was developed with data obtained from site investigations.

7.2.1 Description of the Model

A schematic of the hydraulics of Negambo Lagoon is shown in fig 7.1
Negambo Lagoon covers an extent of 35 Sq km and holds about 45 MCM of water at 0 MSL. The water surface elevation is dependent on :

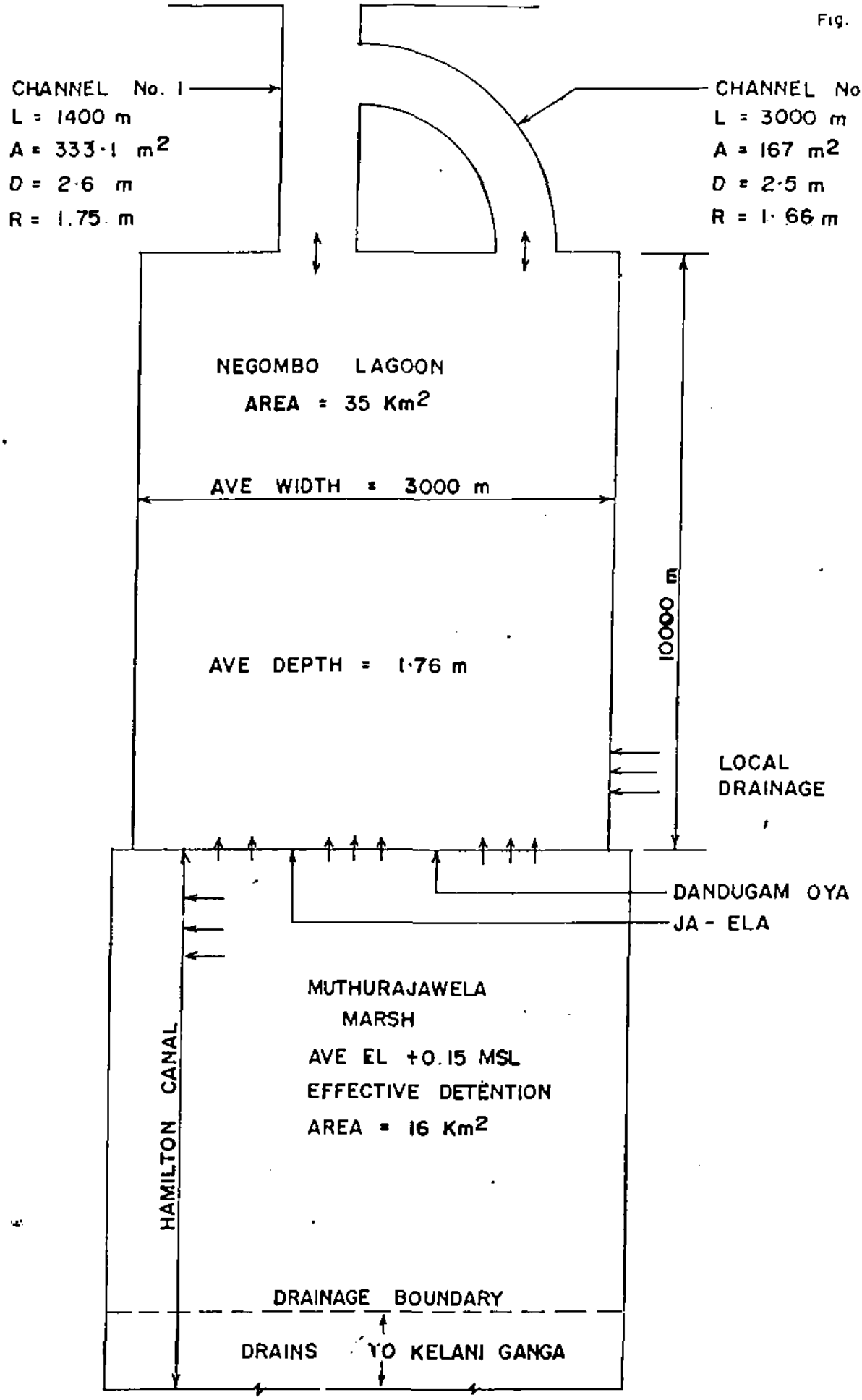
* inflow into the lagoon
* flow in the channel connecting to the sea
* detention capacity of the lagoon

The flow in the channel connecting the lagoon to the sea is a function of the difference between the lagoon and sea water levels which are subject to tidal variation. A maximum tidal variation of + 0.5 m to - 0.5 m applicable to the months of November and May were used in the model as floods could occur during these months.

Interchange between lagoon and sea can be considered as taking place through two channels, the parameters of which are given below:

	Channel No1	Channel No 2
Length of channel in metres	1400	3000
Area of Section A (M^2)	333.1	167
Mannings'n'	0.0225	0.0225
R = Hydraulic Depth	1.75	1.66
Q (M^3/S) = AxR^0.666	21520.2x S^0.5	10398.0 x S^0.5

A part of the Muthurajawela marsh extending from the southern end of the lagoon up to Jayasuriya Road which acts as a physical barrier between northern and southern parts of the marsh, can be considered as providing additional detention storage during storm conditions. The area of this portion of the march has been estimated at 16 sq km and the average elevation is assumed to be + 0.15 MSL. The model takes account of the additional detention storage when the water surface elevation exceeds + 0.15 MSL at the southern end. The inflows fed into the model corresponds to the lagoon inflow resulting from 100 and 200 year return period floods with a storm duration of 120 hours.



SCHEMATIC OF NEGOMBO LAGOON HYDRAULIC CHARACTERISTIC UNDER STORM CONDITIONS

Direct precipitation over the surface of the lagoon and the effective area of the marsh has been added to the detention storage. Losses due to evaporation and infiltration into the ground have been neglected as these are negligibly small during storm conditions.

In operating the model it has been assumed that at time zero, (the beginning of the storm) both lagoon and the sea are at MSL. Since the storm duration is ten times the period from maximum to minimum sea levels, this assumption will not appreciably affect the estimated maximum value of the water surface elevation.

7.2.2 Results Obtained from the Model

The maximum water surface elevations at the southern end of the lagoon caused by the 100 year and 200 year flood inflows are estimated at 0.776 m and1.002 m respectively. The maximum water surface elevations are reached 20 hours and 28.5 hours after the peaks owing to the moderating effect of the large detention capacity of the lagoon. The water surface elevation corresponding to the 100 year peak inflow is 0.686 m MSL. Flood routing is given in Table 7.1.

7.2.3 Estimation of Flood Levels along CKE Trace

Methodology for the estimation of flood levels in Dandugam Oya, Ja-ela and the Muthurajawela marsh is presented in Figure 7.2.

Reach of CKE within the Lagoon (22+250 to 24 + 200)

High flood elevation within this reach (in the northern part of the lagoon) is estimated at 0.77m MSL. This level is higher than the observed flood levels in the area estimated at about 0.3 m MSL.

Dandugam Oya (18 + 725)

The water surface gradient of the Dandugam Oya downstream of A3 under flood conditions was estimated as 0.0000968 and the estimated high flood level at CKE is + 1.19 m MSL.

Ja Ela (15 + 360)

Water surface gradient of Ja Ela downstream of A3 under flood conditions was estimated as 0.00025. and the estimated high flood level at CKE is + 1.93 m MSL.

Reach of CKE between Ja Ela Crossing (15 + 360) & A3 Crossing (7 + 120)

Table 7.1

Negombo Lagoon Flood Routing

100 year Flood - 6 No. Sheets

200 year Flood - 6 No. Sheets

NEGOMBO LAGOON FLOOD ROUTING - 200 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT RAIN mm	DETENTION STORAGE M^3	LAGOON ELEV.		EL AT SOUTHERN END	
							TRIAL M-MSL	FINAL M-MSL	TRIAL M-MSL	FINAL M-MSL
0.0	0.0	0.000	0.000	0.0	2.92	0	0.047	0.000	0.047	0.000
0.5	0.0	0.042	-0.042	-156.2	2.92	289,458	0.053	0.008	0.053	0.008
1.0	0.0	0.083	-0.075	-209.6	2.92	767,547	0.062	0.022	0.062	0.022
1.5	0.0	0.125	-0.103	-245.6	2.92	1,326,135	0.073	0.038	0.073	0.038
2.0	0.0	0.167	-0.129	-274.5	2.92	1,943,161	0.085	0.056	0.085	0.056
2.5	0.0	0.208	-0.153	-299.0	2.92	2,608,292	0.098	0.075	0.098	0.075
3.0	0.0	0.250	-0.175	-320.5	2.92	3,314,764	0.112	0.095	0.112	0.095
3.5	0.0	0.292	-0.197	-339.5	2.92	4,057,647	0.127	0.116	0.127	0.116
4.0	0.0	0.333	-0.217	-356.7	2.92	4,833,139	0.142	0.138	0.142	0.138
4.5	0.0	0.375	-0.237	-372.3	2.92	5,638,190	0.158	0.161	0.158	0.161
5.0	0.0	0.417	-0.256	-386.7	2.92	6,470,286	0.174	0.174	0.174	0.174
5.5	0.0	0.458	-0.284	-408.0	2.92	7,334,441	0.191	0.191	0.191	0.191
6.0	0.0	0.500	-0.309	-425.3	2.92	8,233,330	0.208	0.208	0.208	0.208
6.5	1.1	0.458	-0.250	-382.4	2.92	9,110,156	0.226	0.226	0.226	0.226
7.0	1.2	0.417	-0.191	-334.3	2.92	9,906,113	0.241	0.241	0.241	0.241
7.5	1.3	0.375	-0.134	-279.7	2.92	10,609,837	0.255	0.255	0.255	0.255
8.0	1.3	0.333	-0.078	-214.0	2.92	11,205,412	0.267	0.267	0.267	0.267
8.5	1.4	0.292	-0.025	-120.7	2.92	11,658,016	0.276	0.276	0.276	0.276
9.0	1.5	0.250	0.026	122.5	2.92	11,807,930	0.279	0.279	0.279	0.279
9.5	1.6	0.208	0.070	202.8	2.92	11,666,878	0.276	0.276	0.276	0.276
10.0	1.7	0.167	0.109	252.7	2.92	11,408,768	0.271	0.271	0.271	0.271
10.5	1.8	0.125	0.146	292.1	2.92	11,070,440	0.264	0.264	0.264	0.264
11.0	1.8	0.083	0.181	325.3	2.92	10,666,983	0.256	0.256	0.256	0.256
11.5	1.9	0.042	0.215	354.3	2.92	10,207,628	0.247	0.247	0.247	0.247
12.0	2.0	0.000	0.247	380.4	2.92	9,698,849	0.237	0.237	0.237	0.237
12.5	2.4	-0.042	0.279	404.0	2.92	9,145,827	0.226	0.226	0.226	0.226
13.0	2.8	-0.083	0.310	425.7	2.92	8,552,709	0.215	0.215	0.215	0.215
13.5	3.3	-0.125	0.340	445.9	2.92	7,922,627	0.202	0.202	0.202	0.202
14.0	3.7	-0.167	0.369	464.7	2.92	7,258,191	0.189	0.189	0.189	0.189
14.5	4.1	-0.208	0.398	482.4	2.92	6,561,628	0.176	0.176	0.176	0.176
15.0	4.5	-0.250	0.426	499.1	2.92	5,834,861	0.161	0.161	0.161	0.161
15.5	4.9	-0.292	0.453	515.0	2.92	5,079,576	0.147	0.147	0.147	0.147
16.0	5.3	-0.333	0.480	530.0	2.92	4,297,266	0.131	0.123	0.131	0.123
16.5	5.8	-0.375	0.498	539.7	2.92	3,493,411	0.116	0.100	0.116	0.100
17.0	6.2	-0.417	0.516	549.8	2.92	2,672,509	0.099	0.076	0.099	0.076
17.5	6.6	-0.458	0.535	559.4	2.92	1,834,669	0.083	0.052	0.083	0.052
18.0	7.0	-0.500	0.552	568.6	2.92	980,653	0.066	0.028	0.066	0.028
18.5	7.8	-0.458	0.486	533.5	2.92	151,058	0.050	0.004	0.050	0.004
19.0	8.7	-0.417	0.421	496.3	2.92	-612,029	0.035	-0.017	0.035	-0.017
19.5	9.5	-0.375	0.358	457.4	2.92	-1,305,134	0.021	-0.037	0.021	-0.037
20.0	10.3	-0.333	0.296	416.2	2.92	-1,924,629	0.009	-0.055	0.009	-0.055

NEGOMBO LAGOON FLOOD ROUTING - 200 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT RAIN mm	DETENTION STORAGE M^3	LAGOON ELEV.		EL AT SOUTHERN END	
							TRIAL M-MSL	FINAL M-MSL	TRIAL M-MSL	FINAL M-MSL
20.5	11.2	-0.292	0.237	372.2	2.92	-2,465,902	-0.001	-0.070	-0.001	-0.070
21.0	12.0	-0.250	0.180	324.1	2.92	-2,922,797	-0.010	-0.084	-0.010	-0.083
21.5	12.8	-0.208	0.125	270.3	2.92	-3,286,486	-0.017	-0.094	-0.017	-0.094
22.0	13.7	-0.167	0.073	206.3	2.92	-3,542,654	-0.022	-0.101	-0.022	-0.101
22.5	14.5	-0.125	0.024	117.9	2.92	-3,660,221	-0.025	-0.105	-0.025	-0.105
23.0	15.3	-0.083	-0.021	-111.6	2.92	-3,490,186	-0.021	-0.100	-0.021	-0.100
23.5	16.2	-0.042	-0.058	-184.4	2.92	-3,046,598	-0.013	-0.087	-0.013	-0.087
24.0	17.0	0.000	-0.087	-225.7	2.92	-2,498,751	-0.002	-0.071	-0.002	-0.071
24.5	17.7	0.042	-0.113	-257.3	2.92	-1,883,918	0.010	-0.054	0.010	-0.054
25.0	18.4	0.083	-0.137	-283.3	2.92	-1,215,982	0.023	-0.035	0.023	-0.035
25.5	19.1	0.125	-0.160	-305.8	2.92	-503,124	0.037	-0.014	0.037	-0.014
26.0	19.8	0.167	-0.181	-325.5	2.92	248,947	0.052	0.007	0.052	0.007
26.5	20.5	0.208	-0.201	-343.2	2.92	1,035,935	0.067	0.030	0.067	0.030
27.0	21.2	0.250	-0.220	-359.2	2.92	1,854,454	0.083	0.053	0.083	0.053
27.5	21.9	0.292	-0.239	-373.8	2.92	2,701,746	0.100	0.077	0.100	0.077
28.0	22.6	0.333	-0.256	-387.2	2.92	3,575,511	0.117	0.102	0.117	0.102
28.5	23.2	0.375	-0.273	-399.6	2.92	4,473,793	0.135	0.128	0.135	0.128
29.0	23.9	0.417	-0.289	-411.2	2.92	5,394,903	0.153	0.154	0.153	0.154
29.5	24.6	0.458	-0.304	-422.0	2.92	6,337,364	0.171	0.171	0.171	0.171
30.0	25.3	0.500	-0.329	-438.6	2.92	7,305,780	0.190	0.190	0.190	0.190
30.5	28.6	0.458	-0.268	-396.1	2.92	8,254,450	0.209	0.209	0.209	0.209
31.0	31.8	0.417	-0.208	-348.8	2.92	9,128,053	0.226	0.226	0.226	0.226
31.5	35.0	0.375	-0.149	-295.4	2.92	9,916,802	0.241	0.241	0.242	0.242
32.0	38.2	0.333	-0.092	-232.0	2.92	10,606,267	0.255	0.255	0.255	0.255
32.5	41.4	0.292	-0.037	-146.8	2.92	11,167,816	0.266	0.266	0.266	0.266
33.0	44.7	0.250	0.016	96.2	2.92	11,439,763	0.271	0.271	0.271	0.271
33.5	47.9	0.208	0.063	191.7	2.92	11,412,875	0.271	0.271	0.271	0.271
34.0	51.1	0.167	0.104	246.6	2.92	11,256,472	0.267	0.267	0.268	0.268
34.5	54.3	0.125	0.142	288.7	2.92	11,018,533	0.263	0.263	0.263	0.263
35.0	57.6	0.083	0.179	324.0	2.92	10,716,685	0.257	0.257	0.257	0.257
35.5	60.8	0.042	0.215	354.8	2.92	10,361,169	0.250	0.250	0.250	0.250
36.0	64.0	0.000	0.250	382.3	2.92	9,958,994	0.242	0.242	0.243	0.243
36.5	67.2	-0.042	0.283	407.3	2.92	9,515,309	0.233	0.233	0.234	0.234
37.0	70.4	-0.083	0.316	430.3	2.92	9,034,160	0.224	0.224	0.225	0.225
37.5	73.6	-0.125	0.349	451.7	2.92	8,518,871	0.213	0.213	0.214	0.214
38.0	76.8	-0.167	0.380	471.6	2.92	7,972,166	0.203	0.203	0.204	0.204
38.5	80.0	-0.208	0.411	490.4	2.92	7,396,352	0.191	0.191	0.193	0.193
39.0	83.2	-0.250	0.441	508.2	2.92	6,793,412	0.179	0.179	0.181	0.181
39.5	86.4	-0.292	0.471	525.0	2.92	6,165,076	0.167	0.167	0.168	0.168
40.0	89.6	-0.333	0.500	541.1	2.92	5,512,869	0.154	0.154	0.156	0.156

NEGOMBO LAGOON FLOOD ROUTING - 200 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT KAIN mm	DETENTION STORAGE M^3	LAGOON ELEV.		EL AT SOUTHERN END	
							TRIAL M-MSL	FINAL M-MSL	TRIAL M-MSL	FINAL M-MSL
40.5	92.8	-0.375	0.529	556.5	2.92	4,838,147	0.141	0.141	0.142	0.142
41.0	96.0	-0.417	0.558	571.2	2.92	4,142,126	0.127	0.117	0.129	0.119
41.5	99.2	-0.458	0.576	580.5	2.92	3,430,265	0.113	0.097	0.115	0.099
42.0	101.9	-0.500	0.597	591.1	2.92	2,705,805	0.099	0.076	0.101	0.078
42.5	107.7	-0.458	0.535	559.4	2.92	2,008,026	0.085	0.056	0.087	0.058
43.0	113.6	-0.417	0.473	526.1	2.92	1,379,224	0.072	0.038	0.075	0.041
43.5	119.4	-0.375	0.413	491.7	2.92	821,745	0.061	0.022	0.064	0.025
44.0	125.2	-0.333	0.355	456.1	2.92	337,717	0.052	0.008	0.055	0.011
44.5	131.0	-0.292	0.300	418.9	2.92	-70,292	0.044	-0.004	0.047	0.000
45.0	136.8	-0.250	0.246	379.7	2.92	-399,095	0.037	-0.013	0.040	-0.010
45.5	142.6	-0.208	0.195	337.9	2.92	-644,596	0.032	-0.020	0.036	-0.016
46.0	148.4	-0.167	0.146	292.6	2.92	-801,265	0.029	-0.025	0.033	-0.021
46.5	154.2	-0.125	0.100	241.9	2.92	-861,058	0.027	-0.027	0.032	-0.022
47.0	160.0	-0.083	0.056	181.7	2.92	-810,634	0.028	-0.026	0.033	-0.021
47.5	165.8	-0.042	0.016	96.9	2.92	-619,257	0.031	-0.020	0.037	-0.015
48.0	171.6	0.000	-0.020	-109.1	2.92	-155,670	0.040	-0.007	0.046	-0.002
48.5	186.8	0.042	-0.049	-169.2	1.95	516,848	0.053	0.011	0.059	0.018
49.0	201.9	0.083	-0.072	-205.2	1.95	1,303,114	0.067	0.033	0.075	0.041
49.5	217.1	0.125	-0.092	-231.6	1.95	2,172,830	0.084	0.058	0.093	0.067
50.0	232.3	0.167	-0.109	-252.7	1.95	3,112,627	0.101	0.084	0.112	0.094
50.5	247.4	0.208	-0.125	-270.0	1.95	4,114,258	0.120	0.112	0.132	0.123
51.0	262.6	0.250	-0.138	-284.5	1.95	5,171,826	0.140	0.141	0.153	0.154
51.5	277.8	0.292	-0.151	-296.8	1.95	6,280,793	0.160	0.160	0.175	0.175
52.0	292.9	0.333	-0.173	-318.1	1.95	7,447,233	0.182	0.182	0.199	0.199
52.5	308.1	0.375	-0.193	-335.9	1.95	8,676,118	0.205	0.205	0.223	0.223
53.0	323.2	0.417	-0.211	-351.8	1.95	9,962,654	0.229	0.229	0.249	0.249
53.5	338.4	0.458	-0.229	-366.2	1.95	11,303,769	0.254	0.254	0.276	0.276
54.0	353.6	0.500	-0.246	-379.2	1.95	12,696,880	0.280	0.280	0.304	0.304
54.5	365.6	0.458	-0.178	-322.8	1.95	14,075,498	0.306	0.306	0.332	0.332
55.0	377.7	0.417	-0.111	-254.3	1.95	15,363,390	0.330	0.330	0.358	0.358
55.5	389.8	0.375	-0.045	-161.8	1.95	16,528,034	0.352	0.352	0.381	0.381
56.0	401.8	0.333	0.019	104.4	1.95	17,391,595	0.368	0.368	0.399	0.399
56.5	413.9	0.292	0.076	210.9	1.95	17,941,470	0.377	0.377	0.410	0.410
57.0	426.0	0.250	0.127	272.8	1.95	18,361,433	0.384	0.384	0.419	0.419
57.5	438.0	0.208	0.176	320.8	1.95	18,704,226	0.390	0.390	0.426	0.426
58.0	450.1	0.167	0.223	361.2	1.95	18,989,247	0.394	0.394	0.433	0.433
58.5	462.2	0.125	0.269	396.6	1.95	19,227,730	0.397	0.397	0.438	0.438
59.0	474.2	0.083	0.314	428.5	1.95	19,427,336	0.400	0.400	0.443	0.443
59.5	486.3	0.042	0.358	457.7	1.95	19,593,725	0.401	0.401	0.447	0.447
60.0	498.4	0.000	0.401	484.7	1.95	19,731,299	0.403	0.403	0.450	0.450

NEGOMBO LAGOON FLOOD ROUTING - 200 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT RAIN mm	DETENTION STORAGE M^3	LAGOON ELEV.		EL AT SOUTHERN END	
							TRIAL M-MSL	FINAL M-MSL	TRIAL M-MSL	FINAL M-MSL
60.5	513.2	-0.042	0.444	509.9	1.95	19,846,071	0.403	0.403	0.454	0.454
61.0	528.0	-0.083	0.486	533.4	1.95	19,943,594	0.403	0.403	0.457	0.457
61.5	542.8	-0.125	0.528	555.8	1.95	20,026,439	0.403	0.403	0.459	0.459
62.0	557.6	-0.167	0.569	577.1	1.95	20,096,625	0.402	0.402	0.462	0.462
62.5	572.4	-0.208	0.610	597.6	1.95	20,155,909	0.401	0.401	0.464	0.464
63.0	587.3	-0.250	0.651	617.2	1.95	20,205,829	0.400	0.400	0.466	0.466
63.5	602.1	-0.292	0.691	636.1	1.95	20,247,751	0.398	0.398	0.468	0.468
64.0	616.9	-0.333	0.732	654.3	1.95	20,282,894	0.397	0.397	0.470	0.470
64.5	631.7	-0.375	0.772	672.0	1.95	20,312,356	0.395	0.395	0.472	0.472
65.0	646.5	-0.417	0.812	689.2	1.95	20,337,128	0.393	0.393	0.473	0.473
65.5	661.3	-0.458	0.851	705.9	1.95	20,358,113	0.391	0.391	0.475	0.475
66.0	676.1	-0.500	0.891	722.1	1.95	20,376,133	0.389	0.389	0.477	0.477
66.5	681.9	-0.458	0.847	704.1	1.95	20,414,194	0.389	0.389	0.478	0.478
67.0	687.6	-0.417	0.805	686.5	1.95	20,494,592	0.389	0.389	0.480	0.480
67.5	693.3	-0.375	0.764	668.7	1.95	20,617,113	0.391	0.391	0.483	0.483
68.0	699.0	-0.333	0.724	650.9	1.95	20,781,954	0.393	0.393	0.487	0.487
68.5	704.7	-0.292	0.684	632.9	1.95	20,989,333	0.396	0.396	0.491	0.491
69.0	710.4	-0.250	0.646	614.8	1.95	21,239,478	0.400	0.400	0.497	0.497
69.5	716.1	-0.208	0.608	596.5	1.95	21,532,639	0.404	0.404	0.503	0.503
70.0	721.9	-0.167	0.571	578.1	1.95	21,869,082	0.410	0.410	0.510	0.510
70.5	727.6	-0.125	0.535	559.6	1.95	22,249,094	0.416	0.416	0.518	0.518
71.0	733.3	-0.083	0.500	540.8	1.95	22,672,987	0.424	0.424	0.527	0.527
71.5	739.0	-0.042	0.465	521.9	1.95	23,141,100	0.432	0.432	0.537	0.537
72.0	744.7	0.000	0.432	502.7	1.95	23,653,801	0.441	0.441	0.547	0.547
72.5	747.8	0.042	0.399	483.3	1.95	24,209,115	0.451	0.451	0.559	0.559
73.0	750.9	0.083	0.368	463.9	1.95	24,804,846	0.462	0.462	0.571	0.571
73.5	753.9	0.125	0.337	444.2	1.95	25,441,263	0.474	0.474	0.583	0.583
74.0	757.0	0.167	0.307	424.2	1.95	26,118,987	0.487	0.487	0.597	0.597
74.5	760.1	0.208	0.278	403.7	1.95	26,838,718	0.500	0.500	0.611	0.611
75.0	763.1	0.250	0.250	382.7	1.95	27,601,246	0.515	0.515	0.627	0.627
75.5	766.2	0.292	0.223	361.3	1.95	28,407,474	0.530	0.530	0.643	0.643
76.0	769.3	0.333	0.197	339.2	1.95	29,258,444	0.546	0.546	0.660	0.660
76.5	772.3	0.375	0.171	316.3	1.95	30,155,377	0.563	0.563	0.678	0.678
77.0	775.4	0.417	0.146	292.6	1.95	31,099,726	0.581	0.581	0.697	0.697
77.5	778.5	0.458	0.123	267.8	1.95	32,093,261	0.600	0.600	0.716	0.716
78.0	781.5	0.500	0.100	241.6	1.95	33,138,197	0.620	0.620	0.737	0.737
78.5	783.9	0.458	0.161	307.3	1.95	34,152,517	0.639	0.639	0.757	0.757
79.0	779.2	0.417	0.222	360.8	1.95	35,057,492	0.658	0.658	0.775	0.775
79.5	778.0	0.375	0.283	406.8	1.95	35,867,589	0.674	0.674	0.790	0.790
80.0	776.8	0.333	0.341	446.4	1.95	36,598,486	0.688	0.688	0.804	0.804

NEGOMBO LAGOON FLOOD ROUTING - 200 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT RAIN mm	DETENTION STORAGE M^3	LAGOON ELEV.		EL AT SOUTHERN END	
							TRIAL M-MSL	FINAL M-MSL	TRIAL M-MSL	FINAL M-MSL
80.5	775.6	0.292	0.397	481.9	1.95	37,259,687	0.702	0.702	0.817	0.817
81.0	774.5	0.250	0.452	514.1	1.95	37,857,847	0.714	0.714	0.829	0.829
81.5	773.3	0.208	0.505	543.8	1.95	38,398,172	0.724	0.724	0.839	0.839
82.0	772.1	0.167	0.558	571.3	1.95	38,884,880	0.734	0.734	0.849	0.849
82.5	770.9	0.125	0.609	597.1	1.95	39,321,482	0.743	0.743	0.857	0.857
83.0	769.7	0.083	0.660	621.3	1.95	39,710,961	0.751	0.751	0.865	0.865
83.5	768.6	0.042	0.709	644.2	1.95	40,055,889	0.758	0.758	0.871	0.871
84.0	767.4	0.000	0.758	666.0	1.95	40,358,518	0.764	0.764	0.877	0.877
84.5	766.7	-0.042	0.806	686.7	1.95	40,621,263	0.769	0.769	0.882	0.882
85.0	766.0	-0.083	0.853	706.4	1.95	40,846,357	0.774	0.774	0.887	0.887
85.5	765.3	-0.125	0.899	725.3	1.95	41,035,421	0.778	0.778	0.890	0.890
86.0	764.6	-0.167	0.944	743.4	1.95	41,189,888	0.781	0.781	0.893	0.893
86.5	763.8	-0.208	0.989	760.8	1.95	41,311,063	0.783	0.783	0.896	0.896
87.0	763.1	-0.250	1.033	777.7	1.95	41,400,143	0.785	0.785	0.897	0.897
87.5	762.4	-0.292	1.077	793.9	1.95	41,458,230	0.787	0.787	0.898	0.898
88.0	761.7	-0.333	1.120	809.5	1.95	41,486,342	0.787	0.787	0.899	0.899
88.5	761.0	-0.375	1.162	824.7	1.95	41,485,425	0.787	0.787	0.899	0.899
89.0	760.3	-0.417	1.204	839.4	1.95	41,456,359	0.787	0.787	0.898	0.898
89.5	759.6	-0.458	1.245	853.7	1.95	41,399,968	0.786	0.786	0.897	0.897
90.0	758.9	-0.500	1.286	867.5	1.95	41,317,023	0.784	0.784	0.895	0.895
90.5	756.7	-0.458	1.243	852.8	1.95	41,232,184	0.783	0.783	0.893	0.893
91.0	754.4	-0.417	1.200	838.0	1.95	41,169,891	0.782	0.782	0.892	0.892
91.5	752.2	-0.375	1.157	823.0	1.95	41,130,394	0.782	0.782	0.891	0.891
92.0	749.9	-0.333	1.115	807.9	1.95	41,113,898	0.782	0.782	0.890	0.890
92.5	747.7	-0.292	1.074	792.7	1.95	41,120,614	0.783	0.783	0.890	0.890
93.0	745.5	-0.250	1.033	777.4	1.95	41,150,766	0.784	0.784	0.891	0.891
93.5	743.2	-0.208	0.992	762.0	1.95	41,204,586	0.785	0.785	0.891	0.891
94.0	741.0	-0.167	0.952	746.4	1.95	41,282,317	0.787	0.787	0.893	0.893
94.5	738.7	-0.125	0.912	730.6	1.95	41,384,215	0.790	0.790	0.895	0.895
95.0	736.5	-0.083	0.873	714.7	1.95	41,510,549	0.792	0.792	0.897	0.897
95.5	734.3	-0.042	0.834	698.7	1.95	41,661,602	0.796	0.796	0.900	0.900
96.0	732.0	0.000	0.796	682.5	1.95	41,837,673	0.800	0.800	0.903	0.903
96.5	728.6	0.042	0.758	666.0	1.95	42,038,011	0.804	0.804	0.906	0.906
97.0	725.2	0.083	0.721	649.5	1.95	42,261,806	0.809	0.809	0.910	0.910
97.5	721.7	0.125	0.684	632.8	1.95	42,509,348	0.815	0.815	0.915	0.915
98.0	718.3	0.167	0.648	615.9	1.95	42,781,045	0.821	0.821	0.920	0.920
98.5	714.9	0.208	0.612	598.6	1.95	43,077,332	0.827	0.827	0.925	0.925
99.0	711.5	0.250	0.577	581.2	1.95	43,398,677	0.834	0.834	0.931	0.931
99.5	708.0	0.292	0.542	563.4	1.95	43,745,581	0.841	0.841	0.938	0.938
100.0	704.6	0.333	0.508	545.3	1.95	44,118,584	0.849	0.849	0.945	0.945

