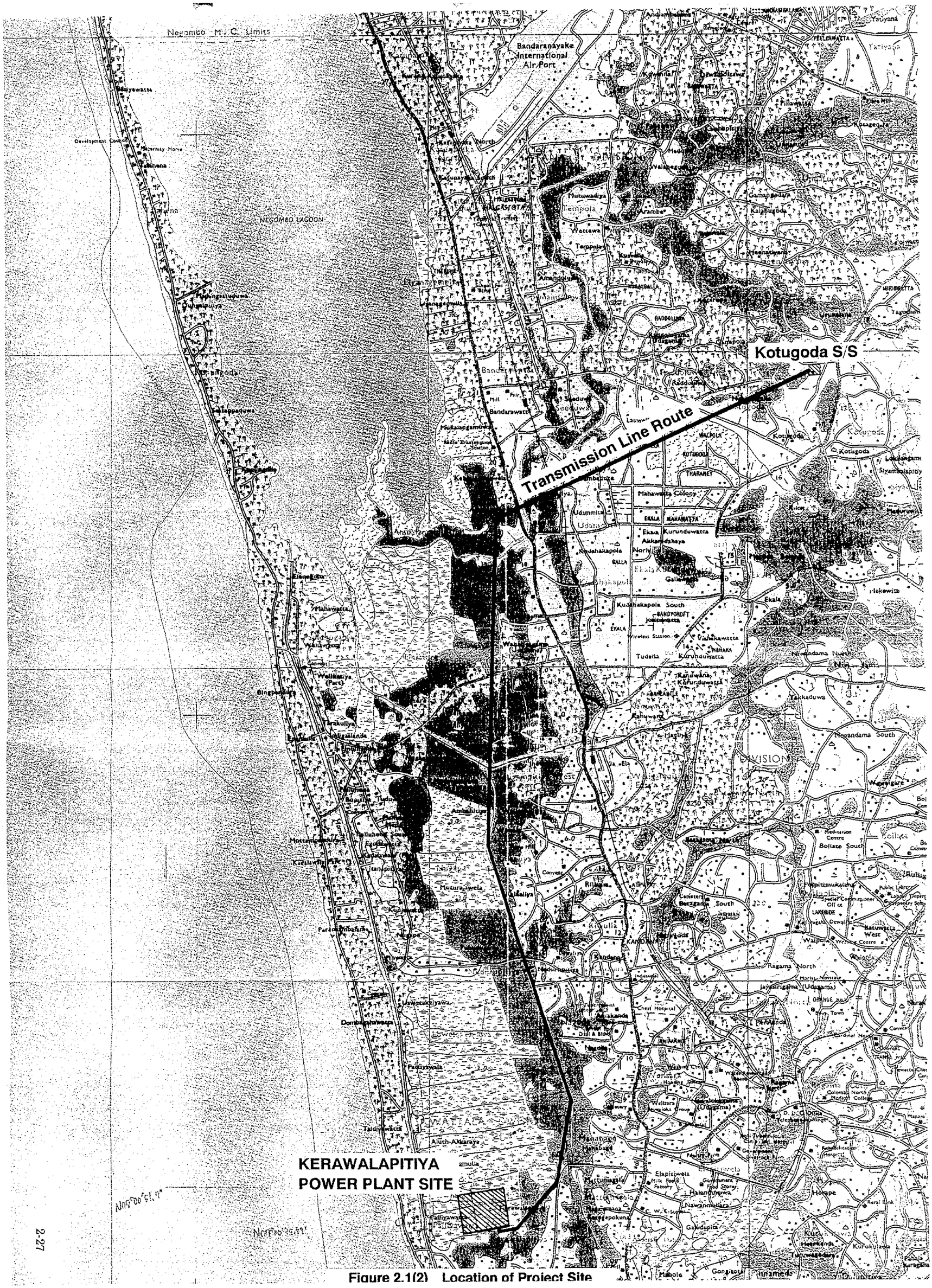


Figure 2.1(2) Location of Project Site