NEGOMBO LAGOON FLOOD ROUTING - 200 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT RAIN mm	DETENTION STORAGE M^3	LAGOON ELEV.		EL AT SOUTHERN END	
							TRIAL M-MSL	FINAL M-MSL	TRIAL M-MSL	FINAL M-MSL
100.5	701.2	0.375	0.474	526.9	1.95	44,518,270	0.858	0.858	0.952	0.952
101.0	697.8	0.417	0.441	508.1	1.95	44,945,274	0.867	0.867	0.960	0.960
101.5	694.4	0.458	0.408	488.9	1.95	45,400,289	0.876	0.876	0.969	0.969
102.0	690.9	0.500	0.376	469.3	1.95	45,884,077	0.886	0.886	0.978	0.978
102.5	687.8	0.458	0.428	500.5	1.95	46,351,517	0.896	0.896	0.987	0.987
103.0	684.6	0.417	0.479	529.7	1.95	46,758,928	0.905	0.905	0.995	0.995
103.5	681.5	0.375	0.530	556.8	1.95	47,110,078	0.912	0.912	1.001	1.001
104.0	678.4	0.333	0.579	582.0	1.95	47,408,528	0.919	0.919	1.007	1.007
104.5	675.2	0.292	0.627	605.7	1.95	47,657,301	0.924	0.924	1.012	1.012
105.0	672.1	0.250	0.674	628.0	1.95	47,859,002	0.928	0.928	1.015	1.015
105.5	668.9	0.208	0.720	649.2	1.95	48,015,909	0.932	0.932	1.018	1.018
106.0	665.8	0.167	0.765	669.2	1.95	48,130,037	0.935	0.935	1.020	1.020
106.5	662.6	0.125	0.810	688.4	1.95	48,203,181	0.937	0.937	1.021	1.021
107.0	659.5	0.083	0.853	706.7	1.95	48,236,958	0.938	0.938	1.022	1.022
107.5	656.4	0.042	0.896	724.2	1.95	48,232,833	0.938	0.938	1.021	1.021
108.0	658.9	0.000	0.938	741.0	1.95	48,197,235	0.937	0.937	1.021	1.021
108.5	655.2	-0.042	0.979	756.9	1.95	48,131,218	0.937	0.937	1.019	1.019
109.0	651.6	-0.083	1.020	772.6	1.95	48,030,252	0.935	0.935	1.017	1.017
109.5	647.9	-0.125	1.060	787.7	1.95	47,894,993	0.933	0.933	1.014	1.014
110.0	644.2	-0.167	1.100	802.3	1.95	47,726,431	0.930	0.930	1.010	1.010
110.5	640.6	-0.208	1.139	816.3	1.95	47,525,490	0.927	0.927	1.006	1.006
111.0	636.9	-0.250	1.177	830.0	1.95	47,293,032	0.923	0.923	1.001	1.001
111.5	633.3	-0.292	1.215	843.2	1.95	47,029,868	0.919	0.919	0.996	0.996
112.0	629.6	-0.333	1.252	855.9	1.95	46,736,759	0.913	0.913	0.990	0.990
112.5	626.0	-0.375	1.288	868.3	1.95	46,414,421	0.908	0.908	0.983	0.983
113.0	622.3	-0.417	1.324	880.3	1.95	46,063,533	0.901	0.901	0.976	0.976
113.5	618.7	-0.458	1.360	892.0	1.95	45,684,735	0.894	0.894	0.968	0.968
114.0	615.0	-0.500	1.394	903.4	1.95	45,278,637	0.887	0.887	0.960	0.960
114.5	612.0	-0.458	1.345	887.3	1.95	44,870,746	0.880	0.880	0.952	0.952
115.0	609.0	-0.417	1.296	871.0	1.95	44,486,584	0.872	0.872	0.944	0.944
115.5	605.9	-0.375	1.247	854.4	1.95	44,126,596	0.866	0.866	0.937	0.937
116.0	602.9	-0.333	1.199	837.7	1.95	43,791,068	0.860	0.860	0.930	0.930
116.5	599.9	-0.292	1.151	820.9	1.95	43,480,297	0.854	0.854	0.923	0.923
117.0	596.9	-0.250	1.104	803.8	1.95	43,194,595	0.849	0.849	0.918	0.918
117.5	593.9	-0.208	1.057	786.6	1.95	42,934,291	0.844	0.844	0.912	0.912
118.0	590.8	-0.167	1.011	769.2	1.95	42,699,730	0.840	0.840	0.907	0.907
118.5	587.8	-0.125	0.965	751.6	1.95	42,491,277	0.837	0.837	0.903	0.903
119.0	584.8	-0.083	0.920	733.7	1.95	42,309,318	0.833	0.833	0.899	0.899
119.5	581.8	-0.042	0.875	715.6	1.95	42,154,261	0.831	0.831	0.896	0.896
120.0	578.8	0.000	0.831	697.3	1.95	42,026,540	0.829	0.829	0.893	0.893
max	783.9	0.500	1.394	903.4	2.92	48,236,958	0.938	0.938	1.022	1.022

NEGOMBO LAGOON FLOOD ROUTING - 100 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT RAIN mm	DETENTION STORAGE M^3	LAGOON ELEV.		EL AT SOUTHERN END	
							TRIAL M-MSL	FINAL M-MSL	TRIAL M-MSL	FINAL M-MSL
0.0	0.0	0.000	0.000	0.0	2.70	0	0.047	0.000	0.047	0.000
0.5	0.0	0.042	-0.042	-156.2	2.70	278,238	0.053	0.008	0.053	0.008
1.0	0.0	0.083	-0.075	-210.0	2.70	745,509	0.062	0.021	0.062	0.021
1.5	0.0	0.125	-0.104	-246.3	2.70	1,293,954	0.072	0.037	0.072	0.037
2.0	0.0	0.167	-0.130	-275.5	2.70	1,901,315	0.084	0.054	0.084	0.054
2.5	0.0	0.208	-0.154	-300.2	2.70	2,557,157	0.097	0.073	0.097	0.073
3.0	0.0	0.250	-0.177	-321.8	2.70	3,254,658	0.111	0.093	0.111	0.093
3.5	0.0	0.292	-0.199	-341.0	2.70	3,988,848	0.125	0.114	0.125	0.114
4.0	0.0	0.333	-0.219	-358.3	2.70	4,755,897	0.140	0.136	0.140	0.136
4.5	0.0	0.375	-0.239	-374.1	2.70	5,552,733	0.156	0.159	0.156	0.159
5.0	0.0	0.417	-0.258	-388.6	2.70	6,376,826	0.172	0.172	0.172	0.172
5.5	0.0	0.458	-0.286	-409.3	2.70	7,232,600	0.189	0.189	0.189	0.189
6.0	0.0	0.500	-0.311	-426.7	2.70	8,122,684	0.206	0.206	0.206	0.206
6.5	0.3	0.458	-0.252	-384.0	2.70	8,990,266	0.223	0.223	0.223	0.223
7.0	0.5	0.417	-0.193	-336.4	2.70	9,776,989	0.239	0.239	0.239	0.239
7.5	0.8	0.375	-0.136	-282.4	2.70	10,472,662	0.252	0.252	0.252	0.252
8.0	1.0	0.333	-0.081	-217.6	2.70	11,061,921	0.264	0.264	0.264	0.264
8.5	1.3	0.292	-0.028	-127.3	2.70	11,512,112	0.273	0.273	0.273	0.273
9.0	1.5	0.250	0.023	115.5	2.70	11,662,961	0.276	0.276	0.276	0.276
9.5	1.8	0.208	0.067	198.6	2.70	11,520,900	0.273	0.273	0.273	0.273
10.0	2.0	0.167	0.106	249.4	2.70	11,258,753	0.268	0.268	0.268	0.268
10.5	2.3	0.125	0.143	289.1	2.70	10,915,622	0.261	0.261	0.261	0.261
11.0	2.5	0.083	0.178	322.5	2.70	10,507,131	0.253	0.253	0.253	0.253
11.5	2.8	0.042	0.211	351.7	2.70	10,042,712	0.244	0.244	0.244	0.244
12.0	3.0	0.000	0.244	377.9	2.70	9,528,948	0.234	0.234	0.234	0.234
12.5	3.5	-0.042	0.276	401.6	2.70	8,971,043	0.223	0.223	0.223	0.223
13.0	4.1	-0.083	0.306	423.4	2.70	8,373,148	0.211	0.211	0.211	0.211
13.5	4.6	-0.125	0.336	443.6	2.70	7,738,419	0.199	0.199	0.199	0.199
14.0	5.2	-0.167	0.365	462.5	2.70	7,069,489	0.186	0.186	0.186	0.186
14.5	5.7	-0.208	0.394	480.2	2.70	6,368,596	0.172	0.172	0.172	0.172
15.0	6.3	-0.250	0.422	496.9	2.70	5,637,675	0.158	0.158	0.158	0.158
15.5	6.8	-0.292	0.449	512.8	2.70	4,878,418	0.143	0.143	0.143	0.143
16.0	7.3	-0.333	0.476	527.8	2.70	4,092,323	0.127	0.117	0.127	0.117
16.5	7.9	-0.375	0.492	536.5	2.70	3,285,793	0.111	0.094	0.111	0.094
17.0	8.4	-0.417	0.511	546.6	2.70	2,463,326	0.095	0.070	0.095	0.070
17.5	9.0	-0.458	0.529	556.2	2.70	1,624,102	0.079	0.046	0.079	0.046
18.0	9.5	-0.500	0.546	565.5	2.70	768,873	0.062	0.022	0.062	0.022
18.5	10.3	-0.458	0.480	530.2	2.70	-61,723	0.046	-0.002	0.046	-0.002
19.0	11.0	-0.417	0.415	492.7	2.70	-825,518	0.031	-0.024	0.031	-0.024
19.5	11.8	-0.375	0.351	453.5	2.70	-1,518,949	0.017	-0.043	0.017	-0.043
20.0	12.5	-0.333	0.290	411.9	2.70	-2,138,271	0.005	-0.061	0.005	-0.061

NEGOMBO LAGOON FLOOD ROUTING - 100 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT RAIN mm	DETENTION STORAGE M^3	LAGOON ELEV.		EL AT SOUTHERN END	
							TRIAL M-MSL	FINAL M-MSL	TRIAL M-MSL	FINAL M-MSL
20.5	13.3	-0.292	0.231	367.3	2.70	-2,678,700	-0.005	-0.077	-0.005	-0.077
21.0	14.0	-0.250	0.173	318.6	2.70	-3,133,803	-0.014	-0.090	-0.014	-0.090
21.5	14.8	-0.208	0.119	263.6	2.70	-3,494,248	-0.021	-0.100	-0.021	-0.100
22.0	15.5	-0.167	0.067	197.7	2.70	-3,744,565	-0.026	-0.107	-0.026	-0.107
22.5	16.3	-0.125	0.018	102.6	2.70	-3,848,592	-0.028	-0.110	-0.028	-0.110
23.0	17.0	-0.083	-0.027	-124.9	2.70	-3,660,912	-0.025	-0.105	-0.025	-0.105
23.5	17.8	-0.042	-0.063	-191.9	2.70	-3,206,784	-0.016	-0.092	-0.016	-0.092
24.0	18.5	0.000	-0.092	-231.6	2.70	-2,655,270	-0.005	-0.076	-0.005	-0.076
24.5	19.2	0.042	-0.118	-262.3	2.70	-2,039,099	0.007	-0.058	0.007	-0.058
25.0	20.0	0.083	-0.142	-287.9	2.70	-1,370,924	0.020	-0.039	0.020	-0.039
25.5	20.7	0.125	-0.164	-310.0	2.70	-658,487	0.034	-0.019	0.034	-0.019
26.0	21.5	0.167	-0.186	-329.5	2.70	92,729	0.049	0.003	0.049	0.003
26.5	22.2	0.208	-0.206	-347.0	2.70	878,567	0.064	0.025	0.064	0.025
27.0	23.0	0.250	-0.225	-362.8	2.70	1,695,732	0.080	0.048	0.080	0.049
27.5	23.7	0.292	-0.243	-377.3	2.70	2,541,531	0.097	0.073	0.097	0.073
28.0	24.4	0.333	-0.261	-390.6	2.70	3,413,707	0.114	0.097	0.114	0.098
28.5	25.2	0.375	-0.278	-403.0	2.70	4,310,340	0.131	0.123	0.132	0.123
29.0	25.9	0.417	-0.294	-414.5	2.70	5,229,766	0.150	0.149	0.150	0.149
29.5	26.7	0.458	-0.309	-425.2	2.70	6,170,530	0.168	0.176	0.168	0.176
30.0	27.4	0.500	-0.324	-435.3	2.70	7,131,341	0.187	0.187	0.187	0.187
30.5	28.8	0.458	-0.272	-398.6	2.70	8,070,105	0.205	0.205	0.205	0.205
31.0	30.1	0.417	-0.211	-351.8	2.70	8,936,164	0.222	0.222	0.222	0.222
31.5	31.5	0.375	-0.153	-299.1	2.70	9,715,052	0.237	0.237	0.238	0.238
32.0	32.8	0.333	-0.096	-236.9	2.70	10,392,985	0.251	0.251	0.251	0.251
32.5	34.2	0.292	-0.041	-154.8	2.70	10,943,534	0.261	0.261	0.262	0.262
33.0	35.5	0.250	0.011	82.0	2.70	11,209,500	0.267	0.267	0.267	0.267
33.5	36.9	0.208	0.058	184.8	2.70	11,172,236	0.266	0.266	0.266	0.266
34.0	38.2	0.167	0.099	241.0	2.70	10,994,273	0.262	0.262	0.263	0.263
34.5	39.6	0.125	0.137	283.6	2.70	10,729,821	0.257	0.257	0.258	0.258
35.0	40.9	0.083	0.174	319.0	2.70	10,397,622	0.251	0.251	0.251	0.251
35.5	42.3	0.042	0.209	349.8	2.70	10,008,315	0.243	0.243	0.243	0.243
36.0	43.7	0.000	0.243	377.2	2.70	9,569,126	0.234	0.234	0.235	0.235
36.5	45.2	-0.042	0.276	402.0	2.70	9,085,594	0.225	0.225	0.225	0.225
37.0	46.8	-0.083	0.308	424.7	2.70	8,562,080	0.215	0.215	0.215	0.215
37.5	48.4	-0.125	0.340	445.8	2.70	8,001,931	0.204	0.204	0.204	0.204
38.0	50.0	-0.167	0.370	465.5	2.70	7,407,921	0.192	0.192	0.192	0.192
38.5	51.6	-0.208	0.400	484.0	2.70	6,782,394	0.180	0.180	0.180	0.180
39.0	53.1	-0.250	0.430	501.5	2.70	6,127,371	0.167	0.167	0.167	0.167
39.5	54.7	-0.292	0.459	518.0	2.70	5,444,611	0.153	0.153	0.154	0.154
40.0	56.3	-0.333	0.487	533.7	2.70	4,735,664	0.140	0.140	0.140	0.140

NEGOMBO LAGOON FLOOD ROUTING - 100 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT RAIN mm	DETENTION STORAGE M^3	LAGOON ELEV. TRIAL M-MSL	LAGOON ELEV. FINAL M-MSL	EL AT SOUTHERN END TRIAL M-MSL	EL AT SOUTHERN END FINAL M-MSL
40.5	57.9	-0.375	0.515	548.7	2.70	4,001,914	0.125	0.114	0.126	0.115
41.0	59.5	-0.417	0.531	557.3	2.70	3,249,809	0.110	0.093	0.111	0.093
41.5	61.0	-0.458	0.551	567.8	2.70	2,483,411	0.095	0.071	0.096	0.071
42.0	62.6	-0.500	0.571	577.9	2.70	1,701,340	0.080	0.048	0.081	0.049
42.5	68.5	-0.458	0.507	544.5	2.70	946,961	0.065	0.027	0.066	0.028
43.0	74.4	-0.417	0.443	509.3	2.70	264,867	0.052	0.007	0.053	0.008
43.5	80.3	-0.375	0.382	472.8	2.70	-342,151	0.040	-0.010	0.041	-0.009
44.0	86.2	-0.333	0.323	434.7	2.70	-871,432	0.029	-0.026	0.030	-0.024
44.5	92.1	-0.292	0.266	394.6	2.70	-1,319,689	0.020	-0.039	0.022	-0.037
45.0	98.0	-0.250	0.211	351.8	2.70	-1,682,706	0.013	-0.049	0.015	-0.047
45.5	103.9	-0.208	0.159	305.4	2.70	-1,954,816	0.007	-0.057	0.009	-0.055
46.0	109.7	-0.167	0.110	253.5	2.70	-2,127,824	0.004	-0.062	0.006	-0.060
46.5	115.6	-0.125	0.063	192.1	2.70	-2,188,282	0.002	-0.064	0.005	-0.061
47.0	121.5	-0.083	0.020	106.9	2.70	-2,106,227	0.004	-0.062	0.007	-0.059
47.5	127.4	-0.042	-0.020	-108.0	2.70	-1,743,495	0.011	-0.051	0.014	-0.048
48.0	133.3	0.000	-0.051	-173.4	2.70	-1,117,901	0.023	-0.034	0.026	-0.030
48.5	142.1	0.042	-0.075	-209.9	1.80	-433,241	0.036	-0.014	0.040	-0.010
49.0	150.9	0.083	-0.098	-239.1	1.80	326,355	0.051	0.007	0.055	0.012
49.5	159.7	0.125	-0.118	-262.6	1.80	1,149,212	0.066	0.030	0.071	0.035
50.0	168.5	0.167	-0.136	-282.4	1.80	2,026,925	0.083	0.055	0.089	0.061
50.5	177.3	0.208	-0.153	-299.4	1.80	2,953,546	0.101	0.081	0.107	0.087
51.0	186.1	0.250	-0.169	-314.1	1.80	3,924,567	0.120	0.109	0.126	0.115
51.5	194.9	0.292	-0.183	-327.1	1.80	4,936,408	0.139	0.137	0.146	0.145
52.0	203.7	0.333	-0.196	-338.6	1.80	5,986,122	0.159	0.167	0.167	0.175
52.5	212.5	0.375	-0.208	-348.9	1.80	7,071,224	0.180	0.180	0.189	0.189
53.0	221.3	0.417	-0.237	-372.2	1.80	8,202,335	0.202	0.202	0.211	0.211
53.5	230.1	0.458	-0.257	-387.5	1.80	9,384,097	0.224	0.224	0.235	0.235
54.0	238.9	0.500	-0.276	-401.6	1.80	10,608,221	0.248	0.248	0.259	0.259
54.5	252.3	0.458	-0.210	-351.0	1.80	11,819,422	0.271	0.271	0.283	0.283
55.0	265.7	0.417	-0.146	-292.2	1.80	12,956,283	0.292	0.292	0.306	0.306
55.5	279.1	0.375	-0.083	-220.1	1.80	13,999,552	0.312	0.312	0.327	0.327
56.0	292.5	0.333	-0.022	-112.5	1.80	14,905,210	0.329	0.329	0.345	0.345
56.5	306.0	0.292	0.037	146.8	1.80	15,504,730	0.339	0.339	0.357	0.357
57.0	319.4	0.250	0.089	228.5	1.80	15,821,485	0.344	0.344	0.364	0.364
57.5	332.8	0.208	0.136	282.2	1.80	16,040,564	0.348	0.348	0.369	0.369
58.0	346.2	0.167	0.181	325.4	1.80	16,196,619	0.349	0.349	0.373	0.373
58.5	359.6	0.125	0.224	362.5	1.80	16,304,564	0.350	0.350	0.375	0.375
59.0	373.0	0.083	0.267	395.4	1.80	16,373,686	0.351	0.351	0.377	0.377
59.5	386.4	0.042	0.309	425.2	1.80	16,410,532	0.350	0.350	0.379	0.379
60.0	399.8	0.000	0.350	452.6	1.80	16,420,037	0.349	0.349	0.380	0.380

NEGOMBO LAGOON FLOOD ROUTING - 100 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT RAIN mm	DETENTION STORAGE M^3	LAGOON ELEV.		EL AT SOUTHERN END	
							TRIAL M-MSL	FINAL M-MSL	TRIAL M-MSL	FINAL M-MSL
60.5	409.6	-0.042	0.390	478.0	1.80	16,402,840	0.347	0.347	0.380	0.380
61.0	419.5	-0.083	0.431	502.1	1.80	16,358,687	0.346	0.346	0.379	0.379
61.5	429.3	-0.125	0.471	524.8	1.80	16,290,114	0.343	0.343	0.379	0.379
62.0	439.1	-0.167	0.510	546.2	1.80	16,199,478	0.340	0.340	0.377	0.377
62.5	448.9	-0.208	0.549	566.7	1.80	16,088,810	0.337	0.337	0.376	0.376
63.0	458.7	-0.250	0.587	586.1	1.80	15,959,879	0.333	0.333	0.374	0.374
63.5	468.5	-0.292	0.625	604.8	1.80	15,814,242	0.329	0.329	0.372	0.372
64.0	478.3	-0.333	0.663	622.8	1.80	15,653,284	0.325	0.325	0.369	0.369
64.5	488.1	-0.375	0.700	640.1	1.80	15,478,243	0.320	0.320	0.366	0.366
65.0	497.9	-0.417	0.737	656.8	1.80	15,290,238	0.316	0.316	0.363	0.363
65.5	507.7	-0.458	0.774	673.0	1.80	15,090,280	0.310	0.310	0.360	0.360
66.0	517.5	-0.500	0.810	688.7	1.80	14,879,293	0.305	0.305	0.356	0.356
66.5	523.4	-0.458	0.763	668.4	1.80	14,686,590	0.300	0.300	0.353	0.353
67.0	529.3	-0.417	0.717	647.8	1.80	14,541,272	0.297	0.297	0.351	0.351
67.5	535.2	-0.375	0.672	627.0	1.80	14,443,782	0.294	0.294	0.349	0.349
68.0	541.1	-0.333	0.627	605.9	1.80	14,394,580	0.292	0.292	0.349	0.349
68.5	547.0	-0.292	0.584	584.6	1.80	14,394,164	0.292	0.292	0.349	0.349
69.0	552.9	-0.250	0.542	562.9	1.80	14,443,079	0.292	0.292	0.350	0.350
69.5	558.8	-0.208	0.500	540.9	1.80	14,541,926	0.293	0.293	0.353	0.353
70.0	564.7	-0.167	0.459	518.5	1.80	14,691,367	0.295	0.295	0.356	0.356
70.5	570.6	-0.125	0.420	495.7	1.80	14,892,138	0.298	0.298	0.361	0.361
71.0	576.5	-0.083	0.381	472.4	1.80	15,145,067	0.302	0.302	0.366	0.366
71.5	582.4	-0.042	0.344	448.5	1.80	15,451,085	0.307	0.307	0.372	0.372
72.0	588.3	0.000	0.307	424.0	1.80	15,811,256	0.313	0.313	0.380	0.380
72.5	590.9	0.042	0.272	398.7	1.80	16,223,901	0.321	0.321	0.388	0.388
73.0	593.6	0.083	0.238	373.0	1.80	16,687,246	0.330	0.330	0.398	0.398
73.5	596.3	0.125	0.205	346.1	1.80	17,202,734	0.339	0.339	0.408	0.408
74.0	599.0	0.167	0.173	318.0	1.80	17,772,527	0.350	0.350	0.419	0.419
74.5	601.6	0.208	0.142	288.2	1.80	18,399,315	0.362	0.362	0.432	0.432
75.0	604.3	0.250	0.112	256.1	1.80	19,086,572	0.375	0.375	0.445	0.445
75.5	607.0	0.292	0.084	221.1	1.80	19,839,013	0.390	0.390	0.460	0.460
76.0	609.6	0.333	0.056	181.3	1.80	20,663,581	0.405	0.405	0.477	0.477
76.5	612.3	0.375	0.030	133.1	1.80	21,572,108	0.423	0.423	0.495	0.495
77.0	615.0	0.417	0.006	59.3	1.80	22,595,245	0.442	0.442	0.515	0.515
77.5	617.6	0.458	-0.016	-96.8	1.80	23,830,087	0.466	0.466	0.539	0.539
78.0	620.3	0.500	-0.034	-140.8	1.80	25,249,843	0.494	0.494	0.568	0.568
78.5	623.2	0.458	0.035	143.6	1.80	26,458,275	0.517	0.517	0.591	0.591
79.0	621.3	0.417	0.100	242.1	1.80	27,323,031	0.534	0.534	0.608	0.608
79.5	621.8	0.375	0.159	305.1	1.80	28,041,189	0.548	0.548	0.622	0.622
80.0	622.3	0.333	0.215	354.5	1.80	28,659,077	0.560	0.560	0.635	0.635

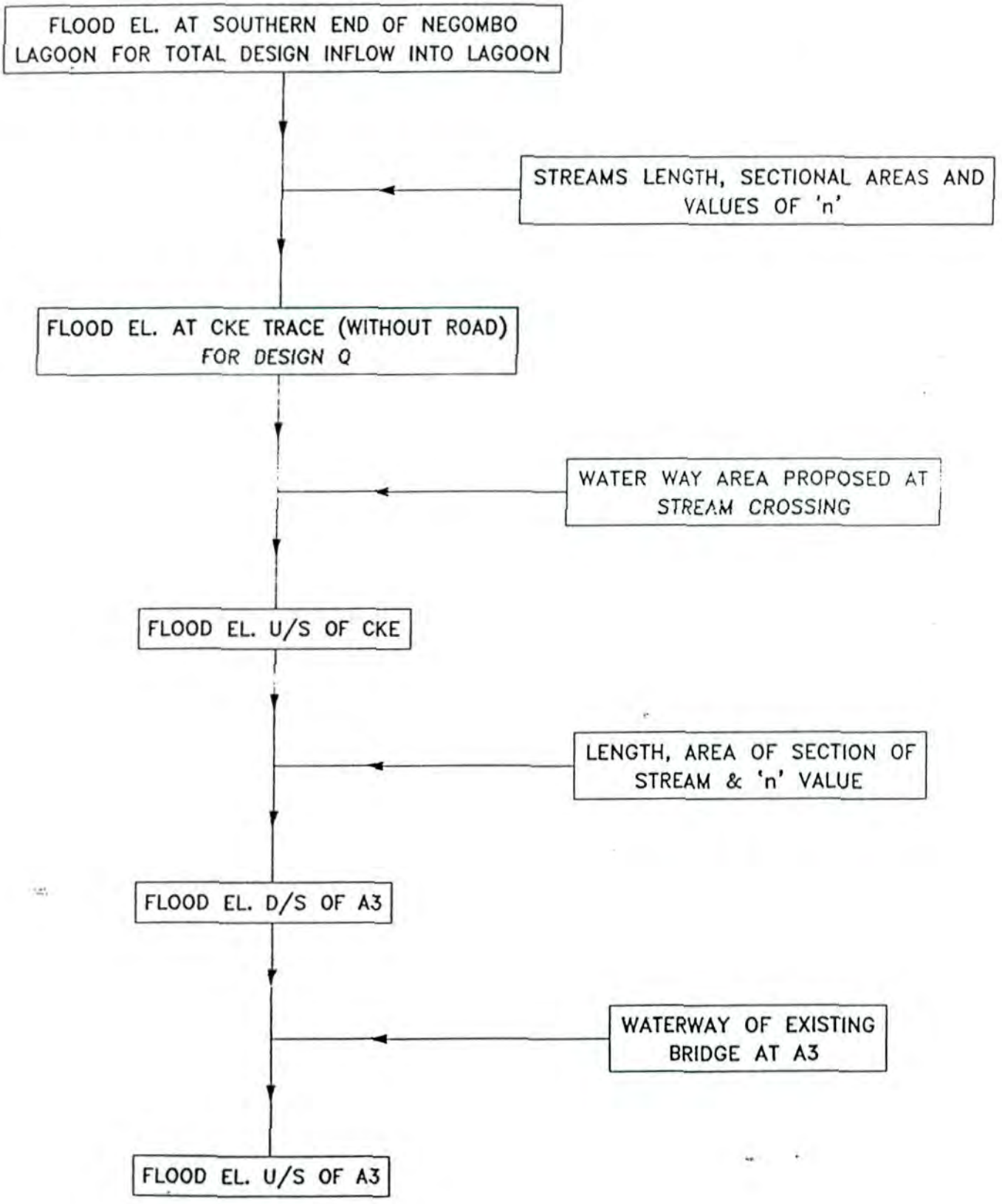
NEGOMBO LAGOON FLOOD ROUTING - 100 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT RAIN mm	DETENTION STORAGE M^3	LAGOON ELEV. TRIAL M-MSL	LAGOON ELEV. FINAL M-MSL	EL AT SOUTHERN END TRIAL M-MSL	EL AT SOUTHERN END FINAL M-MSL
80.5	622.8	0.292	0.268	396.3	1.80	29,195,735	0.571	0.571	0.645	0.645
81.0	623.3	0.250	0.321	433.1	1.80	29,662,528	0.580	0.580	0.654	0.654
81.5	623.8	0.208	0.371	466.1	1.80	30,067,408	0.587	0.587	0.662	0.662
82.0	624.3	0.167	0.421	496.2	1.80	30,416,362	0.594	0.594	0.669	0.669
82.5	624.8	0.125	0.469	524.0	1.80	30,714,108	0.600	0.600	0.675	0.675
83.0	625.3	0.083	0.517	549.9	1.80	30,964,490	0.605	0.605	0.680	0.680
83.5	625.8	0.042	0.563	574.1	1.80	31,170,721	0.609	0.609	0.684	0.684
84.0	626.3	0.000	0.609	596.9	1.80	31,335,537	0.612	0.612	0.687	0.687
84.5	625.4	-0.042	0.654	618.5	1.80	31,460,023	0.615	0.615	0.690	0.690
85.0	624.4	-0.083	0.698	639.1	1.80	31,544,888	0.616	0.616	0.691	0.691
85.5	623.5	-0.125	0.741	658.7	1.80	31,591,911	0.617	0.617	0.692	0.692
86.0	622.6	-0.167	0.784	677.4	1.80	31,602,780	0.618	0.618	0.692	0.692
86.5	621.7	-0.208	0.826	695.3	1.80	31,579,015	0.617	0.617	0.692	0.692
87.0	620.8	-0.250	0.867	712.5	1.80	31,521,995	0.616	0.616	0.691	0.691
87.5	619.8	-0.292	0.908	729.0	1.80	31,432,976	0.615	0.615	0.689	0.689
88.0	618.9	-0.333	0.948	744.9	1.80	31,313,109	0.613	0.613	0.686	0.686
88.5	618.0	-0.375	0.988	760.3	1.80	31,163,454	0.610	0.610	0.683	0.683
89.0	617.1	-0.417	1.027	775.1	1.80	30,984,993	0.607	0.607	0.680	0.680
89.5	616.1	-0.458	1.065	789.4	1.80	30,778,635	0.603	0.603	0.676	0.676
90.0	615.2	-0.500	1.103	803.3	1.80	30,545,229	0.598	0.598	0.671	0.671
90.5	614.3	-0.458	1.057	786.3	1.80	30,312,937	0.594	0.594	0.666	0.666
91.0	613.3	-0.417	1.010	769.0	1.80	30,109,840	0.590	0.590	0.662	0.662
91.5	612.4	-0.375	0.965	751.5	1.80	29,936,426	0.587	0.587	0.659	0.659
92.0	611.5	-0.333	0.920	733.8	1.80	29,793,023	0.584	0.584	0.656	0.656
92.5	610.5	-0.292	0.876	715.9	1.80	29,679,975	0.582	0.582	0.654	0.654
93.0	609.6	-0.250	0.832	697.8	1.80	29,597,649	0.580	0.580	0.652	0.652
93.5	608.7	-0.208	0.789	679.4	1.80	29,546,434	0.580	0.580	0.651	0.651
94.0	607.7	-0.167	0.746	660.9	1.80	29,526,745	0.579	0.579	0.650	0.650
94.5	606.8	-0.125	0.704	642.0	1.80	29,539,027	0.580	0.580	0.651	0.651
95.0	605.9	-0.083	0.663	622.9	1.80	29,583,757	0.581	0.581	0.651	0.651
95.5	604.9	-0.042	0.622	603.5	1.80	29,661,447	0.582	0.582	0.653	0.653
96.0	604.0	0.000	0.582	583.8	1.80	29,772,653	0.585	0.585	0.655	0.655
96.5	601.6	0.042	0.543	563.8	1.80	29,916,659	0.588	0.588	0.658	0.658
97.0	599.2	0.083	0.505	543.4	1.80	30,092,708	0.592	0.592	0.661	0.661
97.5	596.8	0.125	0.467	522.6	1.80	30,301,443	0.596	0.596	0.665	0.665
98.0	594.4	0.167	0.430	501.4	1.80	30,543,698	0.601	0.601	0.669	0.669
98.5	592.0	0.208	0.393	479.6	1.80	30,820,403	0.607	0.607	0.675	0.675
99.0	589.6	0.250	0.357	457.1	1.80	31,132,591	0.614	0.614	0.680	0.680
99.5	587.2	0.292	0.322	434.0	1.80	31,481,432	0.621	0.621	0.687	0.687
100.0	584.8	0.333	0.287	410.1	1.80	31,868,256	0.629	0.629	0.694	0.694

NEGOMBO LAGOON FLOOD ROUTING - 100 YEAR FLOOD INFLOW

A	B	C	D	E	F	G	H		I	
TIME IN HRS	TOTAL INFLOW M^3/S	SEA EL MSL M	LAG.HT. ABOVE SEA (M)	LAGOON OUTFLOW M^3/S	DIRECT RAIN mm	DETENTION STORAGE M^3	LAGOON ELEV.		EL AT SOUTHERN END	
							TRIAL M-MSL	FINAL M-MSL	TRIAL M-MSL	FINAL M-MSL
100.5	582.4	0.375	0.254	385.3	1.80	32,294,598	0.637	0.637	0.703	0.703
101.0	580.0	0.417	0.221	359.4	1.80	32,762,256	0.647	0.647	0.712	0.712
101.5	577.6	0.458	0.189	332.2	1.80	33,273,376	0.657	0.657	0.721	0.721
102.0	575.2	0.500	0.157	303.4	1.80	33,830,583	0.669	0.669	0.732	0.732
102.5	572.0	0.458	0.210	350.8	1.80	34,366,021	0.680	0.680	0.742	0.742
103.0	568.7	0.417	0.263	392.2	1.80	34,815,693	0.689	0.689	0.751	0.751
103.5	565.5	0.375	0.314	428.6	1.80	35,189,527	0.697	0.697	0.758	0.758
104.0	562.2	0.333	0.363	461.1	1.80	35,495,551	0.703	0.703	0.764	0.764
104.5	559.0	0.292	0.411	490.7	1.80	35,739,827	0.708	0.708	0.768	0.768
105.0	555.8	0.250	0.458	517.9	1.80	35,927,137	0.712	0.712	0.772	0.772
105.5	552.5	0.208	0.504	543.2	1.80	36,061,381	0.716	0.716	0.774	0.774
106.0	549.3	0.167	0.549	566.8	1.80	36,145,823	0.718	0.718	0.776	0.776
106.5	546.0	0.125	0.593	588.9	1.80	36,183,245	0.719	0.719	0.776	0.776
107.0	542.8	0.083	0.636	609.9	1.80	36,176,057	0.719	0.719	0.776	0.776
107.5	539.5	0.042	0.678	629.7	1.80	36,126,375	0.719	0.719	0.775	0.775
108.0	536.3	0.000	0.719	648.5	1.80	36,036,072	0.717	0.717	0.773	0.773
108.5	535.1	-0.042	0.759	666.5	1.80	35,908,628	0.715	0.715	0.770	0.770
109.0	533.8	-0.083	0.798	683.5	1.80	35,747,446	0.712	0.712	0.767	0.767
109.5	532.6	-0.125	0.837	699.9	1.80	35,553,957	0.708	0.708	0.763	0.763
110.0	531.3	-0.167	0.875	715.6	1.80	35,329,355	0.704	0.704	0.758	0.758
110.5	530.1	-0.208	0.912	730.7	1.80	35,074,733	0.699	0.699	0.753	0.753
111.0	528.9	-0.250	0.949	745.3	1.80	34,791,100	0.694	0.694	0.748	0.748
111.5	527.6	-0.292	0.986	759.5	1.80	34,479,392	0.688	0.688	0.741	0.741
112.0	526.4	-0.333	1.021	773.1	1.80	34,140,478	0.681	0.681	0.735	0.735
112.5	525.1	-0.375	1.056	786.3	1.80	33,775,168	0.674	0.674	0.728	0.728
113.0	523.9	-0.417	1.091	799.1	1.80	33,384,221	0.667	0.667	0.720	0.720
113.5	522.6	-0.458	1.125	811.5	1.80	32,968,350	0.659	0.659	0.712	0.712
114.0	521.4	-0.500	1.159	823.6	1.80	32,528,222	0.651	0.651	0.703	0.703
114.5	518.5	-0.458	1.109	805.6	1.80	32,089,727	0.642	0.642	0.694	0.694
115.0	515.6	-0.417	1.059	787.2	1.80	31,678,716	0.635	0.635	0.686	0.686
115.5	512.7	-0.375	1.010	768.7	1.80	31,295,684	0.627	0.627	0.678	0.678
116.0	509.8	-0.333	0.961	749.9	1.80	30,941,063	0.621	0.621	0.671	0.671
116.5	506.9	-0.292	0.913	730.8	1.80	30,615,309	0.615	0.615	0.664	0.664
117.0	504.0	-0.250	0.865	711.4	1.80	30,318,911	0.609	0.609	0.658	0.658
117.5	501.1	-0.208	0.818	691.8	1.80	30,052,386	0.605	0.605	0.653	0.653
118.0	498.2	-0.167	0.771	671.8	1.80	29,816,293	0.600	0.600	0.648	0.648
118.5	495.3	-0.125	0.725	651.5	1.80	29,611,230	0.597	0.597	0.644	0.644
119.0	492.4	-0.083	0.680	630.8	1.80	29,437,842	0.594	0.594	0.640	0.640
119.5	489.5	-0.042	0.635	609.7	1.80	29,296,829	0.591	0.591	0.637	0.637
120.0	486.6	0.000	0.591	588.2	1.80	29,188,952	0.589	0.589	0.635	0.635
max	626.3	0.500	1.159	823.6	2.70	36,183,245	0.719	0.719	0.776	0.776

METHODOLOGY FOR ESTIMATION OF FLOOD LEVELS AT JA-ELA & DANDUGAM OYA ROAD CROSSINGS



Within this reach drainage from minor catchments discharge into the marsh on the eastern side of CKE trace. Openings provided in the roadway will lead this drainage onto the marsh on the western side. Drainage within the marsh is through the many channels which connect the Old Dutch Canal to Hamilton Canal and channels discharging directly into the lagoon. Under flood conditions marsh is submerged and drainage is mainly through overland flows. Flood levels under these conditions cannot be estimated with any degree of accuracy. The flood gradient has been calculated on the basis of overland flow and its value is 0.0000334

Reach of CKE between A3 Crossing (7 + 120) & 4 + 400

Flood elevations are those of Kalu Oya. Based on historical flood levels the hundred year return period flood level at Kalu Oya RB is estimated at 2.65 m and 2.60 m at Kalu Oya LB.

Reach of CKE from New Kelani Bridge to 4 + 400

Flood elevations are those of Mudun Ela. Based on historical flood levels the hundred year return period flood is estimated at 2.30 m MSL.

7.3 Design of Major Drainage Crossings & Other Waterway Openings

The waterway areas required to limit the hundred year return period flood afflux to a maximum of 0.1 m were computed using the peak value of flood hydrographs, channel sections, estimated velocities of natural channels.

In the case of Ja Ela it is proposed to provide a bridge spanning the existing waterway and roads on either bank. Hence there is no change in pre project conditions as the waterway is confined by stream banks.

In the case of Dandugam Oya the bridge will span the Oya and the roads on either bank, but the overland flood flows which occurred in pre project conditions have to routed through two no.15 m span bridges and a 10 m span bridge over existing drainage channels.

The location, span, required water ways, HFL and other details are given in Table 7.2.

7.4 Impact of CKE on Flood Levels Upstream of A3.

7.4.1 General

The impact of a 100 year flood upstream of A3 and CKE is shown in Table 7.3 and the Schematic High Flood Water Surface Profiles of Dandugam Oya, Jaela and Kalu Oya are shown in Fig. 7.3, 7.4, and 7.5 respectively. Catchmentwise impact is discussed in the following paragraphs.

PROPOSED COLOMBO - KATUNAYAKA EXPRESSWAY (CKE)
DRAINAGE CROSSINGS AND OTHER WATERWAY OPENINGS

STATION CKE TRACE	CATCHMENT	TYPE OF STRUCTURE	WATERWAY AREA (MIN.) m^2	SPAN/ PIPE DIA. m	SILL EL. m	HFL (U/S) EL. m	MIN. SOFFIT EL (m)	MIN. ROAD EL (m)	REMARKS
0+865	MUDUN ELA	BRIDGE	10	4		2.49 *		3.59 **	DRAINS INTO KELANI GANGA
1+550	MUDUN ELA	CULVERT	0.6	900mm dia.	-0.5	2.49 *		3.59 **	TRIBUTARY OF MUDUN-ELA
2+047	MUDUN ELA	BRIDGE	10	4		2.49 *		3.59 **	DRAINS INTO KELANI GANGA
2+417	MUDUN ELA	BRIDGE	11.5	5		2.49 *		3.59 **	TRIBUTARY OF MUDUN-ELA
2+850	MUDUN ELA	CULVERT	0.6	900mm dia.	-0.5	2.49 *		3.59 **	LOCAL DRAINAGE
3+550	KALU OYA	CULVERT	1.1	1200mm dia.	-0.5	2.63		3.73	LOCAL DRAINAGE
4+100	KALU OYA	CULVERT	0.6	900mm dia.	0.9	2.63		3.73	LOCAL DRAINAGE
4+980	KALU OYA	BRIDGE	26.2	5		2.63		3.73	LB TRIBUTARY OF KALU OYA
5+677	KALU OYA	BRIDGE	18	5		2.70		3.80	TRIBUTARY OF KALU OYA
5+840	KALU OYA	BRIDGE	82.5	15		2.70		3.80	RB TRIBUTARY OF KALU OYA
6+110	KALU OYA	BRIDGE	71	15		2.70		3.80	DO-2nd CROSSING
6+520	KALU OYA	BRIDGE	48.7	15		2.70		3.80	DO -3rd CROSSING
8+730	MINOR CATCH.	BRIDGE	6.9	4		1.18		2.28	LOCAL DRAINAGE
9+625	MINOR CATCH.	BRIDGE	10	4		1.18		2.28	LOCAL DRAINAGE
10+683	MINOR CATCH.	BRIDGE	9.5	4		1.18		2.28	LOCAL DRAINAGE
11+800	-	BRIDGE	31	10		1.18		2.28	OLD DUTCH CANAL CROSSING
12+893	-	BRIDGE	31	10		1.18		2.28	OLD DUTCH CANAL CROSSING
13+393	MINOR CATCH.	BRIDGE	7.5	4		1.18		2.28	CANAL
14+416	MINOR CATCH.	BRIDGE	7.5	4		1.18		2.28	PALLIYA ELA -LOCAL DRAINAGE
14+653	MINOR CATCH.	BRIDGE	11.5	4		1.18		2.28	DIGANA ELA- LOCAL DRAINAGE
15+360	JA-ELA	BRIDGE	200	60		1.93	5.93	6.93	BRIDGE OVER JA-ELA & ROADS ON EITHER BANK
16+219	DANDU. OYA	BRIDGE	5	4		1.21		2.31	CHANNELS DRAINING INTO LAGOON
16+498	DANDU. OYA	BRIDGE	7	4		1.21		2.31	DRAINS OVERLAND FLOW ON LEFT
17+475	DANDU. OYA	BRIDGE	47.8	15		1.21		2.31	BANK OF DANDU. OYA & PARTS OF
18+192	DANDU. OYA	BRIDGE	7.4	5		1.21		2.31	DANDU. & JA-ELA FLOWS VIA MODERAELA
18+730	DANDU. OYA	BRIDGE	191	65		1.21	5.21	6.21	BRIDGE OVER DANDU. OYA & ROADS ON EITHER BANK
19+300	DANDU. OYA	BRIDGE	40.3	15		1.21		2.31	DANDU. OYA EXTRABUTARY DRAINS PART OF DANDU. OYA DISCHARGE
20+375	NEGOM. LAGOON	BRIDGE	12.9	10		1.21		2.31	CHANNEL DRAINING INTO LAGOON DRAINS PART OF OVERLAND FLOW ON RIGHT BANK OF DANDU. OYA
21+320	NEGOM. LAGOON	CULVERT	0.5	900mm dia.	0.0	0.78		1.88	LOCAL DRAINAGE
21+700	NEGOM. LAGOON	CULVERT	0.5	1200mm dia.	-1.0	0.78		1.88	LOCAL DRAINAGE
22+700	NEGOM. LAGOON	BRIDGE	N.A.	10		0.78	3.28	4.28	OPENING FOR HOTEL BOATS & FOR EXCHANGE OF WATER ON EITHER SIDE OF CKE - 2.5m CLEARANCE FOR BOATS
24+100	NEGOM. LAGOON	BRIDGE	N.A.	10		0.78	3.28	4.28	MADABOKKA OPENING. 2.5m CLEARANCE FOR BOATS

NOTE ALL ELEVATIONS ARE MSL VALUES

* HFL COULD BE REDUCED TO 2.35 WITH INCREASED WATERWAY IN CULVERT NO. 3/1 ON A3.

** MINIMUM EL. OF ROADWAY COULD BE REDUCED TO 3.45 WITH INCREASED WATERWAY IN CULVERT NO. 3/1 ON A3

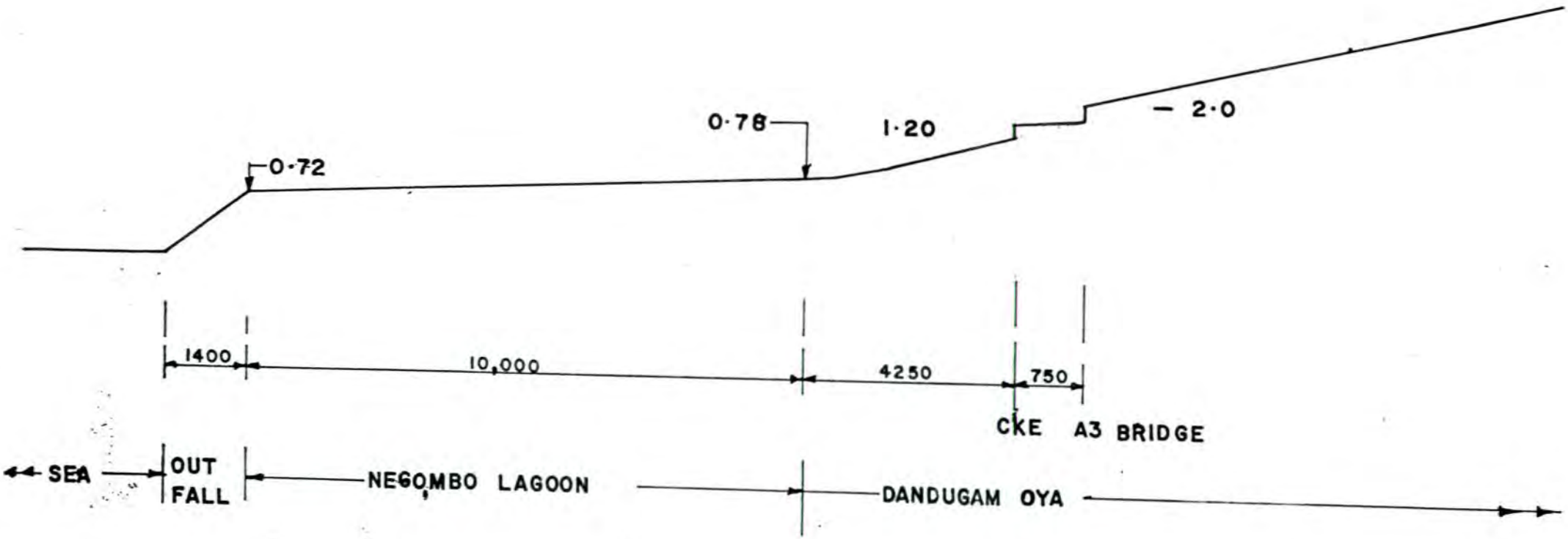
Table 7.2

DETAILED HYDROLOGICAL STUDY OF COLOMBO KATUNAYAKA EXPRESSWAY PROJECT
IMPACT OF 100YEAR RETURN PERIOD FLOOD

CATCHMENT	ESTIMATED PEAK DISCHARGE m^3/s	ESTIMATED PRE-PROJECT FLOOD LEVEL m-MSL		TOTAL EFFECTIVE WATERWAY AREA PROPOSED AT CKE m^2	PROJECTED RISE IN FLOOD LEVEL m-MSL		PROPOSALS TO REDUCE FLOOD IMPACT
		U/S OF A3	U/S OF CKE		U/S OF A3	U/S OF CKE	
MUDUN ELA	21	2.30	2.34	33	0.14 /0.01 *	0.15 /0.05 *	INCREASE WATERWAY AT CULVERT NO.3/1 ON A3 TO 16 m^2
KALU OYA LB	27	NA	2.60	26	0.00	0.03	
KALU OYA CENTRE & RB	82	NA	2.65	80	0.00	0.05	
KALU OYA (A3)	111	2.20	NA	NA	0.00	NA	
MICRO CATCHMENTS	39	-	1.15	53	0.00	0.03	
JA-ELA	291	2.30	1.93	200	0.00	0.00	
DANDUGAM OYA	423	2.00	1.19	300	0.00	0.02	
NEGOMBO LAGOON	626	NA	0.78	NA	0.00	0.00	

NOTE * DENOTES LEVELS AFTER INCREASING WATERWAY IN CULVERT NO 3/1

Table 7.3



SCHEMATIC HIGH FLOOD WATER SURFACE PROFILE OF DANDUGAM OYA

PRE-PROJECT AND POST PROJECT

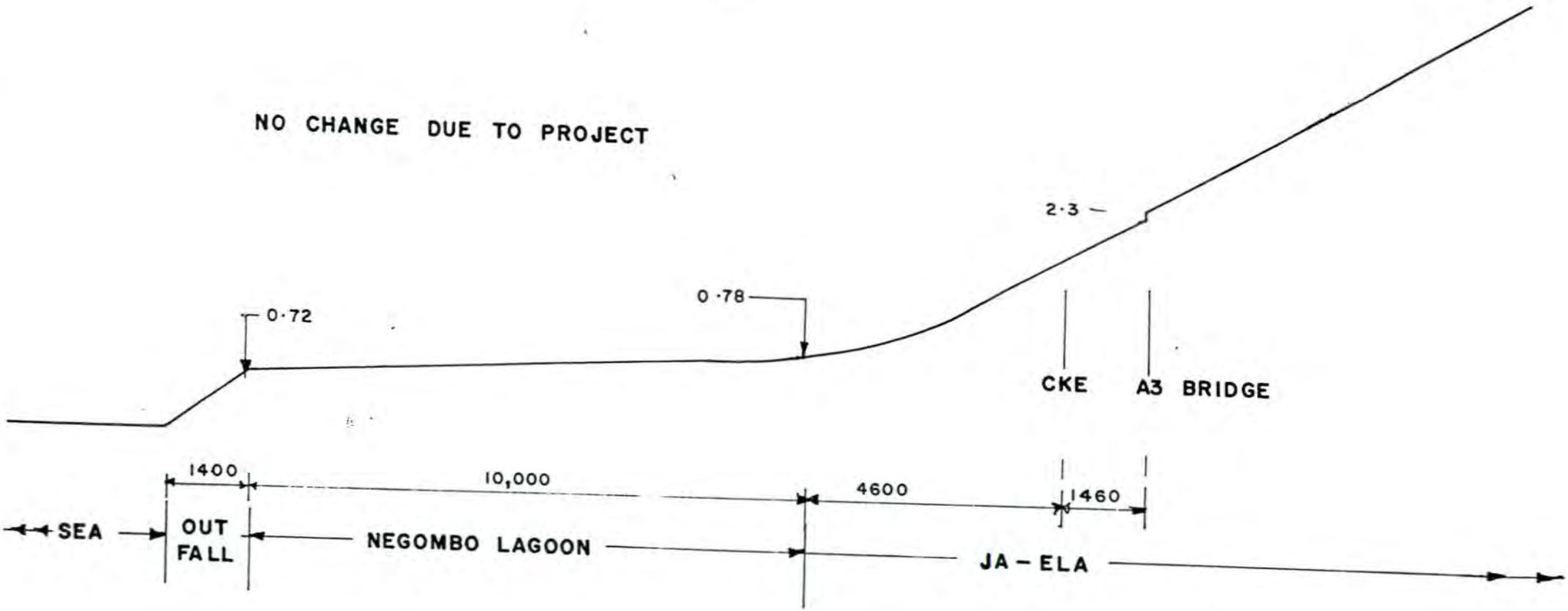
FIG. 7·3

LEGEND

PRE - PROJECT

POST PROJECT CHANGE

ELEVATIONS SHOWN ARE MAX. VALUES AT THE LOCATIONS



SCHEMATIC HIGH FLOOD WATER SURFACE PROFILE OF JA - ELA

PRE - PROJECT AND POST PROJECT

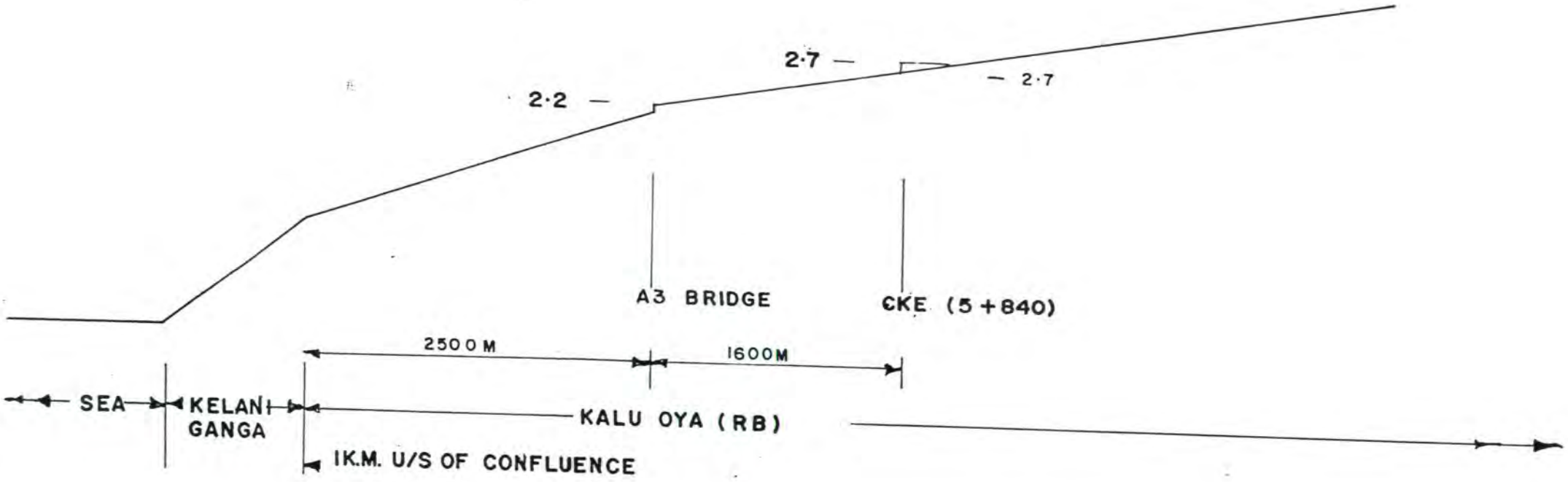
FIG. 7·4

LEGEND

PRE - PROJECT

POST PROJECT CHANGE

ELEVATIONS SHOWN ARE MAX. VALUES AT THE LOCATION



SCHEMATIC HIGH FLOOD WATER SURFACE PROFILE OF KALU OYA PRE- PROJECT AND POST PROJECT

FIG. 7·5

LEGEND

PRE - PROJECT

POST PROJECT CHANGE

ELEVATIONS SHOWN ARE MAX. VALUES AT THE LOCATION

7.4.2 Mudun Ela Catchment

Within Mudun Ela Catchment CKE runs about 760 m upstream of A#. The embankment fill results in a loss of detention in the catchment resulting in an increase in flood peak at A3 crossing. The rise in flood level is estimated at 14 cms. this effect could be mitigated by the provision of an increased water way at culvert 3/1. The available waterways at the existing A3 crossings are grossly inadequate giving rise to increased flood levels and flooding times even under prevailing conditions.

7.4.3 Kalu Oya Catchment

The CKE trace is about 1500 m upstream of A3 and will have no effect on the flooding conditions immediately upstream of A3.

7.4.4 Micro Catchments between Mabole and Ja Ela

The estimated rise in 100 year flood level upstream of CKE is 3 cm. The backwater effect of this rise upstream of A3 is negligibly small.

7.4.5 Ja Ela Catchment

The proposed CKE crossing at Ja Ela intersection will not interfere with the ja Ela waterway and will have no effect on flood levels upstream of CKE or A3.

7.4.6 Dandugam Oya Catchment

CKE intercepts Dandugam Oya 750 m downstream of A3. The estimated rise in 100 year flood level upstream of CKE is 3 cm. This rise will have no effect on flood levels upstream of A3 due to the relatively large difference in flood levels(over 0.75 m)

7.5 Validation of Road Embankment Levels

7.5.1 General

Embankment levels at any point along the road is determined on the basis of the following:

Hydraulic Considerations

[1] 1.1 m above 100 year flood level

[2] 100 year flood level + wave height
[for reach of roadway within Negombo Lagoon and Muthurajawela marsh]

[3] 0.5 m above the 200 year flood level

Clearance and Alignment Considerations

[4] 100 year flood level + clearance for boats or traffic + deck thickness [in the case of bridges]

[5] elevations to suit vertical alignment

7.5.2 Mudun Ela Catchment [0 + 400 to 3 + 209 of CKE]

Estimated 100 year flood level = 2.49 m
Estimated 200 year flood level = 2.69 m

Minimum road elevation to meet requirements 1 to 4 is 3.59 m.

7.5.3 Kalu Oya Catchment [3 + 209 to 7 + 108]

Estimated 100 year flood level = 2.70 m
Estimated 200 year flood level = 3.00 m

Minimum road elevation to meet requirements 1 to 4 is 3.8 m.

7.5.4 Micro Catchments from Malabe to Ja Ela [7 + 108 to 15 + 350]

Estimated 100 year flood level = 1.18 m
Estimated 200 year flood level = 1.43 m

During high flood conditions Muthurajawela marsh on the western side of the roadway will be submerged and will be an extension of the Negombo Lagoon. This body of water could generate waves.

Wave height is estimated using Saville Formula

$$H = \frac{U^2}{g} \times 0.0026 \times \left[\frac{gF}{U2}\right]^{0.47}$$

Where H = wave height in ft.
U = wind velocity in ft/sec
F = fetch in ft.

Following Australian Practice for the condition of the marsh at 100 year flood level a wind velocity of 96 km/hr [2,67m/sec] is used. Fetch, which is the horizontal distance over the water body perpendicular to the roadway is about 2,190m. Wave height calculated using the above formula works out to 0.94 m. Due to the presence of marsh vegetation and canal bunds the actual wave height could be much lower.

Since the wave height is less than 1.1 m this criterion is not the determining factor. Minimum road elevation to meet criteria 1 to 4 is 2.28 m.

7.5.5. Ja Ela Catchment - Bridge at 15 + 360

Estimated 100 year flood level = 1.93 m
Estimated 200 year flood level = 2.43 m

Clearance for traffic on either bank = 4 m
[roads on either bank assumed to be at HFL]

Assumed deck thickness = 1.0 m

Minimum road elevation at the bridge = 6.93 m

7.5.6 Dandugam Oya Catchment

[a] Reach from Ja Ela to Dandugam Oya [18 + 700]

Estimated 100 year flood level = 1.21 m
Estimated 200 year flood level = 1.46 m

Wave Height
Fetch in this area is about 2,800 m and the wave height as calculated from Saville Formula is 1.05 m. Due to presence of sand banks and marsh vegetation the actual wave height could be much less. Since the wave height is less than 1.1 m this extension is not the determining factor.

Minimum road elevation to meet criteria 1 to 4 is 2.31 m.

[b] Dandugam Oya Bridge [18 + 730]

Estimated 100 year flood level = 1.21 m
Estimated 200 year flood level = 1.46 m

Clearance for traffic on either bank = 4m
[roads on either bank assumed to be at HFL]

Assumed deck thickness = 1.0m

Minimum road elevation at the bridge = 6.21m

[c] Reach Dandugam Oya to 21 + 075

Estimated 100 year flood level = 1.21 m
Estimated 200 year flood level = 1.46 m

Wave Height
The fetch in this area is about 3,000m and the wave height calculated from Saville Formula is 1.09m. Since the wave height is less than 1.1m this criteria is not the determining factor.

Minimum road elevation to meet criteria 1 to 4 is 2.31m

7.5.7 Area Draining to Negombo Lagoon 21 + 075 to 24 + 582

Estimated 100 year flood level = 0.78 m
Estimated 200 year flood level = 1.02 m

Wave Height = 1.09 m

Minimum road elevation to meet criteria 1 to 4 is 1.88 m.

7.6 Inventory of Drainage Crossings Across A3

This is presented in Table 7.4

DETAILED HYDROLOGICAL STUDY OF PROPOSED COLOMBO KATUNAYAKE EXPRESSWAY PROJECT. Sheet 1 of 2

INVENTORY OF DRAINAGE CROSSINGS ACROSS A3.

STRUCTURE NO.	LOCATION	TYPE	SILL EL. m-MSL	EL. OF ROAD CENTRE LINE m-MSL	EL. OF WATER SURFACE m-MSL	DIMENSIONS WxH/PIPE DIA. m	AREA OF OPENING m^2	REMARKS
	A1-(0+500)	BOX	0.723	4.581	DRY	0.5x1.0	0.1	CENTER SECTION IS A PIPE (1m dia) FLOW IS TO LAND SIDE
	A1-(0+300)	PIPE	0.641	3.611	0.691	600mm dia.	0.2827431	FLOW IS TO LAND SIDE
	1+100	PIPE	-0.739	3.386	0.121	900mm dia.	0.64	PUMPING MAIN IN ADDITION D/S SECTION IS A BOX (1.31X1.83)
	1+820 2+020	PIPE	0.979	3.11	DRY	600mm dia.	0.2827	U/S SECTION IS A BOX ABANDONED - COMPLETELY SILTED
3/1	2+150	DOUBLE PIPE	-1.34	4.11	-0.01	1300mm dia. 1300mm dia.	1.33 1.33	SCREW TYPE LIFTING GATES D/S OF CULVERT
3/2	2+560	PIPE	2.17	3.49	2.63	600mm dia.	0.28	D/S SECTION IS A BOX (0.93X0.63)
3/3	2+760	BOX	-0.54	3.29	-0.02	0.42X0.7	0.29	
	3+720	BOX	-1.81	1.85	0.28	2.11x1.5	3.165	
	3+920	BOX	-0.82	1.93	0.95	0.58x0.66	0.3828	U/S SECTION IS A PIPE
5/1	4+200	PIPE	-0.05	2.25	0.61	1000mm dia	0.7853975	D/S SECTION IS A BOX (0.84X0.8)
	KALU OYA 4+920	BRIDGE	-2.08	3.62	0.27		102	
6/1	5+430	PIPE	5.7	8.79	DRY	900mm dia.	0.63617198	
7/2	6+637	BOX	3.71	6.01	DRY	1.08X1.03	1.11	
7/3	6+950	PIPE	3.34	5	DRY	900mm dia.	0.636	
8/1	7+680	PIPE	6.47	8.15	DRY	900mm dia.	0.64	
9/1	8+200				DRY			ABANDONED - COMPLETELY SILTED
9/2	8+620	PIPE	-0.04	2.52	0.94	1200mm dia.	1.13	
10/1	9+372	PIPE	2.65	4.74	2.99	600mm dia.	0.2827431	
11/1	10+345	PIPE	7.59	9.02	DRY	600mm dia.	0.28	D/S SECTION IS A BOX (0.84X0.64)
11/2	10+922	PIPE	8.01	9.48	8.11	600mm dia.	0.2827431	
12/1	11+273	PIPE	7.28	9.09	DRY	900mm dia.	0.64	
12/2	11+550	PIPE	7.7	9.16	DRY	800mm dia.	0.5026544	
13/1	12+280	PIPE	5.81	7.48	DRY	500mm dia	0.19634938	D/S SECTION IS A BOX (0.61X0.63)

Page 1.4 - Sheet 1 of 2

DETAILED HYDROLOGICAL STUDY OF PROPOSED COLOMBO KATUNAYAKE EXPRESSWAY PROJECT. Sheet 2 of 2

INVENTORY OF DRAINAGE CROSSINGS ACROSS A3.

STRUCTURE NO.	LOCATION	TYPE	SILL EL. m-MSL	EL. OF ROAD CENTRE LINE m-MSL	EL. OF WATER SURFACE m-MSL	DIMENSIONS WxH/PIPE DIA. m	AREA OF OPENING m^2	REMARKS
13/2	12+980	BOX	5.39	6.98	5.49	1.23X0.86	1.0578	
14/1	13+300	BOX	4.63	6.38	DRY	0.6X0.64	0.38	
14/2	13+827	PIPE	2.92	4.99	3.12	1100mm dia.	0.95033098	
15/1	14+120	PIPE	3.48	5.50	DRY	600mm dia.	0.28	D/S SECTION IS A BOX (0.78X1.1)
	JA-ELA 14+960	BRIDGE	-6.18	3.44	0.48		158	
16/1	15+415	PIPE	0.34	2.09	0.43	900mm dia.	0.64	
16/2	15+425	PIPE	0.24	2.12	DRY	600mm dia.	0.28	U/S SILTED
16/3	15+798	BOX	0.79	1.99	DRY	0.66X0.68	0.45	U/S SECTION IS A PIPE (900mm dia)
17/1	16+545	BOX	1.46	2.92	DRY	1.4X0.95	1.33	
18/1	17+285	BOX	0.41	1.83	DRY	1.8X0.9	1.62	
18/2	17+585	BOX	0.31	1.8	DRY	1.5X1.0	1.5	
18/3	17+956	BOX	0.22	1.92	DRY	1.3X1.0	0.78	
	DAN. OYA 18+500	BRIDGE	-5.57	4.23	0.52		414	
19/1	18+770	PIPE	-0.91	1.73	-0.18	1200mm dia.	1.13	U/S SECTION IS A BOX (1.2X1.0)
20/1	19+400	BOX	0.02	1.61	DRY	1.5X1.0	1.5	
20/2	19+616	PIPE	-0.02	1.58	0.24	600mm dia.	0.28	D/S SECTION IS A BOX (0.7X1.1) SILTED
21/1	20+140	BOX	-0.11	1.49	DRY	1.1X1.0	1.1	
21/2	20+630	BOX	0.14	1.86	DRY	1.4X1.14	1.60	
21/3	20+987	BOX	-0.00	1.81	0.03	1.3X1.15	1.495	
22/1	21+182	PIPE	-0.36	1.71	0.21	600mm dia.	0.28	
22/2	21+810	BOX	0.13	1.89	0.20	1.7X1.1	1.87	
23/1	22+256	BOX	0.13	1.90	0.34	0.95X1.0	0.95	
23/2	22+870	PIPE	0.51	2.24	0.54	900mm dia.	0.63617198	
24/1	23+180	PIPE	0.63	2.31	0.83	800mm dia.	0.50	
24/2	23+500	BOX	0.65	2.46	0.7	1.15X1.16	1.334	

NOTE ELEVATION OF WATER SURFACE IS THE VALUE AT THE TIME OF MEASUREMENT

8. IMPROVEMENTS TO DOWNSTREAM DRAINAGE SYSTEM TO MITIGATE THE IMPACT OF HIGH FLOODS

8.1 The Concept

In general upstream flood levels could be reduced by improvements to the downstream drainage system. However as detailed in chapter 6 the proposed roadway is mainly confined to the flood plains of the river basins intercepted by it and the flood levels are directly dependent on the flood stages in Kelani Ganga or Negombo Lagoon. As such downstream flood elevations cannot be appreciably reduced using cost effective means. Catchmentwise examination of the downstream lead away conditions are presented in the following paragraphs.

8.2 Mudun Ela Catchment

CKE intercepts Mudun Ela drainage streams about 800 m upstream of the confluence with Kelani Ganga. The bed slope of the main stream is 0.0006 and the waterways have adequate capacity. However the flood discharge has to cross existing A3 through two main openings one at 1 + 100 and the other at 2 + 150. The effective waterway area at these culverts are those of a 900 mm diameter pipe and two 1300 mm pipes respectively. If the upstream waterway areas are increased to those of the screw type lifting gates at the downstream end, the discharge capacities can be more than doubled thereby reducing flood levels and flooding time.

8.3 Kalu Oya Catchment

CKE intercepts the three tributories of Kalu Oya about 4500 m upstream of the confluence with Kelani Ganga [2000 m upstream of A3]. The bed slope of the Oya in this reach is 0.000064 and the waterways have adequate capacity. As such appreciable reduction in flood levels cannot be achieved using cost effective techniques.

8.4 Micro Catchments between Mabole and Ja Ela

These drain directly into the Muthurajawela marsh. In this reach the CKE trace runs through the marsh parallel to the Old Dutch Canal which excepting for a distance of 1093 m is on the western side of the trace. Water surface elevations in the marsh under high flood conditions are directly dependent on the water level at the southern end of Negombo Lagoon.

As mentioned in the Report of the Technical Evaluation Committee [para 5 page 4] the feasibility of improving downstream drainage by effecting improvements to Old Dutch Canal was examined.

Although it is feasible to achieve slight reductions with improvements to the Old Dutch

Canal and the network of canals linking Old Dutch Canal and the Hamilton Canal, such improvements are not proposed due to:

[a] high cost of construction and maintenance

Section of Old Dutch Canal from its confluence with Kalu Oya to Ja Ela is choked with weeds due to the very low discharges and will need regular maintenance to keep it clear of weeds as appreciable canal velocities can be expected only during flood conditions.

[b] Provision of an efficient drainage system in the marsh will result in the lowering of the marsh water levels during dry seasons promoting saline intrusion. These changes may not be acceptable from ecological considerations.

[c] The projected rise in post project 100 year flood levels are less than 0.5 cms and the flood conditions downstream of CKE will remain unchanged.

[d] Effectiveness will be seriously hampered during high stages of Kelani Ganga.

8.5 Ja Ela Catchment

CKE trace intersects Ja Ela 1460 m downstream of A3 and this reach of the canal [as well as 1200 m downstream of CKE] is canalised with earthen embankments on both banks rising above projected high flood levels. The proposed under crossing at CKE will span clear of the canal and the roads on either bank and therefore the project will have no effect on the hydraulics of this waterway. Downstream improvements are therefore not considered. However if the proposal to increase the area of the lagoon is implemented, the excavated material could be used to widen and strengthen the embankments on either bank.

8.6 Dandugam Oya Catchment

CKE intercept Dandugam Oya 4250 m upstream of its point of its entry into the lagoon. Drainage from this basin flows into Negombo Lagoon through Dandugam Oya, an extrabutory and through channels taking off Mahadora Ela.

Under high flood conditions the area upstream of the lagoon up to A3 [750 m upstream of CKE crossing] is submerged and becomes a part of lagoon. Flood levels are dependent on parameters of the lagoon and tidal fluctuations in the sea. Downstream improvements can increase the discharge capacity of the streams but will have very little effect on the upstream flood levels.

9. FLOODS MAPPED OUT

9.1 Dandugam Oya Catchment

Inquiries in the field revealed that a significant flood occurred in May 1991 and the informants always associated that with a "dam bursting" upstream in the Attanagalu Oya irrigation system which caused an unusual and sudden flood wave. Hence it was decided to take the maximum flood recorded at A3 during another significant flood that occurred in May 1967.

The estimated catchment rainfall for this storm is given below:

Days	Catchment Rainfall [mm]
1	220.7
2	319.9
3	398.3
4	430.0
5	455.8

From the Depth Duration Analysis done in chapter 3 the following rain storms can be identified.

Return Period	05 Days Rainfall [mm]
50	477.5
100	519.0
200	552.5

Hence the 05 day rain storm which occurred in May 1967 can be concluded to be a storm of 50 years Return Period.

9.2 Ja Ela Catchment

Similarly the estimated rainfall in May 1967 for the Ja Ela Catchment is:

Days	Catchment Rainfall [mm]
1	179.3
2	283.4
3	348.1
4	375.7
5	391.7

From the Depth Duration analysis the following rainstorms can be identified:

Return Period [years]	05 Day Rainfall [mm]
50	460
100	498
200	545

Hence it can be concluded that the 05 day rain storm which occurred in May 1967 was about 50 year Return Period.

9.3 Kalu Oya Catchment

Informants in the field always referred to the major storm of August 1947, which flooded Colombo City caused by storm rainfall in the Kelani Basin. The flood conditions in the Kalu Oya are influenced not only by the rainfall within the Kalu Oya basin but also by the level of the Kelani Ganga, where the Kalu Oya meets near Hekitta. Hence in this case the frequency of occurrence has to be decided by the storm conditions that prevailed over the Kelani Basin in August 1947.

Ref. Report on Kelani Ganga Basin Scheme – Technoproexport – Moscow – 1961.

The maximum daily basin rainfall during the storm was 457 mm.

By an analysis of maximum daily rainfall for the basin the following results were obtained:

Probability of Exceedence [%]	0.5
Return Period [yrs]	200
Average Basin Rainfall [inches]	17.9
Average Basin Rainfall [mm]	455

The following notes were also included in the report:

The intense storm lasts 03 to 05 days. The maximum 24-hour rainfall is about 30% of entire storm. This indicates that the 1947 flood was due to a 200-year storm.

9.4 Mudun Ela Catchment

Since this catchment too is influenced in the same manner as the Kalu Oya catchment it can be concluded that the 4-day rainstorm which occurred in August 1947 was about 200-year return period.

9.5 Field Surveys Done

The Perimeter Survey necessary to identify the flood contour of a known flood that occurred was organized in the following manner:

- The maximum level, which occurred during a known storm, was identified at the A3 drainage crossings viz. Dandugam Oya Bridge, Ja Ela Bridge, Kalu Oya Bridge and Mudun Ela crossings.
- These levels were checked utilizing the nearest bench mark
- The surveyor set out the contour corresponding to this level within the catchment but upstream of A3.
- Using this contour as the centre line, cross sections were taken at 500-meter intervals.
- Flat plans were prepared to a scale of 1:10,000 showing relevant flood contours identified in each catchment and the location of the cross sections taken were also indicated.
- Cross sections were plotted separately to a convenient scale.

The following flood contours were identified for the respective catchments:

Catchment	Identified Storm	Return Period [Yrs]	Flood Contour Level [MSL]
Dandugam Oya	May 1967	50	1.8
Ja Ela	May 1967	50	2.2
Kalu Oya	August 1947	200	2.5
Mudun Ela	August 1947	200	2.5

10. MAPPING OF FLOOD INUNDATION AREAS CORRESPONDING TO HIGH RETURN PERIODS

10.1 Methodology

The following procedure was adopted:

- The flood level of the known flood originally investigated was noted and the return period of this storm was also estimated as shown in chapter 9.
- From the outflow hydrographs developed for this catchment, the peak values for other Return Periods were noted.
- Applying hydraulic principles, the corresponding flood levels of the other return period floods were computed.
- Using the perimeter survey plans and cross sections the contours corresponding to other return period floods were indicated in the flat plans [1:10,000 scale] and on the corresponding cross sections.

Eg. consider the flood levels observed at Dandugam Oya

- From field investigations the observed highest flood level was 1.8 m MSL at A3, which was cross-checked by actual levelling.
- The surveyor traced this contour in the field, upstream of A3 and within the Dandugam Oya Catchment and also took cross sections at 500-meter intervals.
- The dates of the storm was checked and, found to be a 5-day storm in May 1967.
- The total 05-day storm for the catchment was estimated to be 455.8 mm.
- The Rainfall Intensity Duration Tables for Vincit Estate and Katunayake revealed that the 50 year Return Period Storm for a 05-day rainfall was 477.5(mm ?)
- Hence it was concluded that the 05 day rainfall of May 1967 was a 50 year Return Period Storm.
- Using the observed flood level of 1.8 m MSL for a re3turn period of 50 years, the high flood level at A3 for 100 year return period and 200 year return period was estimated using the peak outflows computed for these return periods.
- These flood contours for 100 year and 200 year return period storms were computed, applying hydraulic principles, and estimated to be 2.0 m MSL and 2.5m MSL respectively.
- These contours were then plotted on the survey plan using the 1.8 m MSL contour already plotted by the surveyor.

10.2 Estimation of flood Levels for Different Return Periods

Based on the methodology described above, the high flood levels were computed for all the high return periods for the Catchments of Dandugam Oya, Ja Ela, Kalu Oya and Mudun Ela as shown in Table 10.1.

Flood Levels for Different Return Periods

Table 10.1

	OBSERVED FLOODS		COMPUTED FLOODS			
CATCH-MENT	RETURN PERIOD YEARS	FLOOD LEVEL AT A3 – m	RETURN PERIOD YEARS	FLOOD LEVEL AT A3 – m	RETURN PERIOD YEARS	FLOOD LEVEL AT A3 – m
Dandugam Oya	50	1.8	100	2.0	200	2.5
Ja Ela	50	2.2	100	2.3	200	2.8
Kalu Oya	200	2.5	100	2.2	50	1.95
Mudun Ela	200	2.5	100	2.3	50	1.85

10.3 Duration of Flooding

Flooding times estimated on the basis of flood flows exceeding bankfull discharge are as follows:

CATCHMENT	DURATION OF FLOODING IN DAYS		
	50 year	100 year	280 year
Dandugam Oya	05	05 ½	06
Ja Ela	02	02 ¼	02 ½
Kalu Oya	01 ¾ *	02 *	2 ¼ *
Mudun Ela	05 to 07 days as the flood levels are directly dependent on Kelani Ganga levels.		

* Flooding could be 3 ½ to 4 ½ days depending on the flood levels in Kelani Ganga.

11. ADDITIONAL FLOOD DETENTION AREAS TO MITIGATE THE IMPACT OF FLOODS

11.1 The Concept

If the anticipated post-project 100 year flood levels were significantly higher than the pre-project flood levels, it was envisaged that additional detention areas would be necessary to mitigate the effects of these floods.

However detailed studies presented in this report have shown that the waterway openings proposed in Section 7.2 will limit the rise in the post-project 100 year flood levels immediately upstream of CKE, to 05 cms excepting Mudun Ela catchment where the estimated rise is 15 cm. Even here the rise in flood levels could be limited to 05 cms with increase in the waterway at culvert No. 3/1 on A3. Therefore additional detention areas or other methods of lowering flood levels would not be required.

It is relevant to mention here that there is a proposal to construct a reservoir in the upper reaches of Attanagalu Oya to meet projected domestic and industrial demands during the next two decades. When this reservoir becomes a reality the flood peaks in Dandugam Oya will be appreciably moderated and will help to mitigate the effects of high flood in Dandugam Oya catchment Muthurajawela Marsh and Negombo Lagoon.

Catchmentwise descriptions of the anticipated flood conditions are presented in the following paragraphs:

11.2 Mudun Ela Catchment

Estimated rise in 100 year flood level upstream of CKE is less than 15 cms.

Decrease in catchment detention due to construction of roadway embankment is 404.000 M^3 and is about 30% of catchment detention. Rise in 100 year flood level upstream of A3 [due to decrease in catchment detention] is estimated at 02.5 cm. Pre-project flood levels and rise in flood levels due to CKE could be reduced by increasing the waterway at culvert No. 3/1 on A3.

11.3 Kalu Oya Catchment

Estimated rise in 100 year flood level upstream of CKE is less than 05 cm.

Decrease in catchment detention due to construction of roadway embankment is 339,000 m^3 and is less than 02.7% of the catchment detention. This volume is partly compensated by the increase in detention due to rise in flood level.

Rise in 100 year flood level upstream of A3 [due to decrease in catchment detention] is negligibly small.

11.4 Micro Catchments

Estimated rise in 100 year flood upstream of CKE is less than 03 cms.

Effect on flood levels upstream of A3 - due to backwater is negligible.

11.5 Ja Ela Catchment

No change due to project as the existing waterway of Ja Ela at CKE crossing and reaches upstream and downstream of the roadway will be maintained without any interference. The stream is canalised with embankments on either bank rising above projected water levels. Hence no impact on flood levels upstream of A3.

11.6 Dandugam Oya

Estimated rise in 100 year flood level upstream of CKE is less than 02 cms.

Effect on flood levels upstream of A3 due to backwater is negligible as there is a difference of over 0.75 m within a distance of 750 m between CKE and A3 crossings.

12. MONITORING SYSTEM RECOMMENCED DURING CONSTRUCTION.

As stated in our Inception Report the risk of sedimentation of the lagoon is best to be left to the construction stage with prior warning to the Tenderers to device suitable measures to counteract the problem.

There is not point in recommending elaborate procedures of water sampling and testing continuously, if the sedimentation problem is not seemingly, to be developed to alarming proportions. Therefore, the best option available at the moment is to be aware of the problem and to be prepared with an early warning system. This system should consist of visual observations by persons charged with the specific activity.

In the case of filling by reclamation of sea sand the normal practice is to remove the scum and sediment by proper drainage channels and pipes back into the sea. Hence there will be no sedimentation problem. It is advisable to bring this factor also to the notice of the Tenderers so that they may device appropriate methods to eliminate the depositing of sediments. The placing of fill, will disturb the existing bottom layers of soft mud and sediment. As such turbidity should be seen during the construction stage.

However, we propose that a monitoring system as described below should be undertaken at the four sites shown in Figure 12.1.

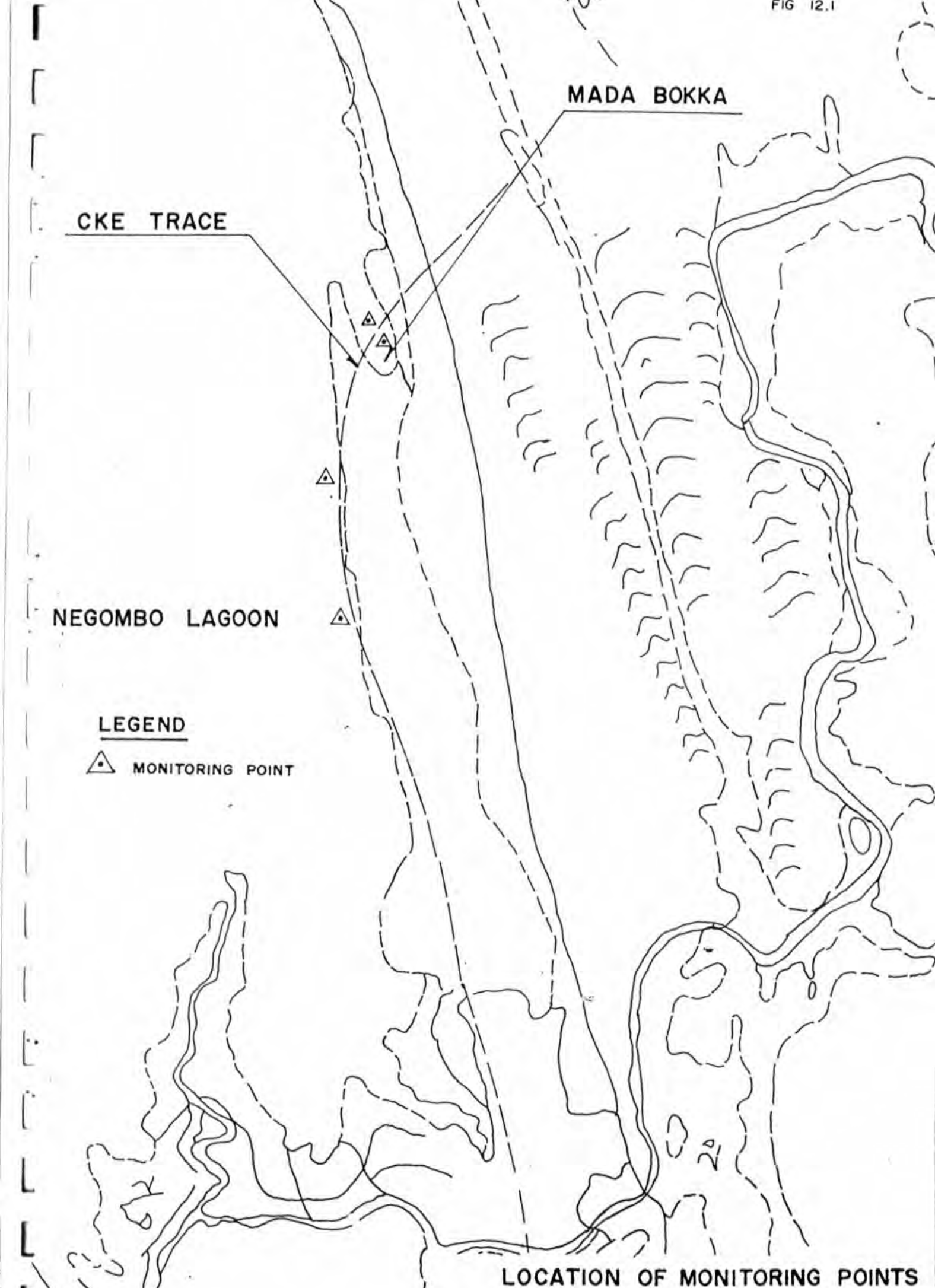
Zone I is the Madabokka area which is vulnerable in the context of prawn spawning, is to be sampled on two locations on either sides of the road trace at a distance of 60.0 m from the centre line. Zone II consisting of the area close to the sea is to be sampled at 02 locations 60.0 mm away from the centre line of the road trace.

The time interval for sampling shall be as shown in Table 12.1

Table 12.1

Condition	Interval of Sampling [days]
Clear weather	10
Rainy weather	03
When construction activities are close to the lagoon area	03

FIG 12.1



LOCATION OF MONITORING POINTS

13. IDENTIFYING AREAS ON VERGES OF NEGOMBO LAGOON FOR EXPANDING ITS AREA

13.1 The Problem

1281 m of the proposed expressway will traverse through the lagoon thereby decreasing its effective area. The surface area is the primary factor that drives the tidal flow which determines the volume of water that is exchanged semi-diurnally with the ocean ensuring the continued functioning of the lagoon. Although the area lost due to the construction of the roadway embankment is only 0.13% of the area of the lagoon, it is considered necessary to compensate for this loss specially in view of the fact that there is an existing problem of encroachment in the lagoon and of siltation in the entrance channels. Compensation area is to be created by the excavation of suitable areas selected on the verges of the lagoon. Area lost due to CKE is 45,000 m^2.

13.2 Selection of Areas for Investigations

From preliminary studies and reconnaissance field visits areas were selected for further investigations and Client's concurrence was obtained before proceeding with the soil investigations. These areas are shown in Figure 13.1. The considerations which led to the selection of these area are:

[a] non-interference with existing developments on the lagoon shore and

[b] likelihood of sandy material being available at very shallow depths

[c] non-interference with the western shore which consists of a narrow strip of sand dunes between the sea and the lagoon

[d] feasibility of increasing the Madabokka area which is considered the most productive area of the lagoon.

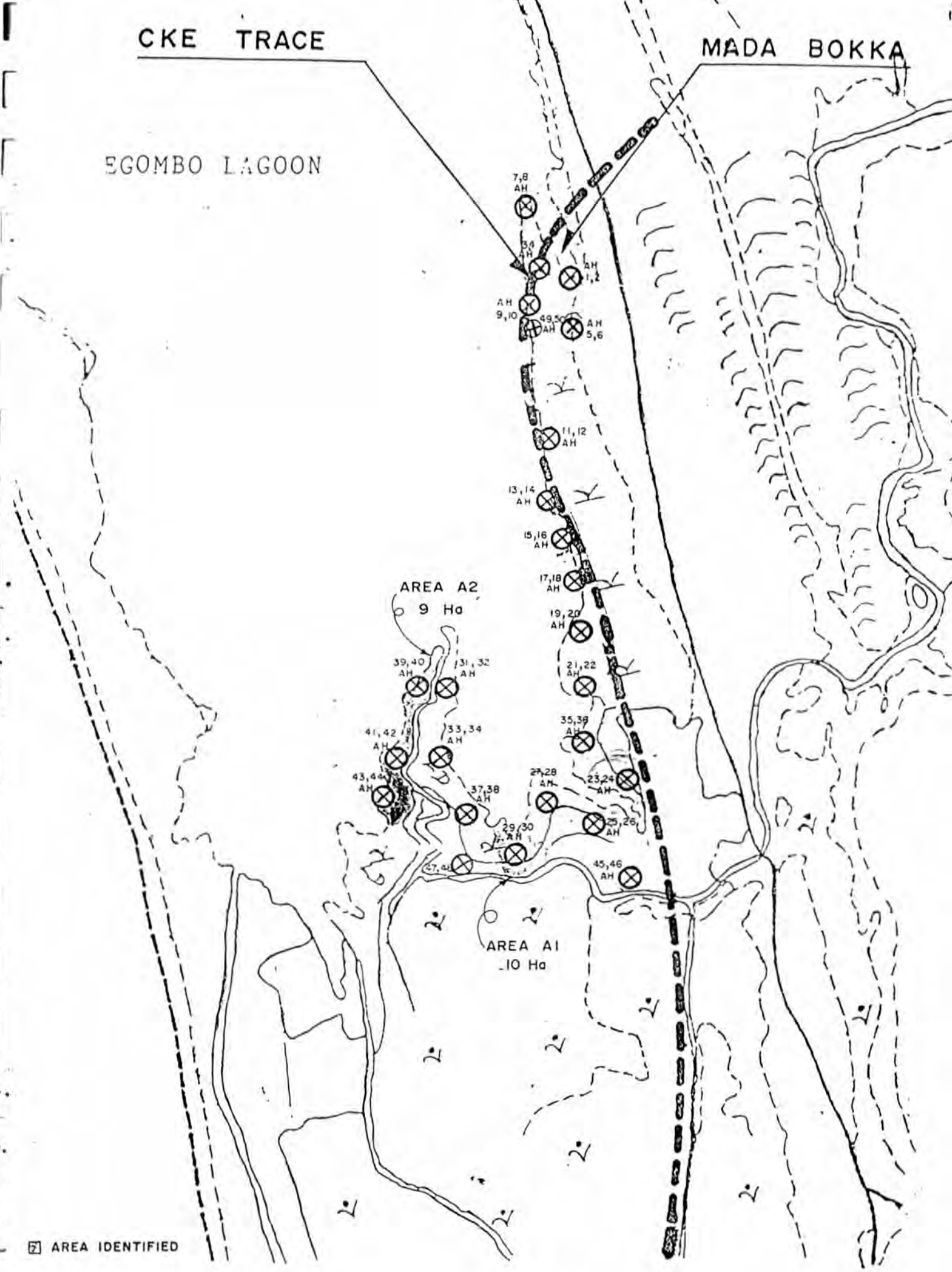
13.3 Augur Hole Survey

A soil survey of the selected areas was carried out by means of 50 augur holes drilled to a depth of 2 m. The location of the augur holes are shown in Figure 13.1.

13.4 Report on Soil Survey

The logs of the augur holes are presented in Figure 13.2 sheets 1 to 5.

In the area covered by the soil survey the top soil cover of about 15 cm in thickness is underlain by silt or clay organic [OL] to a depth of about 80 cm. Below this level the soil consists of clay organic [OH] and clay fat [CH] to the full depth of 2m investigated excepting holes 29, 30, 41, 42, 43, 44, 47 and 48 where the material is poorly graded sand [SP]. Well graded sand was found in holes 39 and 40 below a depth 100 cm.



Location of Area Selected for Auger Hole Survey

Fig.13.2

Logs of Auger Holes

LOG OF AUGER HOLES

LEGEND

= TOP SOIL

OL = SILT OR CLAY ORGANIC

OH = CLAY ORGANIC

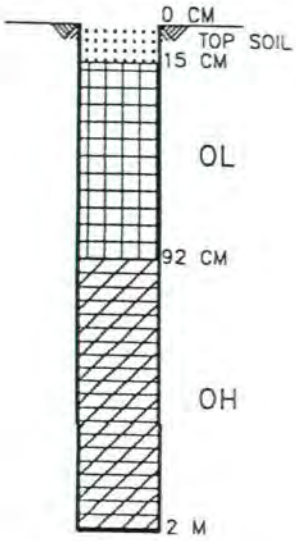
SP = SAND POORLY GRADED

SW = SAND WELL GRADED

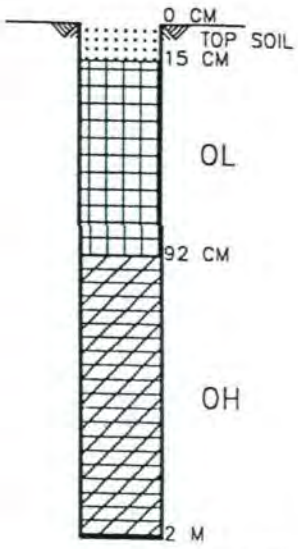
CL = CLAY LEAN

CH = CLAY FAT

AH (1)



AH (2)



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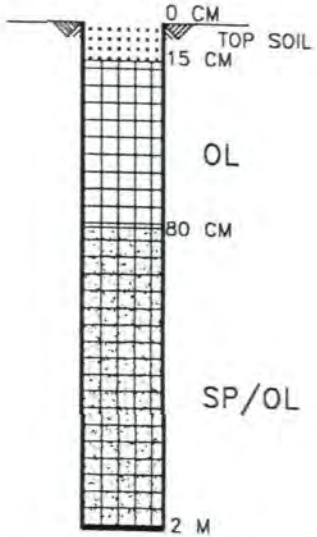
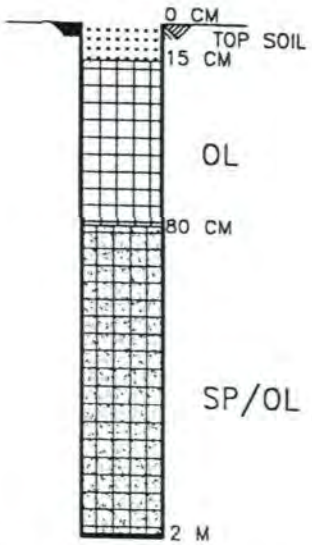


AH (4)



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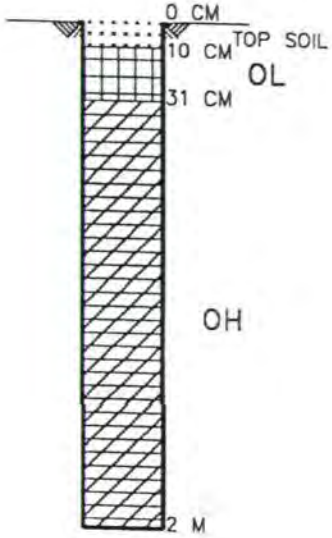

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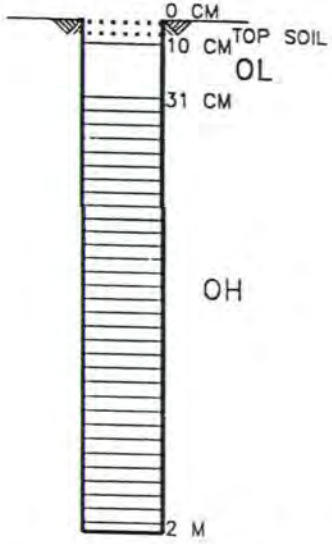
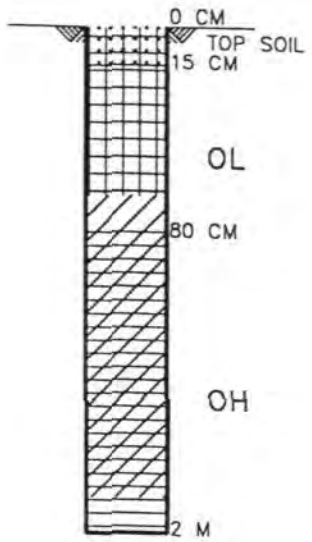


AH (7)



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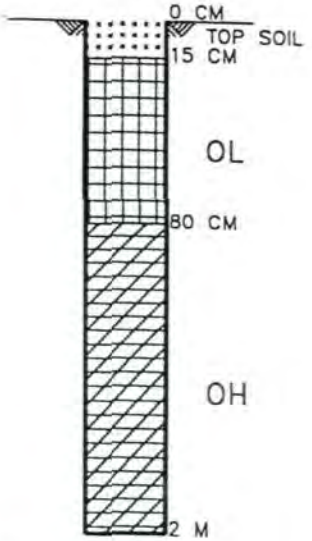
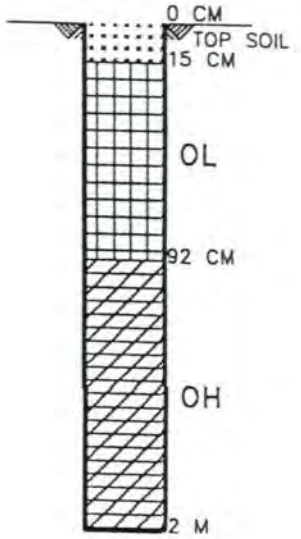
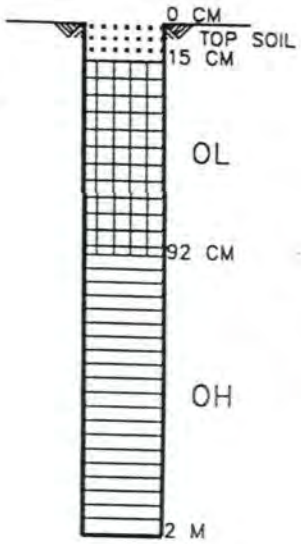


AH (9)



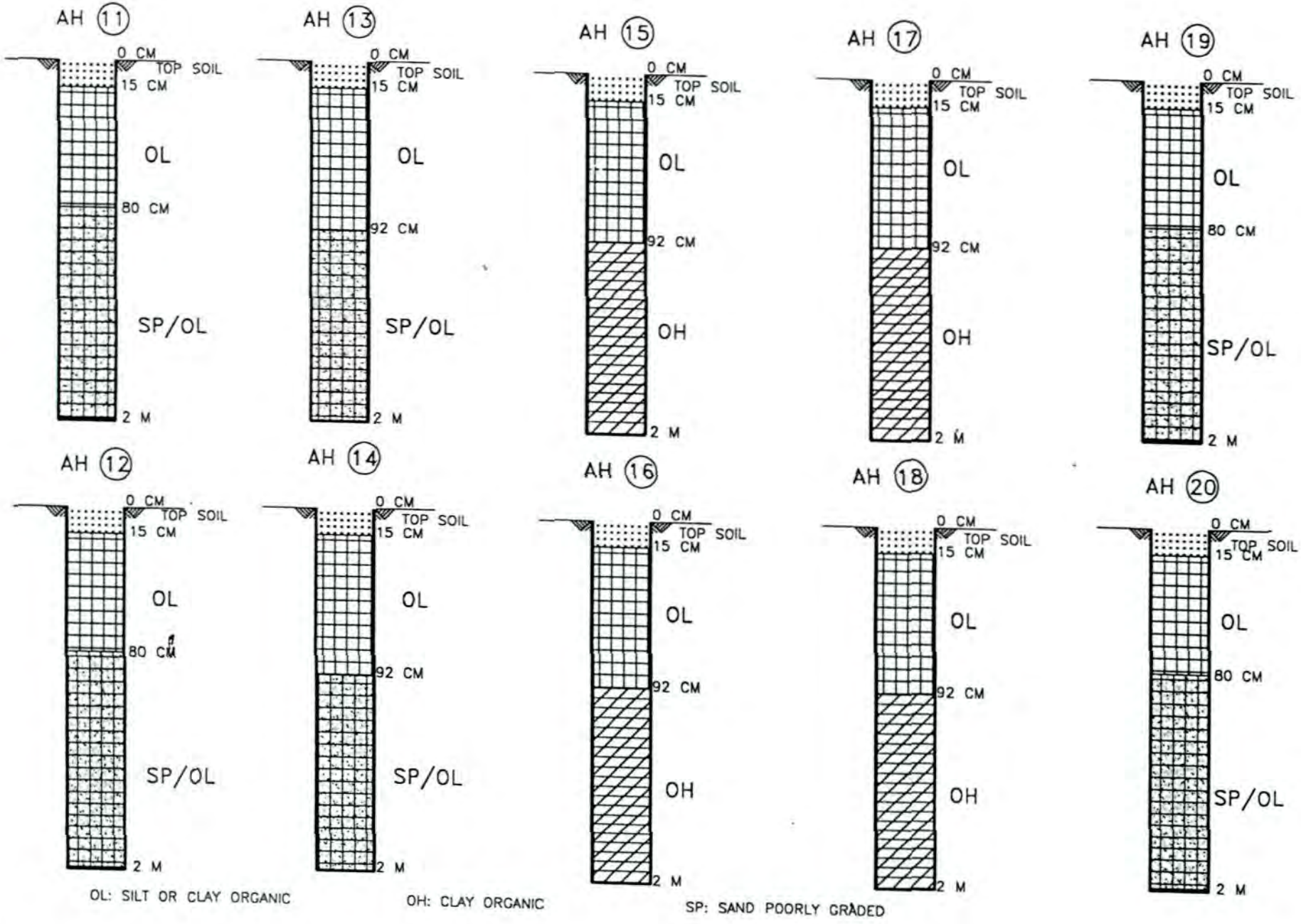
AH (10)



OL: SILT OR CLAY ORGANIC

OH: CLAY ORGANIC

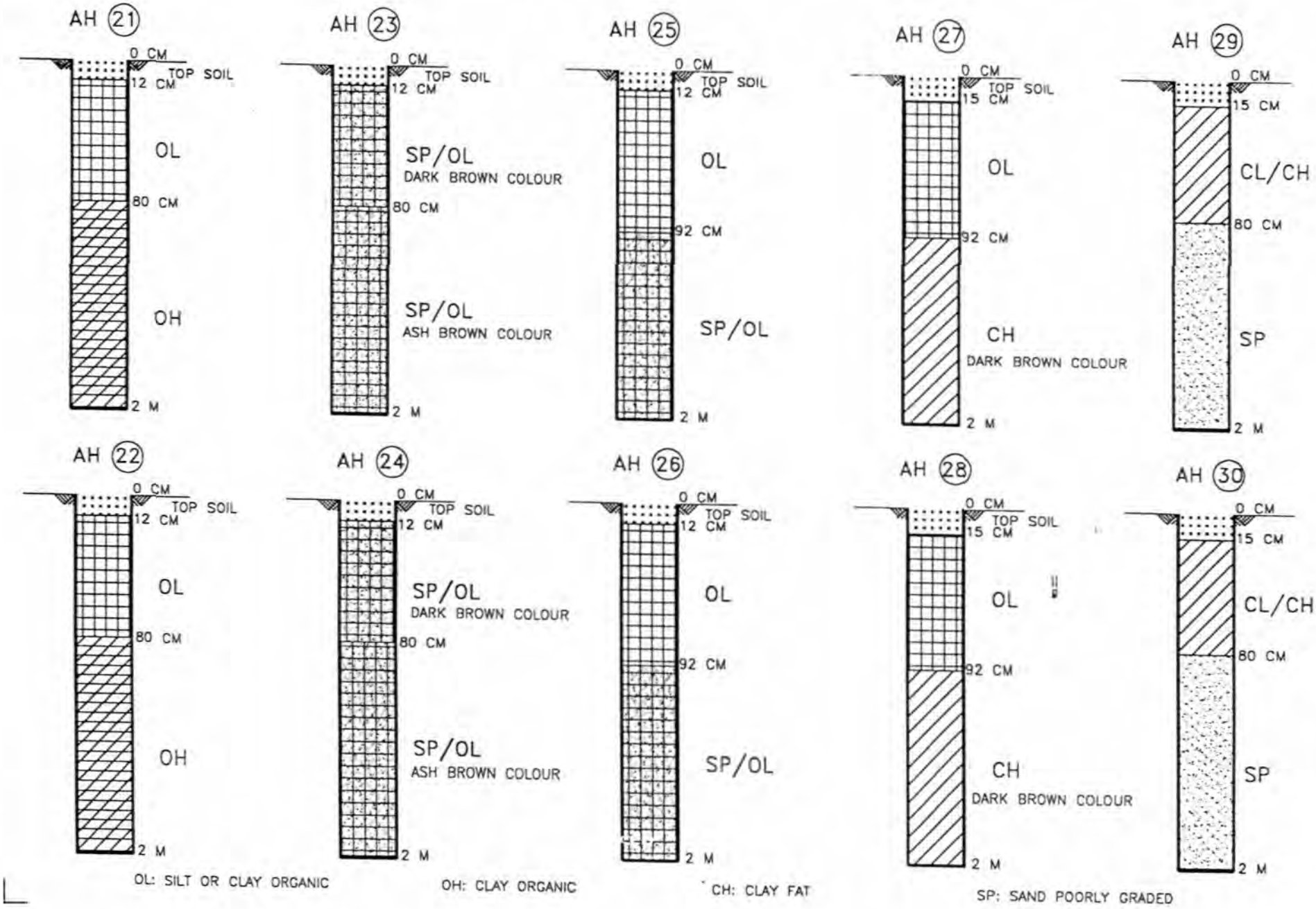
SP: SAND POORLY GRADED



OL: SILT OR CLAY ORGANIC

OH: CLAY ORGANIC

SP: SAND POORLY GRADED


AH (21)
0 CM
TOP SOIL
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OH
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AH (23)
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SP/OL
DARK BROWN COLOUR
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SP/OL
ASH BROWN COLOUR
2 M
AH (25)
0 CM
TOP SOIL
12 CM
OL
92 CM
SP/OL
2 M
AH (27)
0 CM
TOP SOIL
15 CM
OL
92 CM
CH
DARK BROWN COLOUR
2 M
AH (29)
0 CM
15 CM
CL/CH
80 CM
SP
2 M
AH (22)
0 CM
TOP SOIL
12 CM
OL
80 CM
OH
2 M
AH (24)
0 CM
TOP SOIL
12 CM
SP/OL
DARK BROWN COLOUR
80 CM
SP/OL
ASH BROWN COLOUR
2 M
AH (26)
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TOP SOIL
12 CM
OL
92 CM
SP/OL
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AH (28)
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DARK BROWN COLOUR
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AH (30)
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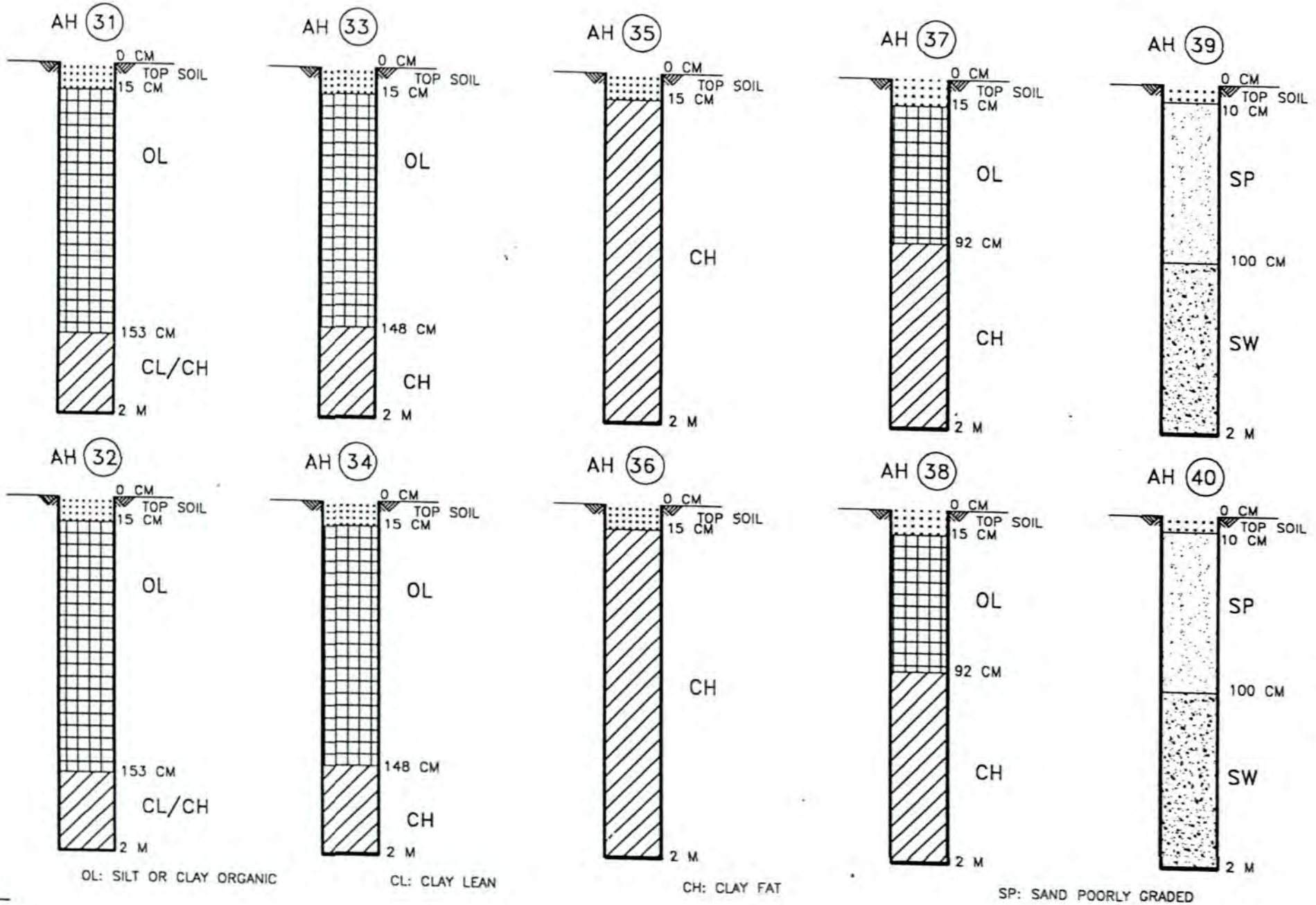
OL: SILT OR CLAY ORGANIC
OH: CLAY ORGANIC
CH: CLAY FAT
SP: SAND POORLY GRADED

Sheet 3 of 5



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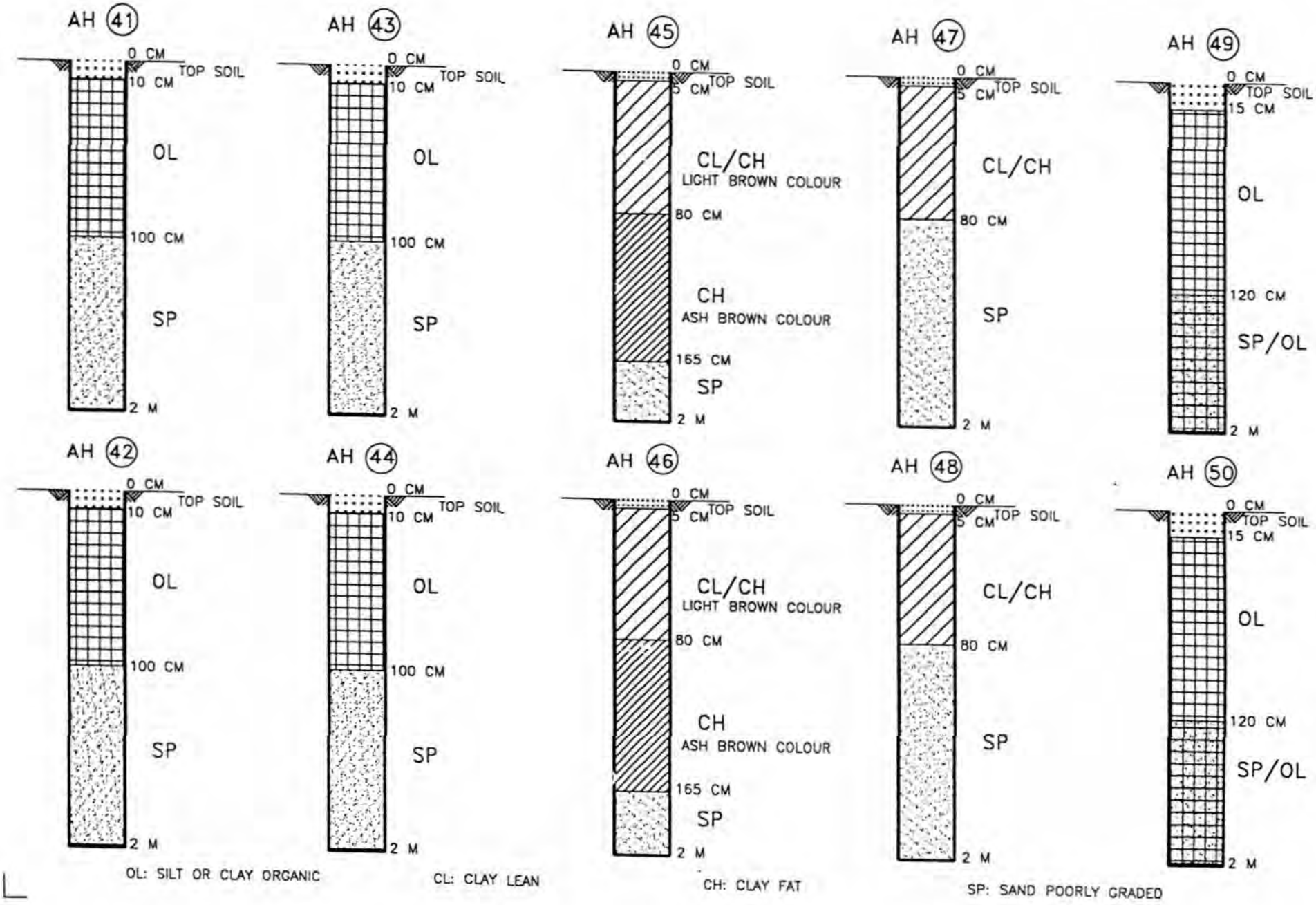
CL: CLAY LEAN

CH: CLAY FAT

SP: SAND POORLY GRADED


AH (41)
0 CM
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OL
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OL
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SP
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AH (45)
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TOP SOIL
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CL/CH
LIGHT BROWN COLOUR
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CH
ASH BROWN COLOUR
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SP
2 M
AH (47)
0 CM
TOP SOIL
5 CM
CL/CH
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SP
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AH (49)
0 CM
TOP SOIL
15 CM
OL
120 CM
SP/OL
2 M
AH (42)
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10 CM
OL
100 CM
SP
2 M
AH (44)
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SP
2 M
AH (46)
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TOP SOIL
5 CM
CL/CH
LIGHT BROWN COLOUR
80 CM
CH
ASH BROWN COLOUR
165 CM
SP
2 M
AH (48)
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TOP SOIL
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CL/CH
80 CM
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AH (50)
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TOP SOIL
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120 CM
SP/OL
2 M
OL: SILT OR CLAY ORGANIC
CL: CLAY LEAN
CH: CLAY FAT
SP: SAND POORLY GRADED

13.5 Identification of Areas

Two areas A1 and A2 have been identified as suitable areas for expanding the lagoon area. These areas have been selected in view of:

[a] availability of sand at depths less than 1m

[b] excavation of these areas will improve hydraulic conditions at the mouth of Dandugam Oya

Area A1 covers an extent of about 10 ha and is bounded by the right bank of Dandugam Oya and the lagoon. Area A2 covers an extent of 9 ha and is bounded by the left bank of Dandugam Oya and the lagoon.

If excavation of one of these areas is solely for the purpose of expanding the lagoon area the average depth of excavation will be about 1 m.

The areas could also be used as a source of embankment fill material with deeper excavation depths.

The extent required to compensate for the area lost due to the roadway is only 5 ha.

13.6 Recommendations

If it is decided to proceed with the expansion of the lagoon area, an environmental impact assessment [EIA] need be carried out as the entire area covered by the survey forms part of mangroves surrounding the southern part of the lagoon.

14. BASELINE SURVEY OF GROUND WATER LEVELS AND WATER QUALITY IN PROJECT AREA

14.1 Objective

Ground water levels and water quality is to be surveyed with a view to establishing baseline data for monitoring during the construction and post project phases.

14.2 Selection of Wells

After reconnaissance visits, 48 dug wells and two water holes were selected so as to provide representative samples from the area traversed by the CKE. As far as possible sample wells were to represent conditions on either side of the roadway. In the reach from Mabole to Katunayake where the trace runs along the Muthurajawela marsh very few wells could be found on the western side and observations were mainly limited to the eastern side.

14.3 Ground Water Survey

Ground water levels were monitored in 50 wells for a period of five months with 2 observations per month. Reference levels at each well were established to MSL datum.

Chemical analysis were performed on 50 samples during the observation period. Microbiological tests were carried out on 25 samples.

Since the period of observation [October to March] included both rainy and dry periods, testing for chemical and physical parameters was carried out on water samples collected from 25 wells in November 1998 and the same 25 wells in February 1999. Microbiological tests were performed on 12 samples collected in November 1998 and 13 samples collected in February 1999 including the 12 wells from which samples were obtained in November 1998..

14.4 Location of Wells

The location of the 50 no. observation wells is given in Annex 2.

14.5 Water Level Observations

Water level observations are presented on Table 14.1. Well water levels especially those close to the lagoon are subject to tidal fluctuations.

14.6 Chemical & Physical Parameters

Results of analyses are presented in Tables 14.2 and 14.3 together with maximum acceptable/allowable concentrations of physical and chemical water quality parameters.

14.7 Microbiological Tests

Results of microbiological tests are given in Annex 2.

14.8 Comments on Water Quality of Samples Tested based on Standards for Potable Water

14.8.1 Colour

About 70% of the samples did not conform to the allowable standards.

14.8.2 Turbidity

About 50% of samples did not conform to the allowable standards.

14.8.3 pH

All samples conformed to allowable standards.

14.8.4 Electrical Conductivity

All samples conformed to allowable standards.

14.8.5 Chloride

All samples conformed to allowable standards.

14.8.6 Total Alkalinity

Only 14% of samples conformed to allowable standards.

14.8.7 Nitrate

All samples conformed to allowable standards.

14.8.8 Nitrite

All samples conformed to acceptable standards.

14.8.9 Total Phosphates

All samples conformed to acceptable standards.

14.8.10 Total Hardness

All samples do not conform to acceptable standards.

14.8.11 Total Iron

About 50% of samples do not conform to acceptable standards.

14.8.12 Free Ammonia

All samples conform to acceptable standards.

14.8.13 Albuminoid Ammonia

All samples conform to acceptable standards.

14.8.14 Bacteriological Examination Reports

All samples were unsatisfactory due to evidence of recent faecal pollution.

COLOMBO-KATUNAYAKA EXPRESSWAY PROJECT

BASELINE SURVEY OF GROUND WATER - GROUND WATER SURFACE ELEVATIONS

WELL NO.	EL. OF REF. BM m-MSL	HT. OF BM ABOVE GR (m)	GR. EL. m-MSL	WATER SURFACE ELEVATION m MSL										
				OCT 25	NOV 14	NOV 22	DEC 11	DEC 28	JAN 13	JAN 29	FEB 8	FEB 23	MAR 15	MAR 30
25W	1.201	0.24	0.961		0.301	0.351	0.481	0.681	0.231	0.301	0.271	0.321	0.121	-0.019
26E	4.28	0.2	4.08		1.395	1.38	1.56	1.47	1.16	1.04	0.96	0.87	1.04	0.86
27E	3.294	0.68	2.614	0.994	0.954	1.194	1.404	1.184	0.914	0.754	0.744	0.614	0.734	0.724
28E	2.008	0.92	1.088		-0.012	0.268	0.428	0.328	0.038	-0.092	-0.112	-0.142	-0.192	-0.222
29E	1.339	0.66	0.679		-0.031	0.189	0.509	0.379	-0.281	-0.391	-0.211	-0.771	-0.751	-0.861
30E	1.872	0.85	1.022	0.952	0.232	0.432	0.552	0.482	-0.028	-0.138	-0.088	0.032	0.032	-0.098
31E	0.855	0.85	0.005	-0.055	-0.455	-0.255	-0.005	-0.125	-0.245	-0.275	-0.155	-0.175	-0.325	-0.445
32E	1.016	0.33	0.686		0.276	0.506	0.536	0.556	0.056	-0.034	0.026	0.006	-0.074	-0.084
33W	0.982	0.13	0.852		-0.108	0.002	0.262	0.172	0.162	0.202	0.192	0.152	0.072	-0.018
34E	1.619	0.85	0.769		-0.091	0.109	0.259	0.199	-0.141	-0.391	-0.411	-0.471	-0.561	-0.751
35E	1.891	0.67	1.221		0.471	0.691	0.741	0.751	0.311	0.201	0.241	0.311	0.231	0.131
36E	2.047	0.71	1.337		0.437	0.567	0.687	0.627	0.727	0.617	0.747	0.677	0.637	0.487
37E	3.978	0.39	3.588		2.178	2.288	2.478	2.348	2.568	2.498	2.508	2.438	2.378	2.368
38E	1.59	0.7	0.89		0.52	0.62	0.71	0.64	0.29	0.09	0.39	0.29	0.02	0.03
40E	1.824	0.63	1.194	0.504	0.494	0.674	0.634	0.504	0.174	0.114	0.094	-0.006	-0.036	-0.066
41E	2.612	0.57	2.042	0.462	0.472	0.572	0.662	0.602	0.502	0.462	0.442	0.422	0.472	0.362
42E	0.736	0.18	0.556	0.226	0.266	0.466	0.336	0.496	0.166	0.216	0.496	0.416	0.366	0.306
43E	2.952	0.82	2.132	2.222	1.812	1.882	2.042	1.932	1.632	1.462	1.672	1.612	1.292	1.092
44E	3.387	0.46	2.927	2.337	1.977	2.007	2.137	2.077	1.587	1.787	1.747	1.867	1.427	1.547
45E	2.402	0.54	1.862	1.612	1.332	1.432	1.392	1.682	1.322	1.122	1.182	1.132	0.972	0.902
46E	2.812	0.48	2.332	2.312	2.272	2.232	2.382	2.252	1.982	1.952	2.222	2.032	1.872	1.682
47E	2.862	0.7	2.162	2.312	1.882	1.952	2.062	1.982	1.692	1.642	1.882	1.682	1.662	1.442
48E	2.078	0.4	1.678	1.378	1.408	1.688	1.558	1.518	1.198	1.218	1.518	1.378	1.238	1.078
49E	2.387	0.23	2.157	1.907	1.877	1.987	2.137	2.047	1.667	1.707	1.987	1.847	1.767	1.687
50 E	2.162	0.66	1.502	1.162	1.242	1.262	1.332	1.332	0.972	0.942	1.152	1.062	0.862	0.772

NOTE : E IN THE WELL NO. DENOTES LOCATION IS EAST OF CKE TRACE & W WEST OF CKE TRACE

COLOMBO-KATUNAYAKA EXPRESSWAY PROJECT

BASELINE SURVEY OF GROUND WATER - GROUND WATER SURFACE ELEVATIONS

WELL NO.	EL. OF REF. BM m-MSL	HT. OF BM ABOVE GR (m)	GR. EL. m-MSL	WATER SURFACE ELEVATION m MSL										
				OCT 25	NOV 14	NOV 22	DEC 11	DEC 28	JAN 13	JAN 29	FEB 8	FEB 23	MAR 15	MAR 30
1E	1.368	0.74	0.628	-0.012	-0.282	-0.002	0.208	-0.122	-0.332	-0.312	0.198	-0.552	-0.722	-0.712
2W	0.323	-0.08	0.403	-0.137	-0.377	-0.047	0.153	-0.157	-0.377	-0.347	-0.297	-0.377	-0.477	-0.417
3W	3.798	0.62	3.178	0.948	1.068	1.248	1.378	0.878	0.518	0.638	0.538	0.318	-0.042	0.048
4W	3.656	0.56	3.096	1.266	0.936	1.246	1.366	1.026	0.936	0.856	0.846	0.636	0.496	0.636
5E	2.839	0.78	2.059	1.449	0.699	1.119	1.309	0.739	0.689	0.539	0.489	0.329	0.299	0.329
6E	5.583	0.83	4.753	2.743	2.603	3.343	3.573	2.663	2.543	2.503	2.283	2.243	2.133	2.043
7W	2.533	0.28	2.253	2.123	2.013	2.163	2.253	2.043	2.083	1.993	1.903	1.853	1.813	1.833
8E	5.003	0.84	4.163	2.413	1.863	2.453	2.343	1.903	1.803	1.603	1.483	1.373	1.283	1.263
9	3.99	0.96	3.03	1.27	1.35	1.78	1.66	1.41	1.09	1.16	1.16	1.12	1.03	1.08
10W	3.798	0.86	2.938	0.448	0.848	1.438	1.298	0.898	0.778	0.488	0.558	0.498	0.478	0.558
10(A)E	4.135	0.38	3.755		2.185	2.495	2.805	2.255	2.035	1.805	1.815	1.835	1.595	1.795
11W	1.973	0.14	1.833	0.973	0.883	0.923	1.253	1.023	0.863	0.753	0.853	0.813	0.793	0.893
12E	5.053	0.85	4.203	0.403	0.303	0.793	0.923	0.343	0.193	0.153	0.093	0.073	-0.007	0.073
13W	4.978	0.55	4.428	0.668	0.458	0.628	0.858	0.568	0.478	0.298	0.358	0.278	0.218	0.288
14E	3.853	1.13	2.723	0.673	0.623	0.703	0.953	0.723	0.533	0.393	0.383	-0.947	0.413	0.333
15W	2.699	0.8	1.899	0.799	0.779	0.939	1.049	0.919	0.659	0.529	0.429	-1.441	0.499	0.419
16W	2.067	0.3	1.767		0.927	0.997	1.247	1.087	0.647	0.547	0.547	-1.373	0.547	0.427
17E	5.96	0.54	5.42	1.46	1.43	1.64	1.83	1.53	1.43	1.28	1.24	3.73	1.1	1.08
18W	1.852	0.63	1.222		-1.848	-1.798	-1.598	-1.718	-1.638	-1.718	-1.488	0.352	-1.788	-1.768
19W	5.778	0.7	5.078		1.708	1.738	1.958	1.858	1.758	1.638	1.588	1.878	1.618	1.638
20E	1.009	0.54	0.469		0.329	0.199	0.289	0.229	0.089	0.069	0.099	-2.401	0.029	-0.071
21E	1.151	0.87	0.281	0.101	0.181	0.381	0.491	0.401	0.101	0.071	0.151	-1.529	0.061	-0.049
22E	1.352	0.78	0.572	-0.128	-0.058	0.142	0.252	0.162	-0.138	-0.288	-0.188	-0.228	-0.268	-0.468
23E	5.209	0.78	4.429		1.759	3.979	1.929	1.839	1.669	1.509	1.429	1.309	1.429	1.407
24E	2.202	0.5	1.702		1.312	1.482	1.372	1.532	0.972	0.902	1.122	1.282	0.882	0.852

HYDROLOGICAL STUDY - PROPOSED COLOMBO KATUNAYAKE EXPRESSWAY
BASELINE SURVEY OF GROUND WATER - CHEMICAL AND PHYSICAL PARAMETERS

DATE OF SAMPLING - 16 NOVEMBER 1998

Well No.	Colour (Hazen units)	Turbidity (NTU)	pH	E.C. us/cm	Chloride mg/l	T. Al. mg/l	Nitrate mg/l	Nitrite mg/l	T.pH. mg/l	T.D.S. mg/l	T. H. mg/l	T.Iron mg/l	F . Am. mg/l	A . Am. mg/l
1	15	3.6	7.3	350	32	152	< 0.1	< 0.001	< 0.04	233	112	1.6	< 0.01	< 0.01
3	5	0.9	6.8	760	68	124	< 0.1	< 0.001	0.04	507	184	0.6	< 0.01	< 0.01
5	< 2.5	1.5	7.3	310	20	100	< 0.1	< 0.001	< 0.04	207	112	0.6	0.03	0.46
6	< 2.5	0.6	6.6	337	76	40	< 0.1	< 0.001	< 0.04	225	88	0.6	< 0.01	< 0.01
9	< 2.5	0.9	7.6	415	40	64	10	< 0.001	< 0.04	277	112	0.6	< 0.01	< 0.01
10	0	0.6	6.8	240	16	64	7.5	< 0.001	0.06	160	80	0.6	< 0.01	< 0.01
11	5	2	7.6	349	64	80	< 0.1	< 0.001	0.04	233	72	0.06	< 0.01	< 0.01
12	5	0.6	7.5	717	88	44	1.5	0.01	0.04	478	184	0.02	< 0.01	< 0.01
13	25	1	7.6	427	28	52	< 0.1	< 0.001	< 0.04	285	164	0.18	< 0.01	< 0.01
14	10	0.7	7.4	387	48	128	< 0.1	< 0.001	< 0.04	258	120	0.45	< 0.01	< 0.01
15	25	0.7	7.6	342	36	80	0.5	< 0.001	< 0.04	228	80	0.41	< 0.01	< 0.01
16	15	0.5	7.6	1140	210	580	< 0.1	< 0.001	< 0.04	760	210	0.06	< 0.01	< 0.01
18	25	1	6.8	350	24	96	< 0.1	< 0.001	0.12	233	108	0.37	< 0.01	< 0.01
20	> 110	50	7.4	665	72	160	< 0.1	< 0.001	< 0.04	443	176	7.15	< 0.01	< 0.01
21	60	55	7.2	352	40	132	< 0.1	< 0.001	< 0.04	235	120	5.3	< 0.01	< 0.01
22	50	11	7.6	353	36	96	< 0.1	< 0.001	0.04	235	96	1.58	< 0.01	< 0.01
24	50	3	6.8	728	52	124	< 0.1	< 0.001	0.8	485	232	0.43	< 0.01	< 0.01
25	30	6.5	7.6	257	16	80	< 0.1	< 0.001	< 0.04	493	92	1.89	< 0.01	< 0.01
30	20	3.3	7.6	128	184	152	< 0.1	< 0.001	0.08	171	254	0.28	< 0.01	< 0.01
38	5	1.2	7.6	1177	220	220	< 0.1	< 0.001	0.12	847	220	0.06	< 0.01	< 0.01
44	20	1	7.3	700	100	260	< 0.1	< 0.001	< 0.04	775	140	0.33	< 0.01	< 0.01
47	20	9.3	6.8	752	92	248	< 0.1	< 0.001	0.06	508	196	1.12	< 0.01	< 0.01
48	15	4	7.4	675	84	240	< 0.1	0.006	< 0.04	450	208	3.5	< 0.01	< 0.01
50	10	2	7.4	318	28	120	< 0.1	< 0.001	0.06	212	132	0.7	< 0.01	< 0.01

E.C - ELECTRICAL CONDUCTIVITY
T.Al - TOTAL ALKALINITY
T.pH - TOTAL PHOSPHATES

T.D.S. - TOTAL DISSOLVED SOLIDS
T.H. - TOTAL HARDNESS
T.Iron - TOTAL IRON

F.Am. - FREE AMONIA
A.Am - ALBUMINOID AMMONIA

HYDROLOGICAL STUDY - PROPOSED COLOMBO KATUNAYAKE EXPRESSWAY
BASELINE SURVEY OF GROUND WATE - CHEMICAL AND PHYSICAL PARAMETERS

DATE OF SAMPLING - 22 FEBRUARY 1999

WELL NO.	Colour (Hazen units)	Turbidity (NTU)	pH	E.C. us/cm	Chloride mg/l	T. Al. mg/l	Nitrate mg/l	Nitrite mg/l	T.Ph. mg/l	T.D.S. mg/l	T. H. mg/l	T.Iron mg/l	F . Am. mg/l	A . Am. mg/l
1	6	6.5	7.5	370	40	152	0.2	< 0.001	0.12	194	144	1.2	< 0.01	< 0.01
3	8	17	7.5	810	92	144	0.4	< 0.001	0.14	498	220	1.2	< 0.01	< 0.01
5	5	1.5	6.9	170	28	24	< 0.1	< 0.001	0.06	108	44	0.8	<0.01	<0.01
6	5	1.3	7.6	320	40	100	0.1	< 0.001	0.06	141	112	0.3	< 0.01	< 0.01
9	6	3.4	7.3	300	32	36	0.6	< 0.001	0.14	170	84	0.8	< 0.01	< 0.01
10	5	1.1	7.5	210	24	56	0.1	< 0.001	0.06	233	56	0.3	< 0.01	< 0.01
11	5	5	6.7	230	44	12	0.3	< 0.001	0.14	151	20	0.5	< 0.01	< 0.01
12	5	2.7	7.3	620	76	28	1	<0.001	0.06	470	140	0.3	< 0.01	< 0.01
13	5	3	6.3	460	36	4	0.4	0.024	0.06	354	112	0.6	< 0.01	< 0.01
14	12	19	7.5	390	48	132	0.2	< 0.001	0.14	230	124	1.7	< 0.01	< 0.01
15	>5	1.7	7.4	214	32	44	<0.1	< 0.001	0.06	140	40	0.5	< 0.01	< 0.01
16	10	7.6	7.6	1113	144	196	< 0.1	< 0.001	0.32	580	192	0.7	< 0.01	< 0.01
17	10	6.5	7.2	539	56	24	3	< 0.001	0.06	460	116	0.9	< 0.01	< 0.01
18	>5	1.5	7.4	285	36	48	0.8	< 0.001	0.06	200	68	0.2	< 0.01	< 0.01
19	5	2.1	6.6	146	20	20	< 0.1	< 0.001	< 0.04	180	28	0.1	< 0.01	< 0.01
20	110	94	7.4	503	56	144	< 0.1	< 0.001	0.06	380	140	>5.0	< 0.01	< 0.01
21	110	123	7.4	423	32	168	< 0.1	< 0.001	0.06	460	180	>5.0	< 0.01	< 0.01
22	10	20	7.6	425	40	104	< 0.1	< 0.001	0.1	345	132	2	< 0.01	< 0.01
24	50	20	7.6	421	424	208	< 0.1	< 0.001	2.8	263	352	2	< 0.01	< 0.01
25	15	22	7.6	324	16	112	< 0.1	< 0.001	0.06	240	124	3	< 0.01	< 0.01
30	10	15	6.8	1900	350	60	< 0.1	< 0.001	0.06	1400	240	1.6	< 0.01	< 0.01
38	5	9.3	6.8	752	92	248	< 0.1	< 0.001	0.06	508	196	1.12	< 0.01	< 0.01
44	10	4	7.4	675	84	240	< 0.1	0.006	< 0.04	450	208	3.5	< 0.01	< 0.01
47	10	2	7.4	318	28	120	< 0.1	< 0.001	0.06	212	132	0.7	< 0.01	< 0.01
48	5	8.5	7.6	646	64	200	<0.1	<0.001	0.08	980	192	>5	<0.01	<0.01
50	5	8.3	7.6	2180	20	140	<0.1	<0.001	0.16	1298	250	4	<0.01	<0.01

E.C - ELECTRICAL CONDUCTIVITY
T.Al - TOTAL ALKALINITY
T.pH - TOTAL PHOSPHATES

T.D.S. - TOTAL DISSOLVED SOLIDS
T.H. - TOTAL HARDNESS
T.Iron - TOTAL IRON

F.Am. - FREE AMONIA
A.Am - ALBUMINOID AMMONIA

Table 14.3

15. Concluding Remarks.

After detailed studies the following conclusions were reached :

1. The proposed expressway will have very little effect on the flood levels east of A3.

2. The anticipated rise in 100-year flood peaks due to the expressway is less than 5 cm. except in the case of Mudun Ela where a rise of 15 cm. is projected upstream of CKE and 14 cm. upstream of A3. However the projected rise in flood levels could be reduced by over 10 cm. if the waterway area in culvert No. 3/1 on A3 is increased to 16 sq. meters. Even under prevailing conditions the flood levels and flooding times in Mudun Ela are aggravated due to the constricted passages in A3.

3. Since the anticipated rise in high flood levels upstream of CKE and A3 are minimal there is no need for the provision of additional detention areas.

4. The flood levels downstream of CKE are controlled by the water surface elevation of Negombo Lagoon in the case of Dandugam Oya, Ja Ela and micro-catchments, and Kelani Ganga in the case of Kalu Oya and Mudun Ela. Appreciable reduction in downstream levels cannot be achieved with cost effective techniques. However in the case of Mudun Ela it is recommended that the waterway area in culvert No. 3/1 be increased.

5. Adoption of 1.1 meters as free board over the 100 year return period flood, in the preliminary design is justified, after comprehensive analyses done during the study,which included estimation of probable wave heights and allowing a free board of 0.5 meters above the 200 year flood level.

6. The area of the lagoon lost due to the expressway traversing a part of the lagoon is only 0.13% of the Negombo Lagoon surface area.

7. The volume of water in the lagoon at MSL is estimated at around 45 MCM, based on depth measurements. This figure is higher than the value given in published reports (22.5 MCM). The average depth works out to 1.3 meters .

ANNEX I

MONTHLY RAINFALL DATA

HALGAHAPITIYA	– JANUARY 1965 TO DECEMBER 1998
COLOMBO	- JANUARY 1965 TO DECEMBER 1998
KATUNAYAKE	- JANUARY 1965 TO DECEMBER 1998
HENARATHGODA	- JANUARY 1965 TO DECEMBER 1998
VINCIT ESTATE	- JANUARY 1965 TO DECEMBER 1998
PASYALA	- JANUARY 1965 TO DECEMBER 1998
WALPITA	- JANUARY 1965 TO DECEMBER 1998

[DAILY RAINFALL DATA FOR THIS PERIOD IS AVAILABLE ON DISKETTE]

STATION NAME : HALGAHAPITIYA GROUP
LAT: 7.23N LON: 80.10E ELEV: ******M
ELEMENT : Precip,Total Mly in Millimeters
Missing data values are coded as -9.9M

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1965	19.2	105.5	64.3	268.4	449.8	126.7	41.3	482.6	238.5	395.4	218.0	214.2
1966	100.3	124.0	133.6	489.5	123.6	103.5	65.7	95.7	577.0	540.8	192.0	186.1
1967	71.3	96.6	232.1	194.7	234.4	322.2	193.0	125.5	177.4	543.7	381.6	108.0
1968	49.4	23.3	153.0	364.9	-9.9M	473.4	354.5	20.7	284.2	340.5	336.2	43.6
1969	50.6	159.9	64.0	405.5	505.1	136.4	7.1	176.8	74.2	460.2	235.2	425.0
1970	45.5	21.1	107.7	389.6	301.6	222.1	245.6	24.3	152.5	519.0	234.0	109.0
1971	83.0	154.8	135.3	340.3	365.1	395.9	176.7	216.9	480.2	187.4	44.7	159.7
1972	2.0	.0	105.4	216.4	471.1	127.3	78.9	94.4	293.9	442.1	281.3	163.9
1973	16.5	58.7	169.5	280.4	229.7	278.5	126.7	117.9	44.7	340.6	414.6	293.9
1974	.0	161.9	118.1	474.2	248.1	171.8	231.5	97.4	435.6	171.3	142.7	202.5
1975	118.9	201.5	190.3	332.2	490.3	206.2	179.6	216.1	244.3	258.2	457.7	134.0
1976	9.7	.0	257.1	273.7	95.7	48.5	85.3	131.5	45.8	557.5	578.0	100.8
1977	11.9	102.3	443.2	314.0	954.6	144.0	30.6	139.7	86.6	602.6	233.2	13.7
1978	.0	130.3	336.9	104.2	501.3	211.8	36.9	27.2	210.9	305.0	494.3	136.0
1979	.0	119.2	103.4	96.3	94.8	435.7	73.2	16.8	388.9	341.8	363.5	46.0
1980	2.3	.0	152.2	231.4	203.4	264.7	95.3	171.6	313.4	316.4	425.5	97.1
1981	166.6	82.6	122.2	174.7	311.7	303.5	93.8	151.7	380.0	280.4	349.4	71.4
1982	.0	.0	127.5	136.4	353.2	455.9	222.7	234.6	101.0	408.8	559.9	93.2
1983	11.7	.0	.5	60.6	154.6	233.8	131.7	140.0	-9.9M	147.9	175.6	213.1
1984	276.2	242.7	487.9	445.4	461.8	201.3	271.2	22.5	181.5	253.5	440.8	55.4
1985	90.5	257.4	221.8	181.3	386.4	477.0	121.3	119.8	179.0	566.6	406.9	125.5
1986	200.4	132.4	71.7	316.3	177.3	80.9	5.9	152.3	219.1	243.2	240.0	105.4
1987	6.7	.0	15.2	230.1	181.7	256.3	10.2	195.5	188.3	206.2	257.9	39.5
1988	.0	231.1	47.3	476.0	119.4	366.3	-9.9M	-9.9M	-9.9M	-9.9M	-9.9M	-9.9M
1989	-9.9M	-9.9M	-9.9M	190.1	204.5	352.7	343.9	36.2	132.2	347.6	403.0	86.4
1990	168.1	.0	165.8	103.6	354.3	116.6	184.4	1.3	20.7	364.4	584.2	178.2
1991	75.9	19.1	272.9	110.6	214.1	154.3	76.2	52.4	39.2	322.8	230.0	46.5
1992	12.7	.0	.0	215.7	418.0	217.4	209.9	147.1	261.3	427.9	442.8	54.8
1993	37.0	38.7	162.3	227.9	286.6	58.1	185.6	-9.9M	229.0	736.7	385.6	257.3
1994	175.3	98.9	193.7	526.2	385.2	91.7	89.7	57.6	166.5	792.6	489.4	-9.9M
1995	196.3	9.1	189.3	706.4	420.7	411.4	110.6	163.3	125.1	447.8	525.3	13.8
1996	34.2	134.0	6.8	272.7	64.6	132.7	168.2	175.3	379.9	179.5	241.6	58.5
1997	.0	29.3	34.8	300.3	335.8	133.2	290.7	89.3	462.3	573.7	456.3	175.7
1998	20.1	.0	44.4	136.5	295.9	187.3	299.6	214.2	257.1	360.4	168.5	207.9

STATION NAME : COLOMBO
LAT: 6.90N LON: 79.87E ELEV: 7.3M
ELEMENT : Precip,Total Mly in Millimeters
Missing data values are coded as -9.9M

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1965	42.4	105.4	48.7	355.0	609.7	74.7	54.6	131.3	227.6	507.2	220.2	227.3
1966	166.2	25.7	223.4	334.5	147.3I	135.6	102.2	26.7	551.3	387.9	218.0	67.2
1967	15.8	75.5	114.9	108.4	593.5	156.5	239.0	152.0	256.6	619.5	319.5	347.3
1968	93.3	13.5	86.5	224.7	97.8	270.9	271.3	47.3	151.2	200.5	285.1	120.6
1969	153.9	76.6	58.4	286.4	562.1	85.6	26.2	212.4	55.7	559.2	255.5	427.2
1970	95.2	95.9	170.6	441.0	602.5	129.3	242.6	27.8	201.9	307.7	476.1	60.1
1971	85.2	69.4	85.9	246.5	195.1	218.8	108.6	94.1	366.1	386.5	86.6	180.7
1972	15.5	.0	68.3	157.0	467.1	146.1	42.1	61.3	197.5	463.2	315.1	163.7
1973	10.5	43.2	110.8	254.0	317.5	250.3	91.9	56.5	40.5	416.3	411.1	244.4
1974	.0	148.5	62.7	562.1	488.8	271.1	193.5	108.1	210.5	127.2	158.5	189.8
1975	20.5	29.2	151.2	490.8	298.3	303.5	152.4	68.5	270.9	124.9	580.4	73.7
1976	20.0	.0	67.2	140.6	208.9	87.8	72.3	192.7	29.3	527.6	475.2	274.3
1977	11.2	116.1	356.8	133.3	750.7	218.5	51.2	119.7	145.9	871.2	188.4	51.4
1978	6.2	11.3	147.0	151.3	565.1	110.1	87.7	27.9	103.1	187.0	387.2	170.6
1979	3.2	124.8	77.9	225.8	143.0	244.0	111.7	50.5	453.7	254.5	466.9	294.6
1980	.6	.0	29.9	228.1	214.8	277.9	35.7	141.5	176.2	451.9	267.0	172.3
1981	117.4	93.3	102.5	199.7	441.3	182.4	34.5	79.9	120.1	193.1	460.2	54.1
1982	4.1	.2	311.8	108.8	323.7	195.0	160.9	123.6	104.9	186.6	434.9	51.0
1983	.0	43.0	60.3	83.0	336.5	118.6	163.1	94.0	291.5	94.8	241.7	223.6
1984	211.5	179.6	162.5	254.0	491.0	176.3	127.8	4.9	339.3	161.3	360.2	24.2
1985	83.5	160.8	116.1	76.3	253.2	316.9	19.6	111.2	275.7	343.4	244.9	230.9
1986	144.9	78.4	91.4	216.8	230.9	93.8	10.5	76.2	128.4	163.0	58.9	203.4
1987	98.4	.0	73.2	179.3	193.4	116.3	12.0	404.8	509.6	506.5	217.4	136.0
1988	3.0	63.6	206.4	185.0	146.2	352.7	101.6	122.4	374.3	117.9	286.9I	96.0I
1989	35.8	6.0	146.3	332.9	399.1	217.2	138.2I	49.1I	174.5I	450.4	284.7	31.5
1990	182.7	36.9	184.0	368.9	324.3	184.1	206.3	17.9	29.6	374.1	255.8	178.8
1991	78.8	55.2	146.4	142.1	317.4	304.9	121.0	88.8	112.4	353.1	292.7	79.1
1992	19.8	3.5	.9	151.5	485.7	601.3	218.1	70.9	323.0	216.7	401.5	78.4
1993	.6	15.2	94.7	225.3	582.5	154.7	38.9	38.6	345.4	502.0	305.4	268.0
1994	84.7	117.4	134.4	101.4	480.1	81.7	104.7	73.4	370.3	477.0	427.4	30.5
1995	92.3	12.9	30.7	374.6	446.5	365.3	93.9	135.9	97.1I	320.8	405.7	19.2
1996	97.9	102.1	.2	291.9	126.5	129.6	209.7	206.6	282.8	305.9	239.2	168.6
1997	.0	70.0	25.9	92.2	274.2	191.1	187.0	69.2	417.3	618.7	440.3	138.2
1998	57.9	.0	36.4	119.8	194.2	256.3	462.2	127.8	209.0	304.1	267.3	327.6

STATION NAME : KATUNAYAKA
LAT: 7.17N LON: 79.88E ELEV: 8.5M
ELEMENT : Precip,Total Mly in Millimeters
Missing data values are coded as -9.9M

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1965	9.8	33.5	15.0	186.6	408.1	60.6	22.0	331.4	147.7	519.9	228.3	208.7
1966	108.4	42.7	97.2	271.0	108.4	121.2	55.1	9.9	474.3	449.3	213.8	100.7
1967	32.1	62.3	163.8	86.1	350.3	188.0	159.1	111.4	339.1	708.6	427.9	82.1
1968	5.0	113.6	63.4	255.8	117.8	253.5	247.0	28.1	159.4	343.7	230.9I	129.7I
1969	46.0	97.9	80.2	453.8	307.2	66.6	28.6	163.0	27.6	766.0	222.7	348.6
1970	118.4	36.9	204.4	628.0	381.2	166.0	201.2	5.9	242.5	478.9	460.7	114.5
1971	79.6	140.2	93.1	172.9	155.1	264.9	51.8	82.2	416.8	235.1	5.8	170.2
1972	2.5	.0	86.4	109.4	499.3	86.6	69.2	48.9	204.1	417.0	259.7	185.7
1973	1.2	50.5	186.7	322.3	291.4	203.6	90.9	44.5	40.5	397.6	269.4	215.6
1974	.0	29.6	117.5	391.0	258.6	140.8	192.1	91.5	323.8	69.5	155.9	181.2
1975	8.4	83.6	87.1	264.6	255.9	198.7	166.9	68.4	211.8	162.6	407.4	163.8
1976	12.4	.0	155.4	236.0	135.3	49.0	75.4	128.0	69.7	485.7	446.9	153.8
1977	6.8	80.6	321.7	57.1	781.9	108.2	33.8	118.1	124.1	806.2	258.1	14.9
1978	1.6	22.8	252.3	204.7	581.6	137.4	6.3I	7.6	64.4	353.1	429.4I	42.0
1979	1.3	238.3	168.1	210.6	87.9	247.4	78.0	9.0	307.3	256.5	363.1	197.3
1980	.0	.0	100.2	296.6	76.8	324.2	12.0	120.7	221.6	355.8	222.6	100.7
1981	124.2	64.3	42.0	142.4	366.3	184.4	26.9	100.1	191.6	276.9	432.4	50.4
1982	.2	.0	148.2	231.9	350.7	314.6	196.9	183.8	71.7	214.3	713.5	56.4
1983	.0	.0	.0	35.3	152.4	109.8	76.9	150.6	325.8	136.4	252.3	201.6
1984	174.6	157.0	198.5	361.0	392.3	151.3	105.2	.5	123.4	268.0	312.8	54.9
1985	35.0	192.5	62.3	89.2	362.8	263.6	36.0	200.5	91.1	217.9	308.3	127.0
1986	72.1	188.7	146.7	165.0	341.5	48.0	48.5	121.0	152.8	411.9	134.7	213.9
1987	25.2	.0	64.9	-9.9M	153.1	153.6	9.8	300.3	404.2	617.1	285.7	39.8
1988	.0	144.1	148.1	247.1	130.0	229.7	69.4	131.7	322.6	162.4	359.6I	51.4
1989	25.0	.0	84.4	248.5	129.1	189.2	140.4	28.6I	135.4I	253.7	276.4	50.1
1990	172.3	8.7	140.4	191.7	214.4	58.7	110.9	1.0	11.7	313.5	678.2	173.6
1991	83.2	10.9	235.7	97.5	197.2	296.3	127.1	33.4	97.3	251.5	143.2	79.6
1992	5.0	.3	.0	100.9	557.5	152.1	101.6	61.3	337.8	335.2	262.5	59.3
1993	8.2	12.1	88.5	206.6	408.2	76.7	56.7	46.5	260.7	378.0	284.4	204.8
1994	59.9	66.9	111.4	98.7	326.7	90.6	97.9	36.2	326.0	430.5	311.9	9.6
1995	59.8	12.0	54.6	279.7	557.3	285.8	87.5	71.3	70.4I	224.3	442.7	34.7
1996	106.0	64.6	2.7	232.9	106.3	65.0	111.8	287.7	211.8	242.6	199.2	164.6
1997	2.0	99.0	33.7	137.4	254.7	117.9	195.5	25.5	346.0	362.3	435.6	121.9
1998	13.6	2.2	87.8	287.9	287.3	181.9	283.5	136.6	174.2	386.2	310.8	313.4

STATION NAME : GAMPAHA, HENARATHGODA
LAT: 7.10N LON: 79.98E ELEV: 9.1M
ELEMENT : Precip,Total Mly in Millimeters
Missing data values are coded as -9.9M

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1965	1.2	109.1	131.9	156.9	484.8	119.4	43.6	428.0	296.6	471.5	122.6	182.5
1966	60.8	68.7	223.5	270.9	99.8	100.8	87.3	48.8	483.8	384.5	214.7	151.5
1967	73.1	70.0	134.8	94.7	408.0	293.6	184.1	209.3	287.3	846.1	347.8	133.4
1968	25.1	71.1	208.0	287.8	104.2	482.5	377.3	53.1	254.8	142.7	173.6	56.2
1969	118.3	121.9	49.2	505.0	499.6	101.2	5.7	152.7	76.4	438.0	275.2	347.4
1970	118.8	90.4	148.2	456.5	568.6	226.4	149.5	20.4	128.8	916.5	311.0	73.7
1971	116.8	72.9	107.4	114.6	278.3	228.8	120.7	251.6	346.9	438.5	41.7	188.0
1972	2.0	.0	127.2	139.0	544.8	134.4	82.4	65.5	277.0	413.6	323.4	217.7
1973	6.2	35.7	145.4	296.7	393.4	238.2	135.7	70.9	25.5	276.6	257.2	239.0
1974	.0	179.5	103.4	361.8	512.3	290.3	223.4	109.3	403.9	72.2	100.3	191.6
1975	6.5	72.4	160.5	236.0	401.5	288.5	138.6	101.9	341.1	269.1	628.5	175.6
1976	.0	.0	124.0	181.9	98.8	71.1	145.1	133.7	53.4	241.2	357.5	233.4
1977	54.4	51.4	206.5	223.7	985.7	189.1	15.2	105.6	139.5	-9.9M	-9.9M	-9.9M
1978	3.1	60.5	218.5	136.6	575.4	151.7	16.7	20.6	141.8	393.6	465.7	64.5
1979	8.9	113.9	118.5	147.5	91.0	414.6	80.6	39.6	367.6	295.2	351.4	382.1
1980	.0	.0	56.4	241.0	256.2	-9.9M	74.1	193.8	206.9	278.7	291.9	183.4
1981	180.9	87.4	82.2	125.0	334.2	292.5	71.2	165.5	283.6	266.8	442.2	52.5
1982	.0	.0	122.7	151.2	346.2	-9.9M	176.7	335.6	76.0	254.6	457.5	-9.9M
1983	.0	.0	.0	126.4	500.4	163.8	160.7	133.2	-9.9M	111.9	183.6	257.7
1984	255.9	205.1	203.9	526.3	437.1	216.4	205.2	3.5	185.0	293.2	235.2	22.9
1985	71.8	182.5	288.1	155.4	322.5	376.0	26.1	194.2	147.2	393.3	326.5	237.1
1986	202.1	72.1	110.8	164.6	201.4	68.6	27.5	148.2	232.8	283.2	207.3	117.5
1987	16.9	.0	11.7	309.6	183.6	292.4	4.9	284.6	428.9	714.4	224.6	26.4
1988	.0	167.6	99.4	265.6	290.9	370.6	101.1	293.0	383.7	30.7	270.8	118.1
1989	16.1	.0	84.8	212.5	202.8	347.3	267.3	61.1	293.1	228.5	215.8	55.6
1990	165.5	.0	172.6	177.6	338.0	112.8	187.4	.0	47.3	357.4	430.5	143.4
1991	127.1	19.1	166.3	97.5	740.0	472.6	152.0	68.2	96.3	448.4	347.4	59.9
1992	1.3	.0	.0	167.0	443.2	190.9	172.0	58.4	357.6	269.4	263.4	59.8
1993	2.0	25.2	134.8	175.1	286.3	109.4	95.1	43.8	368.4	547.8	310.9	161.3
1994	69.0	107.2	51.6	160.8	429.2	98.0	93.9	81.6	350.3	427.3	283.4	3.4
1995	107.7	29.7	10.2	536.7	434.3	358.9	143.9	123.1	79.1	213.1	404.8	17.1
1996	123.4	44.3	26.1	148.0	90.9	79.0	134.0	220.1	451.4	-9.9M	220.3	171.6
1997	24.5	36.2	18.6	136.3	340.9	202.4	176.4	45.1	388.8	388.6	446.6	275.8
1998	45.8	16.8	94.2	220.8	252.4	233.8	482.9	208.7	271.8	352.7	298.8	293.8

STATION NAME : MAHARAKA (VINCIT)
LAT: 7.08N LON: 80.22E ELEV: ******M
ELEMENT : Precip,Total Mly in Millimeters
Missing data values are coded as -9.9M

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1965	13.5	211.0	212.7	313.0	586.2	135.6	85.6	487.6	258.3	449.8	160.6	263.4
1966	83.7	79.8	200.3	536.7	196.0	238.1	98.0	147.8	727.8	444.2	232.2	157.8
1967	94.0	108.8	263.0	182.5	331.4	461.1	204.4	196.5	222.9	664.5	378.2	172.6
1968	14.6	6.7	263.7	285.8	202.3	608.8	372.0	49.7	430.9	362.7	304.7	145.2
1969	82.2	60.5	123.8	673.3	807.7	179.1	20.0	272.8	142.3	672.4	265.5	561.3
1970	164.9	208.3	170.8	709.0	332.2	260.3	304.6	60.4	262.7	548.4	329.0	110.9
1971	71.8	137.0	155.6	498.9	394.7	251.3	199.6	334.5	499.0	376.1	118.6	287.2
1972	78.0	.0	249.8	383.7	578.1	223.9	174.2	160.4	316.2	576.1	544.8	235.6
1973	10.4	94.0	381.9	490.5	364.0	340.7	335.0	110.9	72.6	327.8	302.7	438.9
1974	.0	285.7	306.1	722.0	246.8	293.8	312.9	108.1	484.3	240.2	128.0	293.9
1975	25.5	174.4	276.7	427.4	596.8	330.3	219.9	216.7	484.4	382.9	1002.4	184.7
1976	23.9	.0	127.4	480.8	94.6	122.1	187.5	235.3	65.1	526.7	632.4	197.3
1977	26.2	183.8	253.4	426.8	994.7	247.3	43.8	283.4	130.6	789.8	589.8	28.9
1978	17.7	181.5	287.6	199.2	617.7	178.6	77.9	74.1	225.2	239.9	588.1	164.8
1979	14.3	176.6	144.9	184.2	185.2	533.3	164.8	48.7	684.8	430.9	474.9	409.9
1980	3.6	.0	182.0	513.3	396.5	278.0	221.4	169.8	394.8	281.9	490.6	111.2
1981	102.1	43.4	187.8	-9.9M	390.0	349.3	161.5	178.5	423.1	343.7	340.7	78.3
1982	1.3	.0	161.0	-9.9M	567.0	559.8	238.3	265.0	230.5	647.2	554.9	83.3
1983	.0	32.3	.5	74.8	283.5	183.4	155.7	304.2	477.1	160.1	363.5	502.5
1984	374.9	170.9	507.3	545.5	494.7	311.5	415.0	28.8	190.4	377.4	491.4	95.2
1985	94.6	359.9	310.1	256.5	576.9	765.9	171.0	279.1	209.0	683.7	481.8	305.6
1986	225.3	201.5	153.1	445.9	188.6	134.8	92.2	177.4	291.2	326.2	248.6	278.7
1987	51.8	.0	68.4	409.8	321.6	347.5	5.1	418.9	440.0	863.9	401.5	75.2
1988	1.3	366.9	210.1	575.5	298.2	473.2	364.1	475.0	607.5	122.4	563.4	24.7
1989	10.7	.0	137.7	148.9	351.5	624.2	431.3	69.8	298.0	405.2	444.3	172.9
1990	164.1	79.0	459.6	185.2	364.0	207.5	304.2	10.7	63.0	-9.9M	683.8	226.1
1991	128.4	2.8	329.3	314.1	513.1	451.0	180.1	68.6	81.6	300.2	348.3	94.8
1992	6.3	.0	5.8	189.6	488.2	282.2	268.1	131.7	380.6	561.5	505.5	140.3
1993	8.1	76.0	148.8	299.1	422.7	334.3	156.2	120.0	339.9	677.2	464.1	207.2
1994	64.6	180.5	122.0	156.7	379.3	170.5	148.3	94.5	226.6	689.0	520.2	3.0
1995	161.5	42.9	42.3	558.7	561.7	405.0	96.4	271.3	106.9	525.5	474.5	33.0
1996	87.5	96.2	81.1	273.1	126.3	377.9	150.3	177.9	618.8	319.0	152.3	74.6
1997	4.0	53.5	65.0	282.5	502.8	165.0	466.0	109.8	609.8	903.6	683.6	409.9
1998	56.1	.0	73.9	329.9	456.1	272.9	527.3	275.0	486.1	398.7	298.2	439.3

STATION NAME : PASYALA
LAT: 7.15N LON: 80.13E ELEV: ******M
ELEMENT : Precip.Total Mly in Millimeters
Missing data values are coded as -9.9M

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1965	15.2	160.2	116.5	187.5	677.8	143.5	54.3	460.6	240.5	370.3	158.6	186.9
1966	138.0	99.3	212.5	561.5	97.7	-9.9M	81.4	81.4	605.8	386.6	266.6	135.8
1967	82.1	66.0	356.0	221.5	243.7	334.8	173.4	105.1	199.0	732.0	323.5	172.6
1968	11.5	26.1	156.0	277.2	108.2	518.0	445.0	51.3	322.8	472.0	283.3	61.8
1969	108.2	250.6	63.6	560.8	677.7	117.2	15.8	146.3	58.5	536.5	205.7	577.4
1970	292.4	164.8	175.7	645.1	368.6	321.5	334.0	40.6	195.4	695.3	312.5	101.2
1971	82.7	192.9	116.9	278.5	366.9	294.9	138.4	270.4	459.1	281.0	61.6	313.8
1972	12.4	.0	142.2	211.5	536.3	108.6	131.3	88.2	377.9	552.7	551.9	224.9
1973	34.4	100.1	228.3	372.1	240.5	339.3	204.3	143.9	58.8	-9.9M	-9.9M	-9.9M
1974	.0	215.6	190.5	758.6	470.5	225.5	297.1	116.3	536.9	58.8	124.0	316.0
1975	36.0	137.3	141.6	411.8	448.6	275.7	185.8	164.2	313.7	331.1	688.4	95.6
1976	9.7	3.0	145.0	258.7	118.3	85.7	152.9	131.6	73.5	563.0	401.3	134.8
1977	19.1	172.5	262.5	403.7	959.0	219.6	17.8	190.2	112.5	798.7	476.9	84.6
1978	6.9	137.5	302.8	178.6	567.2	146.8	53.9	46.3	106.7	326.7	614.3	124.2
1979	2.8	176.3	134.9	181.3	86.1	538.9	116.1	30.6	-9.9M	522.0	449.2	39.0
1980	.0	.0	95.9	310.6	238.4	238.9	160.3	175.7	187.1	283.2	357.6	127.3
1981	231.0	81.8	91.1	151.9	386.6	301.9	64.5	134.8	370.2	398.8	296.6	105.9
1982	.0	.0	175.9	119.5	377.7	413.6	137.7	315.6	111.5	541.2	534.5	137.7
1983	.0	.0	.0	107.8	268.3	240.8	63.6	166.5	307.5	129.8	346.2	274.6
1984	233.8	314.6	374.7	390.0	326.1	161.8	448.1	30.6	54.3	181.2	346.5	36.4
1985	51.5	226.7	263.5	197.6	318.2	381.7	38.4	62.4	105.8	601.2	409.5	168.0
1986	255.8	147.8	158.5	291.7	151.6	58.7	7.1	92.8	241.0	291.0	155.3	91.9
1987	10.5	.0	21.0	254.9	172.2	240.9	.0	144.3	218.5	749.5	203.1	15.5
1988	.0	233.2	92.6	29.3	116.8	243.6	177.8	222.2	371.1	80.5	572.6	30.4
1989	20.1	.0	90.7	-9.9M	171.7	-9.9M	-9.9M	30.0	64.1	196.9	302.9	60.4
1990	239.1	20.4	111.9	130.8	229.2	122.5	92.9	.0	.0	314.3	633.4	165.0
1991	186.0	13.0	136.0	150.5	374.1	354.0	170.0	33.0	99.0	463.2	376.0	30.0
1992	.0	.0	.0	258.0	362.5	303.3	424.2	314.9	267.1	459.1	322.6	116.0
1993	.0	-9.9M	186.3	499.9	422.2	176.5	227.6	75.6	233.6	523.5	450.3	284.1
1994	113.9	116.9	90.1	261.2	291.2	91.3	110.6	110.9	193.9	556.9	474.8	4.1
1995	103.7	10.5	56.8	732.8	441.9	338.7	144.6	208.5	135.3	433.3	472.4	.0
1996	69.8	180.4	97.2	317.1	61.2	186.6	111.8	174.0	459.6	-9.9M	189.1	100.2
1997	.0	60.8	11.4	315.1	319.6	123.9	403.0	87.0	409.4	687.0	373.0	366.0
1998	29.0	7.0	35.0	203.2	327.4	275.0	322.5	291.0	349.3	405.5	269.0	311.0

STATION NAME : MALPITA
LAT: 7.27N LON: 80.05E ELEV: ******M
ELEMENT : Precip.Total Mly in Millimeters
Missing data values are coded as -9.9M

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1965	10.6	64.9	100.8	280.6	383.7	138.1	60.1	356.4	187.5	380.6	163.1	176.1
1966	82.7	34.8	101.6	341.2	135.1	123.2	56.8	39.3	524.3	414.7	163.3	135.6
1967	58.3	119.8	191.0	178.8	168.6	349.5	109.6	93.0I	157.0	596.7	359.1	266.2
1968	3.7	34.2	141.8	204.7	91.1	234.6	416.5	.0	211.7	271.9	70.4	21.3
1969	55.9	88.3	32.5	165.3	344.7	75.3	7.6	104.8	56.2	331.0	135.5	318.7
1970	56.1	101.6	114.2	462.8	484.0	373.2	143.9	2.5	146.7	568.5	334.0	110.1
1971	70.7	137.6	124.9	230.4	288.2	361.6	107.1	89.0	422.4	249.9	9.0	137.4
1972	.0	.0	101.4	179.2	418.8	75.0	83.6	47.6	278.6	387.0I	205.7	109.0
1973	2.7	123.0	275.8	328.9	203.9	246.5	125.1	90.8	36.2	359.9	446.9	185.2
1974	.0	128.5	82.9	462.1	177.9I	124.5	229.7	80.7	297.4	165.3	228.7	234.8
1975	49.0	122.9	112.3	224.9	516.0	224.0	148.5	196.7	248.7	237.0	575.2I	126.5
1976	16.3	3.5	156.8	326.0	82.0	36.8	61.8	127.8	58.5	417.7	585.8	268.3
1977	.0	180.7	245.8	208.5	824.8	164.9	38.3	150.1	85.7	565.9	235.4	5.1
1978	.0	19.1	156.7	99.1	489.0	153.0	13.8	28.6	49.8	121.7	459.1	103.1
1979	53.3	102.0	73.7	104.3	85.2	331.3	61.2	12.0	377.4	312.6	319.2	111.3
1980	.0	.0	74.4	138.1	166.8	232.6	54.1	94.6	196.6	-9.9M	145.1	47.7
1981	37.6	32.3	21.3	73.4	80.9	41.5	88.2	131.5	123.4	221.8	345.7	48.3
1982	.0	.0	165.2	137.3	286.7	422.2	193.1	273.4	80.2	354.7	451.9	49.1
1983	.0	.0	.0	75.5	171.0	257.5	133.0	87.7	286.6	-9.9M	192.0	112.7
1984	230.3	259.0	382.3	453.7	530.4	134.4	179.7	14.7	190.4	209.3I	472.2	77.5
1985	48.5	178.9	167.7	116.9	359.8	276.9	79.4	125.1	124.0	382.9	307.6	79.7
1986	110.8	46.5	68.7	227.0	170.6	81.3	19.2	92.1	142.6	269.7	253.2	43.2
1987	12.7	.0I	6.4	291.1	186.4	216.6	32.8	152.5	185.6	553.8	232.2	-9.9M
1988	.0	238.0	98.6	379.0	133.1	270.7	21.4	175.8	304.0	164.9	241.6	27.9
1989	30.8	.0	69.4	-9.9M	-9.9M	-9.9M	-9.9M	-9.9M	-9.9M	-9.9M	-9.9M	-9.9M
1990	24.1	7.1	115.8	98.9	257.5	84.7	153.2	.0	14.5	366.9	554.9	127.3
1991	50.5	66.3	205.2	139.0	246.2	416.6	-9.9M	-9.9M	-9.9M	-9.9M	130.0	74.9
1992	.0	.0	.0	98.4	252.6	177.6	148.9	52.9	355.4	379.9	360.6	74.9
1993	10.5	33.3	138.9	223.7	255.5	94.5	59.3	58.6	206.0	379.1	230.9	236.6
1994	42.2	84.0	99.0	228.1	268.5	49.9	101.6	28.9	77.1	424.2	284.4	.0
1995	117.7	4.2	97.5	451.0	308.2	249.2	53.1	107.3	81.4	293.1	492.8	10.1
1996	58.1	126.2	3.5	345.2	85.0	83.7	76.1	121.2	248.7	160.5	208.6	105.9I
1997	5.4	15.8	38.6	291.8	232.9	86.7	321.0	68.8	375.4	624.6	535.5	142.4
1998	48.0	.0	57.6	131.0	280.0	210.9	204.7	200.9	305.9	344.8	267.7	201.6

ANNEX 2

BACTERIOLOGICAL EXAMINATION REPORTS

LOCATION OF WELLS

12 No. WATER SAMPLES COLLECTED ON 16/11/98

13 No. WATER SAMPLES COLLECTED ON 23/02/99

LOCATION OF WELLS

W.1 On 1st turn off from Peliyagoda on Kandy Road Bridge to left. There is a temple. Well is in Temple.

W.2 On 1st turn off from Negombo [i.e. at 1st culvert] there is a three wheeler garage. Dugwell is there.

W.3 On Dutugemunu Mawatha well is just opposite the Assessment No. 279/A, 1,400 km from junction on Negombo Road.

W.4 On Telangapatha RHS of road, Wanawasala Road about 500 m before the Meegahawatte Bench mark.

W.5 On Wanawasala Road, after crossing the proposed highway 2nd permanent house. Well on RHS of Road.

W.6 Turn right just after railway crossing Hunupitiya on Dharmaramaya Road. Well at Dharmaramaya Temple.

W.7 Cross the railway line from Temple and find the bathing well.

W.8 Hunupitiya Station Road LHS. Last house before railway line.

W.9 Along Wattala Road from Hunupitiya after passing the Wattala Court House behind Shan Agency Post Office.

W.10 Pass Enderamulla railway crossing about 300 m. RHS of road, well at 633A.

W.11 On Duwa Road before Dias Garage, Wattala after crossing the proposed highway, well is about 100m from centre line on LHS of road. Just at gravel road junction.

W.12 After passing Dias Garage 1st well on lane.

W.13 Turn left on Container Road before proposed highway crossing on 1st house RHS House No. 777/5.

W.14 Turn off from Gunesekera Mawatha before filling area after passing marshy area 1st house [under construction]. Well on RHS.

W.15 On Gunasekera Mawatha before filling area RHS of road at the Dancing School.

W.16 After passing the centre line of CKE on left hand side lane, house No. 400/18.

W.17 Wattala on Percy Dias Mawatha 1st well on LHS.

W.18 On St. Saviour's Road, Weligampitiya, Elapara.

W.19 At Tapowanaramaya Temple.

W.20 On Uswetakeiyawa Road RHS last house before filling area.

W.21 Turn right from Uswetakeiyawa before bridge. Well is on RHS 1st boutique.

W.22 RHS of Wewala Cemetary 1st house.

W.23 Opposite house No. 68 on St. Mary's Road, Mabole turn from Negombo Road opposite Ragama Road.

W.24 On RHS last house before bridge on Pamunugama Road.

W.25 On RHS. Same Road on Dammika Hardware Stores.

W.26 On Lankamatha Mawatha 1/95.

W.27 On Amunupitiya Thotupala Road, Auction land.

W.28 On last house on Morawatta Road.

W.29 On house before last on RHS on Thotewatte Wewala.

W.30 Just after gravel road from Wahitiyagama 1st well on RHS Negombo Road.

W.31 At last house on Pathirana Place.

W.32 After bridge on Mullewatte footpath 1st well on LHS.

W.33 Ja Ela Bund Road 2nd house after passing Heen Ela bridge.

W.34 Tudella Gammeda para.

W.35 On Negombo Road on LHS 1st well after 18/3 culvert.

W.36 On Ranasinghe Road, Indiritiya.

W.37 No. 40, Jacob Mawatha.

W.38 At No. 73, Gammeda Para at Ambalanmulla.

W.39 First well on LHS after 18 km road.

W.40 After Pamunugama Road 1st well on Negombo Road.

W.41 1st Lane, 2nd house pit after Wahitiyagama bridge.

W.42 Negombo Road 1st well on LHS after Dandugam Oya bridge.

W.43 Gammeda Para junction LHS Ambalanmulla.

W.44 Well next to Co-operative Wholesale Shop.

W.45 Well opposite Seeduwa Police Station on LHS.

W.46 Well next to Priyantha Holdings LHS.

W.47 Well on 1st Lane before Airport Gardens Hotel [at Siriweda Medura] on LHS.

W.48 Well on LHS opposite Singapore Garden.

W.49 Well just opposite the bus halt before Airport Junction on LHS.

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தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை

National Water Supply & Drainage Board

CENTRAL LABORATORY
TELAWELA ROAD, RATMALANA

Date : 199.....

WATER QUALITY REPORT

1. Laboratory Sample No.....
2. Date & Time of Collection : .....
3. Sample Collected By : .....
4. Report to be Sent to : .....
5. Source of Sample : .....
6. Other Details : .....

PHYSICAL QUALITY		Max. Concentration Acceptable / Allowable
Colour	:	5,30
Turbidity	:	2/8
CHEMICAL QUALITY		
pH	:	7.0/8.5 – 6.5/9.0
Electrical Conductivity	:	750/3, 500 μs/cm
		Results in mg/1
Chloride (as Cl)	:	200/1200
Free residual Chlorine (as Cl_2)	:	0.2
Total Alkalinity (as $CaCO_3$)	:	200/400
Free Ammonia	:	0.06
Albuminoid Amonia	:	0.15
Nitrate (as N)	:	10
Nitrate (as N)	:	0.01
Fluoride (as F)	:	0.6/1.5
Total Phosphates (as PO_4)	:	2.0
Total Residue	:	500/2000
Total Hardness (as $CaCO_3$)	:	250/600
Total Iron (as Fe)	:	0.3/1.0
Sulphate (as SO_4)	:	200/400

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.....
Lab Assistant

.....
Chemist

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தேசிய நீர் வழங்கல் வடிகாலமைப்பு சபை
National Water Supply & Drainge Board

සභාපති
தலைவர்
Chairman } 634488

උප සභාපති
உப தலைவர்
Vice Chairman } 635883

ප්‍රධාන කාර්යාලය
பொது அலுவலகம்
General Office } 635281 - 3, 635247, 635887, 635996.

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த. பெ. இல.
P. O. Box } 14

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கல்கிசை.
Mt. Lavinia

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முகாமைஎாளர்
General Manager } 636449

Telex : 21482 NWSDB CE
Fax : 636449, 637178, 635999

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காலி வீதி,
Galle Road,

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இரத்மலானை.
Ratmalana, Sri lanka

මගේ අංකය
எனது இல.
My No.

ඔබේ අංකය
உமது இல.
Your No.

199.....

CENTRAL LABORATORY
TELAWALA ROAD, RATMALANA

Date : 1998/11/26

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/98/420

Source of Sample : W - 3
Well at Sat.ganuna Mawatha,
[illegible]

Date & Time of Collection : 1998/11/25 at 10.50 A.M.

Date & Time of Receive in Lab : 1998/11/27 at 09.15 A.M.

Report Required By : Mr.G.E.M.Gomez
Team leader,
E . C. L.

Results:-

Temperature	: 29 C
Total Heterotrophic Bacteria per 100 ml of sample at 34.5 C.	: Too Numerous to count.
Total number of all types of coliform bacteria present in 100ml of sample at 37 C.	: More than 1100
Number of E coli in 100ml of sample at 44 C.	: 240.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

H. A. K. AMARAKOON
SENIOR CHEMIST
CENTRAL LABORATORY
Water Supply & Drainage BOARD
TELAWALA ROAD
RATMALANA.

MINISTRY OF HOUSING & URBAN DEVELOPMENT

Chief of.Lab.Services

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Ratmalana, Sri lanka

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எனது இல.
My No.

ඔබේ අංකය
உமது இல.
Your No.

199.....

CENTRAL LABORATORY
TELAWALA ROAD, RATMALANA

Date : 1998/11/26

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/98/421

Source of Sample : W - 5
Well at No. 57/5 Telangapatha Road, Kotte.

Date & Time of Collection : 1998/11/16 at 11.10 A.M.

Date & Time of Receipt in Lab : 1998/11/17 at 09.15 A.M.

Report Required By : Mr.G.E.M.Gomez
Team leader,
E . C. L

Results:-

Temperature	: 29 C
Total Heterotrophic Bacteria per 100 ml of sample at 34.5 C.	: Too Numerous to count.
Total number of all types of coliform bacteria present in 100ml of sample at 37 C.	: More than 1100
Number of E coli in 100ml of sample at 44 C.	: 240.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

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H. A. K. AMARAKOON
SENIOR CHEMIST
CENTRAL LABORATORY
NATIONAL WATER SUPPLY & DRAINAGE BOARD
TELAWALA ROAD
RATMALANA.

MINISTRY OF HOUSING & URBAN DEVELOPMENT
"Water, Every Drop is Precious"

Chief of.Lab.Services

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
தேசிய நீர் வழங்கல் வடிகாலமைப்பு சபை
National Water Supply & Drainge Board

தலைவர் / Chairman } 634488
උප தலைவர் / Vice Chairman } 635883
பொது அலுவலகம் / General Office } 635281 - 3, 635247, 635887, 635996.
P. O. Box } 14 Mt. Lavinia
முகாமையாளர் / General Manager } 636449
Telex : 21482 NWSDB CE
Fax : 636449, 637178, 635999
காலி வீதி. / Galle Road, Ratmalana, Sri lan

My No.

Your No.

CENTRAL LABORATORY 199.....
TELAWALA ROAD, RATMALANA

Date : 1998/11/26

Subject : Bacteriological Examination of Wat

Lab.Reg. No : Bac/98/425

Source of Sample : W - 18
Well at Totupola Road,
Welisara , Ragama.

Date & Time of Collection : 1998/11/15 at 02.25 P.M.

Date & Time of Receipt in Lab : 1998/11/17 at 09.15 A.M

Report Required By : Mr. S.E.M.Gomez,
Team leader,
E. C. L.

Results:-

Temperature	: 29 C
Total heterotrophic Bacteria per 100 ml of sample at 34.5 C	: Too Numerous to count.
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More than 1100.
Number of E coli in 100ml of sample at 44 C.	: 240.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

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"Water - Every Drop Is Precious" DRAINAGE BOARD

Chief of.Lab.Service

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National Water Supply & Drainge Board

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உப தலைவர்
Vice Chairman } 635883

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General Office } 635281 - 3, 635247, 635887, 635996.

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Mt. Lavinia

කළමනාකාර
முகாமையாளர்
General Manager } 636449

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Fax : 636449, 637178, 635999

ගාල්ල පාර,
காலி வீதி,
Galle Road,

රත්මලාන
இரத்மலானை,
Ratmalana, Sri lanka

මගේ අංකය
எனது இல.
My No.

ඔබේ අංකය
உமது இல.
Your No:

CENTRAL LABORATORY
EKALA ROAD, RATMALANA.....

Date : 1998/11/26

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/98/425

Source of Sample : W - 21
Well at Kalaeli Mulla,
Jaelle.

Date & Time of Collection : 1998/11/16 at 04.05. P.M.

Date & Time of Receipt in Lab : 1998/11/17 at 9.15 A.M.

Report Required By : Mr. G.E.M.Gunas
Team Leader
S. U.

Results:-

Total Heterotrophic Bacteria per 100 ml of sample at 34.5 C : Too Numerous to count.

Total number of all types of coliform bacteria precent in 100ml of sample at 37 C. : More than 1100.

Number of E coli in 100ml of sample at 44 C. : 240.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

H. A. K. AMARAKOON
SENIOR CHEMIST
CENTRAL LABORATORY
NATIONAL WATER SUPPLY & DRAINAGE BOARD
EKALA ROAD
RATMALANA.

Chief of.Lab.Services

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National Water Supply & Drainge Board

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උප සභාපති உப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාලය பொது அலுவலகம் General Office 635281 - 3, 635247, 635887, 635996.
තැ. පෙ. අංකය த. பெ. இல. P. O. Box 14 කඩුරේගොඩ கல்கிஸை. Mt. Lavinia
කළමනාකාර් முகாமையாளர் General Manager 636449
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මගේ අංකය எனது இல. My No.

ඔබේ අංකය உமது இல. Your No.

199.....

CENTRAL LABORATORY
TELAWALA ROAD, RATMALANA

Date : 1998/11/26

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/98/427

Source of Sample : W - 25
Well at Pamunugama Road,
Jaella.

Date & Time of Collection : 1998/11/25 at 03.55 P.M.

Date & Time of Receipt in Lab : 1998/11/27 at 09.15 a.m.

Report Required By : Mr S.E.M.Perera
Team Leader,
E. S. ..

Results:-

Temperature : 29 C

Total plate Count
Bacteria per 100 ml of sample at 34.5 C : Too Numerous to count.

Total number of all types of coliform bacteria precent in 100ml of sample at 37 C. : More than 1100.

Number of E coli in 100ml of sample at 44 C. : 240.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the client.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

H. A. K. AMARAKOON
SENIOR CHEMIST
CENTRAL LABORATORY
NATIONAL WATER SUPPLY & DRAINAGE BOARD
TELAWALA ROAD
RATMALANA.

Chief of.Lab.Services

MINISTRY OF HOUSING & URBAN DEVELOPMENT

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முகாமையாளர்
General Manager } 636449

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ගාල්ල පාර,
காலி வீதி,
Galle Road, රත්මලාන
இரத்மலானை,
Ratmalana, Sri lanka

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My No.

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உமது இல.
Your No.

CENTRAL LABORATORY 199.....
TELAWALA ROAD, RATMALANA

Date : 1998/11/26

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/98/428

Source of Sample : W - 38
Well at Gammulla Road,
Ambalanmulla Seeduwa.

Date & Time of Collection : 1998/11/16 at 05 [illegible] P.M.

Date & Time of Receipt in Lab : 1998/11/17 at 09.15 A.M.

Report Required By : Mr. G.E.N.Somen.
Team leader,
E. C. L.

Results:-

Temperature	: 29 C
Total Heterotrophic Bacteria per 100 ml of sample at 34.5 C	: Too Numerous to count.
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More than 1100.
Number of E coli in 100ml of sample at 44 C.	: 240.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

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H. A. K. AMARAKOON
SENIOR CHEMIST
CENTRAL LABORATORY
NATIONAL WATER SUPPLY & DRAINAGE BOARD
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காலி வீதி.
Galle Road,

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இரத்மலானை.
Ratmalana, Sri lanka

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எனது இல.
My No.

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உமது இல.
Your No.

199.....

CENTRAL LABORATORY
TELAWALA ROAD, RATMALANA

Date : 1998/11/26

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/98/419

Source of Sample : W - 1
Well at Peliyagoda Neegradaramaya Temple

Date & Time of Collection : 1998/11/16 at 10.40 A.M.

Date & Time of Receipt in Lab : 1998/11/17 at 09.15 A.M.

Report Required By : Mr.B.E.M.Gomez
Team Leader,

Results:-

Temperature	: 29 C
Total Heterotrophic Bacteria per 100 ml of sample at 34.5 C.	: Too Numerous to count.
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: 1100 <
Number of E coli in 100ml of sample at 44 C.	: 93.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

H. A. K. AMARAKOON
SENIOR CHEMIST
CENTRAL LABORATORY
NATIONAL WATER SUPPLY & DRAINAGE BOARD
TELAWALA ROAD
RATMALANA.

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எனது இல. My No.

உமது இல.

199.....

CENTRAL LABORATORY
TELAWALA ROAD,RATMALANA

Date : 1998/11/26

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/98/422

Source of Sample : W - 9
Well at No.33 Station Road,
Wattela.

Date & Time of Collection : 1998/11/16 at 11.10 A.M.

Date & Time of Receipt in Lab : 1998/11/17 at 09.15 A.M.

Report Received By : Mr.G.E.M.Gomez
Team leader,
E . C. L

Results:-

Temperature	: 29 C
Total Heterotrophic Bacteria per 100 ml of sample at 34.5 C.	: Too Numerous to count.
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More than 1100
Number of E coli in 100ml of sample at 44 C.	: 93.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

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H. A. K. AMARAKOON.
SENIOR CHEMIST
CENTRAL LABORATORY
TELAWALA ROAD

Chief of.Lab.Services

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199.....

CENTRAL LABORATORY
TELAWALA ROAD, RATMALANA

Date : 1998/

Suoject : Bacteriological Examination of Water

Lab.Reg. No : Bac/98/[illegible]

Source of Sample : 4 - 15
Gunaseera Mawatha.
Wellawatta, Waltala.

Data & Time of Collection : 1998/[illegible] at 11.00 P.M.

Date & Time of Receipt in Lab : 1998/[illegible] at 12.15 P.M.

Report Required by : Mr. S.E.M.Gunas
Year Leader,
[illegible]

Results:-

Temperature [illegible]

Total Heterotrophic Bacteria per 100 ml of sample at 34.5 C : Too Numerous to count.

Total number of all types of coliform bacteria present in 100ml of sample at 37 C. : 110.

Numoer of E coli in 100ml of sample at 44 C. : 97.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

H. A. K. AMARAKOON
SENIOR LECTURER
MINISTRY OF HOUSING, URBAN DEVELOPMENT
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NATIONAL WATER SUPPLY & DRAINAGE BOARD
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Vice Chairman } 635883

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காலி வீதி.
Galle Road,

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ரத்மலானை,
Ratmalana, Sri lanka

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எனது இல.
My No.

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உமது இல.
Your No.

CENTRAL LABORATORY
TELAWALA ROAD, RATMALANA

199.....

Date : 1998/11/26

Subject : Bacteriological Examination of Water

Lab.Reg. No Bac/98/429

Source of Sample : W - 44
Well at No.205,
Ambalanmulla, Seeduwa.

Date & Time of Collection : 998/11/16 at 05.20. P.M

Date & Time of Receipt in Lab : 1998/11/17 at 09.15 A.M.

Report Required By : Mr. G.E.M Gomez,
Team leader,
E. C. L.

Results:-

Temperature	: 29 C
Total Heterotrophic Bacteria per 100 ml of sample at 34.5 C	: Too Numerous to count.
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More than 1100.
Number of E coli in 100ml of sample at 44 C.	: 460.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the client. It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board. This report is limited specifically to this specimen.

H. A. K. AMARAKOON
SENIOR CHEMIST
CENTRAL LABORATORY
NATIONAL WATER SUPPLY & DRAINAGE BOARD
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RATMALANA.

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உமது இல. / Your No.

199.....

CENTRAL LABORATORY
TELAWALA ROAD,RATMALANA

Date : 1998/11/20

Subject : Bacteriological Examination of Wate

Lab.Reg. No : Bac/98/430

Source of Sample : W - 47
Well at No 422,
Negambo Road, Seeduwa.

Date & Time of Collection : 1998/11/16 at 05.45. P.M.

Date & Time of Receipt in Lab : 1998/11/17 at 09.15 A.M.

Report Required By : Mr. S.E.M.Gomez,
Team leader,
E. C. L.

Results:-

Temperature	: 29 C
Total Heterotrophic Bacteria per 100 ml of sample at 34.5 C	: Too Numerous to count.
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More than 1100.
Number of E coli in 100ml of sample at 44 C.	: 460.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

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H. A. K. AMARAKOON
SENIOR CHEMIST
CENTRAL LABORATORY
NATIONAL WATER SUPPLY & DRAINAGE BOARD
TELAWALA ROAD
RATMALANA.

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உப தலைவர்
Vice Chairman } 635883

ප්‍රධාන කාර්යාලය
பொது அலுவலகம்
General Office } 635281 - 3, 635247, 635887, 635996.

ත. ප. අංකය
த. பெ. இல.
P. O. Box } 14

ගල්කිස්ස
கல்கிஸை.
Mt. Lavinia

කළමනාකාර
முகாமையாளர்
General Manager } 636449

Telex : 21482 NWSDB CE
Fax : 636449, 637178, 635999

ගාල්ල පාර.
காலி வீதி.
Galle Road,

රත්මලාන
இரத்மலானை.
Ratmalana, Sri lanka

මගේ අංකය
எனது இல.
My No.

ඔබේ අංකය
உமது இல.
Your No.

199.....

CENTRAL LABORATORY
TELAWALA ROAD, RATMALANA

Date : 1998/11/25

Suoject : Bacteriological Examination of Water

Lab.Reg. No : Bac/98/427

Source of Sample : W - 13
Well at Mabola,
Watte'a.

Date & Time of Collection : 1998/11/16 at 12.30 P.M.

Date & Time of Receipt in Lat : 1998/11/17 at 09.15 A.M.

Report Required By : Mr.G.E.M.Gomez
Team leader,
E . C. L

Results:-

Temperature	: 29 C
Total Heterotrophic Bacteria per 100 ml of sample at 34.5 C.	: 930
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: 09
Number of E coli in 100ml of sample at 44 C.	: 00

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

H. A. K. AMARAKOON
SENIOR CHEMIST
MINISTRY OF HOUSING & URBAN DEVELOPMENT
CENTRAL LABORATORY
NATIONAL WATER SUPPLY & DRAINAGE BOARD
TELAWALA ROAD
RATMALANA.

"Water - Every Drop is Precious"

.....
Chief of.Lab.Services

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
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National Water Supply & Drainage Board

සභාපති தலைவர் Chairman 634488
උප සභාපති உப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාලය பொது அலுவலகம் General Office 635281-3, 635247, 635996
සී.ජී.ඩී. අංකය த.பெ. இல. P.O. Box 14 මවුන්ට්ලවිනියා கல்கிஸை Mt. Lavinia.
කළමනාකාරීගේ முகாமையாளர் General Manager 636449
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ගාල්ල පාර, காலி வீதி, Galle Road, රත්මලාන, இரத்மலானை, Ratmalana, Sri Lanka.
මිගේ අංකය எனது இல. My No.
ඔබේ අංකය உமது இல. Your No.
199 .....

CENTRAL LABORATORY
TELAWALA ROAD,RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/85

Source of Sample : W - 01

Date & Time of Collection : 23/02/1999 at 01.35 PM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More than 1100.
Number of E coli in 100ml of sample at 44 C.	: More than 1100.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the client.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

.....
Lab.Assistant
S/=

.....
Chemist.

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை
National Water Supply & Drainage Board

தலைவர் / தலைவர் / Chairman 634488
உப தலைவர் / உப தலைவர் / Vice Chairman 635883
பிரதான காரியாலயம் / பொது அலுவலகம் / General Office 635281-3, 635247, 635996
பொது முகாமையாளர் / பொது முகாமையாளர் / General Manager 636449
Telex : 21482 NWSDB CE
Fax : 636449, 637178, 635999
பி.பெ. අංකය / த.பெ. இல. / P.O. Box 14
තලවිල. / கல்கிசை / Mt. Lavinia.
ගාල්ල පාර, / காலி வீதி, / Galle Road,
රත්මලාන. / இரத்மலானை. / Ratmalana, Sri Lanka.
මගේ අංකය / எனது இல. / My No.
ඔබේ අංකය / உமது இல. / Your No.

199 .....

CENTRAL LABORATORY
TELAWALA ROAD,RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/86

Source of Sample : W - 03

Date & Time of Collection : 23/02/1999 at 01.25 PM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More than 1100.
Number of E coli in 100ml of sample at 44 C.	: More than 1100.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

.....
Lab.Assistant
S/=

.....
Chemist.

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
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National Water Supply & Drainage Board

සභාපති தலைவர் Chairman 634488
උප සභාපති உப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාලය பொது அலுவலகம் General Office 635281-3, 635247, 635996
තැ.පෙ. අංකය த.பெ. இல. P.O. Box 14 වත්තල Mt. Lavinia.
සාමාන්‍යාධිකාරි முகாமையாளர் General Manager 636449
Telex : 21482 NWSDB CE
Fax : 636449, 637178, 635999
ගාල්ල පාර, காலி வீதி, Galle Road, රත්මලාන. இரத்மலானை. Ratmalana, Sri Lanka.
මගේ අංකය எனது இல. My No.
ඔබේ අංකය உமது இல. Your No.
199 .....

CENTRAL LABORATORY
TELAWALA ROAD,RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/87

Source of Sample : W - 05

Date & Time of Collection : 23/02/1999 at 12.45 PM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: 460.
Number of E coli in 100ml of sample at 44 C.	: 460.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

.....
Lab.Assistant
S/=

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Chemist.

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
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National Water Supply & Drainage Board

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උප සභාපති உப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාල பொது அலுவலகம் General Office 635281-3, 635247, 635996
කළමනාකාර්ය முகாமையாளர் General Manager 636449
Telex : 21462 NWSDB CE
Fax : 636449, 637178, 635999
තැ.පෙ. අංකය த.பெ. இல. P.O. Box 14 මවුන්ට්ලවිනියා Mt. Lavinia.
ගාල්ල පාර, காலி வீதி, Galle Road, රත්මලාන, இரத்மலானை. Ratmalana, Sri Lanka.
මගේ අංකය எனது இல. My No.
ඔබේ අංකය உமது இல. Your No.

199 .....

CENTRAL LABORATORY
TELAWALA ROAD, RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/88

Source of Sample : W - 09

Date & Time of Collection : 23/02/1999 at 12.15 PM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: 1100.
Number of E coli in 100ml of sample at 44 C.	: 1100.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

.....
Lab.Assistant
S/=

.....
Chemist.

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
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National Water Supply & Drainage Board

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උප සභාපති உப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාලය பொது அலுவலகம் General Office 635281-3, 635247, 635996
කළමනාකාර්‍ය முகாமையாளர் General Manager 636449
Telex : 21482 NWSDB CE
Fax : 636449, 637178, 635999
තැ.පෙ. අංකය த.பெ. இல. P.O. Box 14 ගල්කිස්ස. கல்கிஸை Mt. Lavinia.
ගාල්ල පාර, காலி வீதி, Galle Road, රත්මලාන. இரத்மலானை. Ratmalana, Sri Lanka.
මගේ අංකය எனது இல. My No.
ඔබේ අංකය உமது இல. Your No.
199 .....

CENTRAL LABORATORY
TELAWALA ROAD,RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/89

Source of Sample : W - 13

Date & Time of Collection : 23/02/1999 at 11.40 AM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: 150.
Number of E coli in 100ml of sample at 44 C.	: 93.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

.....
Lab.Assistant
S/=

.....
Chemist.

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
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National Water Supply & Drainage Board

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උප සභාපති உ.ப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාලය பொது அலுவலகம் General Office 635281-3, 635247, 635996
කළමනාකාර (ජනරාජයාණන් General Manager 636449
Telex : 21482 NWSDB CE
Fax : 636449, 637178, 635999
තැ.පෙ. අංකය த.பெ. இல. P.O. Box 14 රත්මලාන. கல்கிஸை Mt. Lavinia.
ගාල්ල පාර, காலி வீதி, Galle Road, රත්මලාන. இரத்மலானை. Ratmalana, Sri Lanka.
මගේ අංකය எனது இல. My No.
ඔබේ අංකය உமது இல. Your No.
199 .....

CENTRAL LABORATORY
TELAWALA ROAD, RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/90

Source of Sample : W - 15

Date & Time of Collection : 23/02/1999 at 10.25 AM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: 240.
Number of E coli in 100ml of sample at 44 C.	: 240.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

.....
Lab.Assistant
S/=

.....
Chemist.

පානීය ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
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National Water Supply & Drainage Board

සභාපති தலைவர் Chairman 634488
උප සභාපති உப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාලය பொது அலுவலகம் General Office 635281-3, 635247, 635996
කළමනාකාර සාමාන්‍යාධිකාරී முகாமையாளர் General Manager 636449
Telex : 21482 NWSDB CE
Fax : 636449, 637178, 635999
තැ.පෙ. අංකය த.பெ. இல. P.O. Box 14 වත්තල Mt. Lavinia.
ගාල්ල පාර, காலி வீதி, Galle Road, රත්මලාන, இரத்மலானை. Ratmalana, Sri Lanka.
මගේ අංකය எனது இல. My No.
ඔබේ අංකය உமது இல. Your No.
199 .....

CENTRAL LABORATORY
TELAWALA ROAD, RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/91

Source of Sample : W - 17

Date & Time of Collection : 23/02/1999 at 11.30 AM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More Than 1100.
Number of E coli in 100ml of sample at 44 C.	: More Than 1100.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

.....
Lab.Assistant
S/=

.....
Chemist.

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
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National Water Supply & Drainage Board

සභාපති தலைவர் Chairman 634488
උප සභාපති உப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාලය பொது அலுவலகம் General Office 635281-3, 635247, 635996
තැ.පෙ. අංකය த.பெ. இல. P.O. Box 14 මවුන්ට්ලේනියා. கவுண்ட்லேனியா Mt. Lavinia.
කළමනාකාර් முகாமையாளர் General Manager 636449
Telex : 21482 NWSDB CE
Fax : 636449, 637178, 635999
ගාල්ල පාර, காலி வீதி, Galle Road, රත්මලාන. இரத்மலானை. Ratmalana, Sri Lanka.
මගේ අංකය எமது இல. My No.
ඔබේ අංකය உமது இல. Your No.
199 .....

CENTRAL LABORATORY
TELAWALA ROAD,RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/92

Source of Sample : W - 18

Date & Time of Collection : 23/02/1999 at 10.55 AM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: 240.
Number of E coli in 100ml of sample at 44 C.	: 240.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the client.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

Hbulasckara
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Lab.Assistant
S/=

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Chemist.

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை
National Water Supply & Drainage Board

සභාපති தலைவர் Chairman 634488
උප සභාපති உப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාලය பொது அலுவலகம் General Office 635281-3, 635247, 635996
සාමාන්‍යාධිකාරී முகாமையாளர் General Manager 636449
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සැ.ත. අංකය த.பெ. இல. P.O. Box 14 මොරටුව. கல்கிசை Mt. Lavinia.
යකඩ පාර. காலி வீதி. Galle Road, රත්මලාන. இரத்மலானை Ratmalana, Sri Lanka
මගේ අංකය எமது இல. My No.
ඔබේ අංකය உமது இல. Your No.
199 .....

CENTRAL LABORATORY
TELAWALA ROAD,RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/93

Source of Sample : W - 21

Date & Time of Collection : 23/02/1999 at 09.15 AM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More Than 1100.
Number of E coli in 100ml of sample at 44 C.	: More Than 1100.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

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Lab.Assistant
S/=

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Chemist.

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை
National Water Supply & Drainage Board

සභාපති தலைவர் Chairman 634488
උප සභාපති உப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාලය பொது அலுவலகம் General Office 635281-3, 635247, 635995
තැ.පෙ. අංකය த.பெ. இல. P.O. Box 14 වල්ලිවත්ත கல்கிஸை Mt. Lavinia.
කළමනාකාරී முகாமையாளர் General Manager 636449
Telex : 21482 NWSDB CE
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ගාල්ල පාර காலி வீதி. Galle Road, රත්මලාන இரத்மலானை. Ratmalana, Sri Lanka.
මගේ අංකය எனது இல. My No.
ඔබේ අංකය உமது இல. Your No.
199 .....

CENTRAL LABORATORY
TELAWALA ROAD,RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/95

Source of Sample : W - 38

Date & Time of Collection : 23/02/1999 at 07.25 AM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More Than 1100.
Number of E coli in 100ml of sample at 44 C.	: More Than 1100.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

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Lab.Assistant
S/=

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Chemist.

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை
National Water Supply & Drainage Board

සභාපති தலைவர் Chairman 634488
උප සභාපති உப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාලය பொது அலுவலகம் General Office 635281-3, 635247, 635996
P.O. Box 14 මහනීවත. கல்கிஸை Mt. Lavinia.
කළමනාකාර්ය முகாமையாளர் General Manager 636449
Telex : 21482 NWSDB CE
Fax : 636449, 637178, 635999
ගාල්ල පාර, காலி வீதி, Galle Road, රත්මලාන. இரத்மலானை. Ratmalana, Sri Lanka.
මගේ අංකය எனது இல. My No.
ඔබේ අංකය உமது இல. Your No.

199 .....

CENTRAL LABORATORY
TELAWALA ROAD,RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/96

Source of Sample : W - 44

Date & Time of Collection : 23/02/1999 at 07.15 AM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More Than 1100.
Number of E coli in 100ml of sample at 44 C.	: 460.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

HHWaseKara
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Lab.Assistant
S/=

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Chemist.

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை
National Water Supply & Drainage Board

සභාපති தலைவர் Chairman 634468
උප සභාපති உப தலைவர் Vice Chairman 635883
ප්‍රධාන කාර්යාලය பொது அலுவலகம் General Office 635281-3, 635247, 635996
කළමනාකාරී முகாமையாளர் General Manager 636449
Telex : 21482 NWSDB CE
Fax : 636449, 637178, 635999
ඔබේ අංකය உமது இல. Your No.
මගේ අංකය எமது இல. My No.
තැ.පෙ. අංකය த.பெ. இல. P.O. Box 14 මහනිවත, கல்கிசை Mt. Lavinia.
ගාල්ල පාර, காலி வீதி, Galle Road, රත්මලාන, இரத்மலானை. Ratmalana, Sri Lanka.

199 .....

CENTRAL LABORATORY
TELAWALA ROAD,RATMALANA

Date : 1999/03/18

Subject : Bacteriological Examination of Water

Lab.Reg. No : Bac/99/97

Source of Sample : W - 47

Date & Time of Collection : 23/02/1999 at 07.45 AM.

Date & Time of Receipt in Lab : 23/02/1999 at 02.55 PM.

Report Required By : Mr.G.E.M.Gomez,
Team Leader - E.C.L,
Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Results:-

Temperature	: 29 C
Total number of all types of coliform bacteria precent in 100ml of sample at 37 C.	: More Than 1100.
Number of E coli in 100ml of sample at 44 C.	: More Than 1100.
Total Bacteria Count	: More Than 1100.

Remarks:- Unsatisfactory. There is evidence of recent faecal pollution.

This report is issued for the information of the clent.It shall not be published in total or in part without authority of the General Manager, National Water Supply & Drainage Board.This report is limited specifically to this specimen.

HPnlasekara
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Lab.Assistant
S/=

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Chemist.