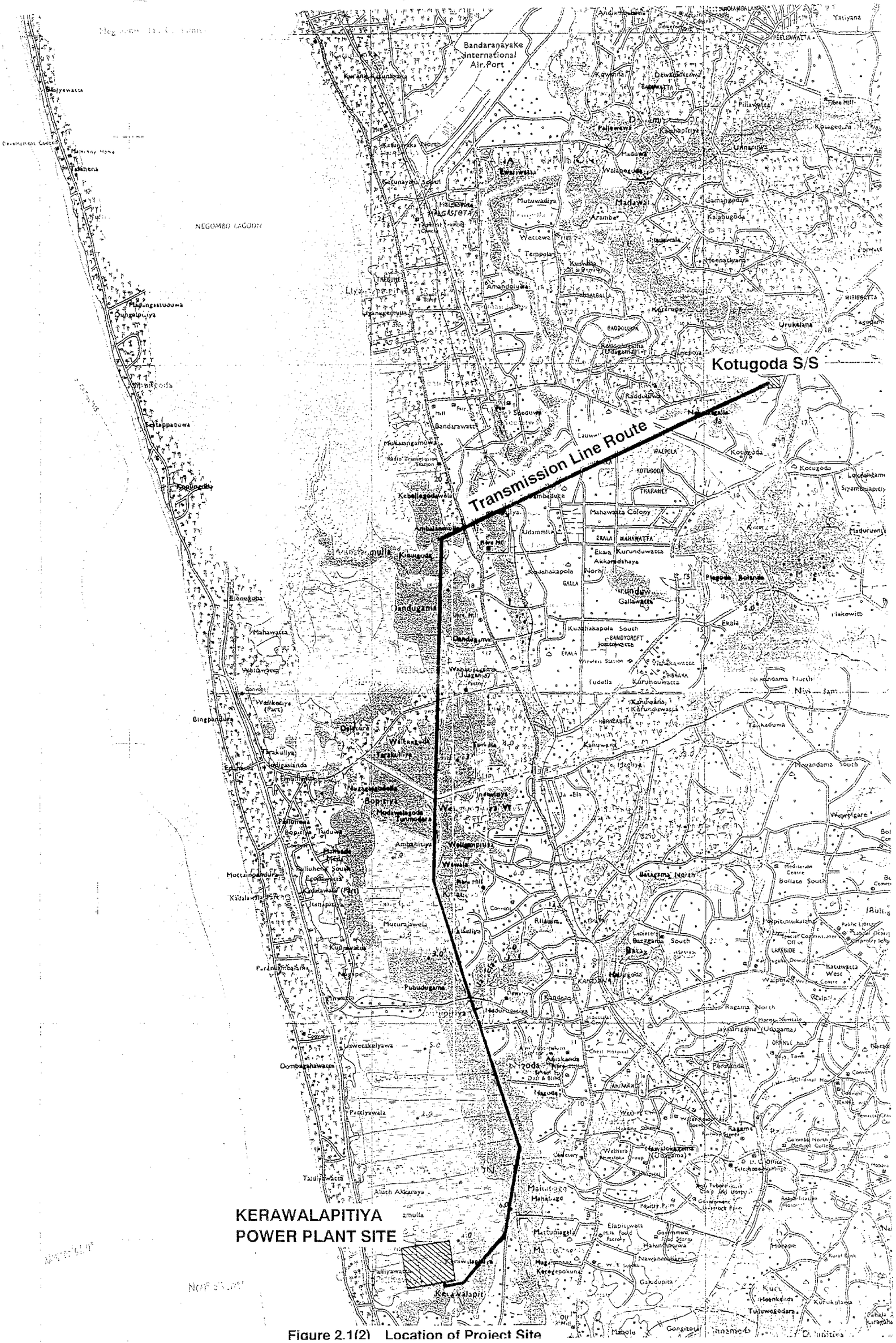


Figure 2.1(2) Location of Project Site

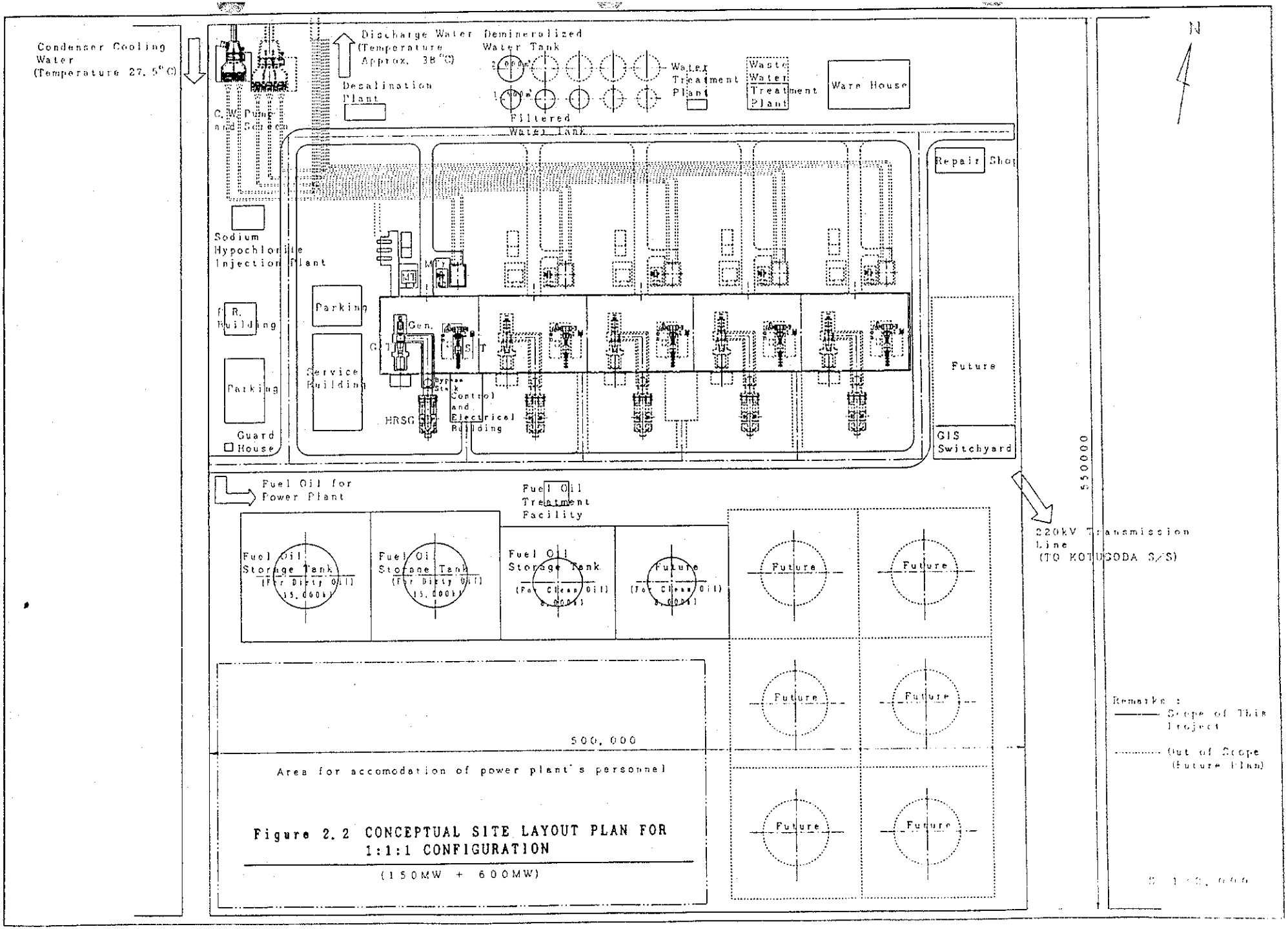


Figure 2.2 CONCEPTUAL SITE LAYOUT PLAN FOR 1:1:1 CONFIGURATION

(150MW + 600MW)

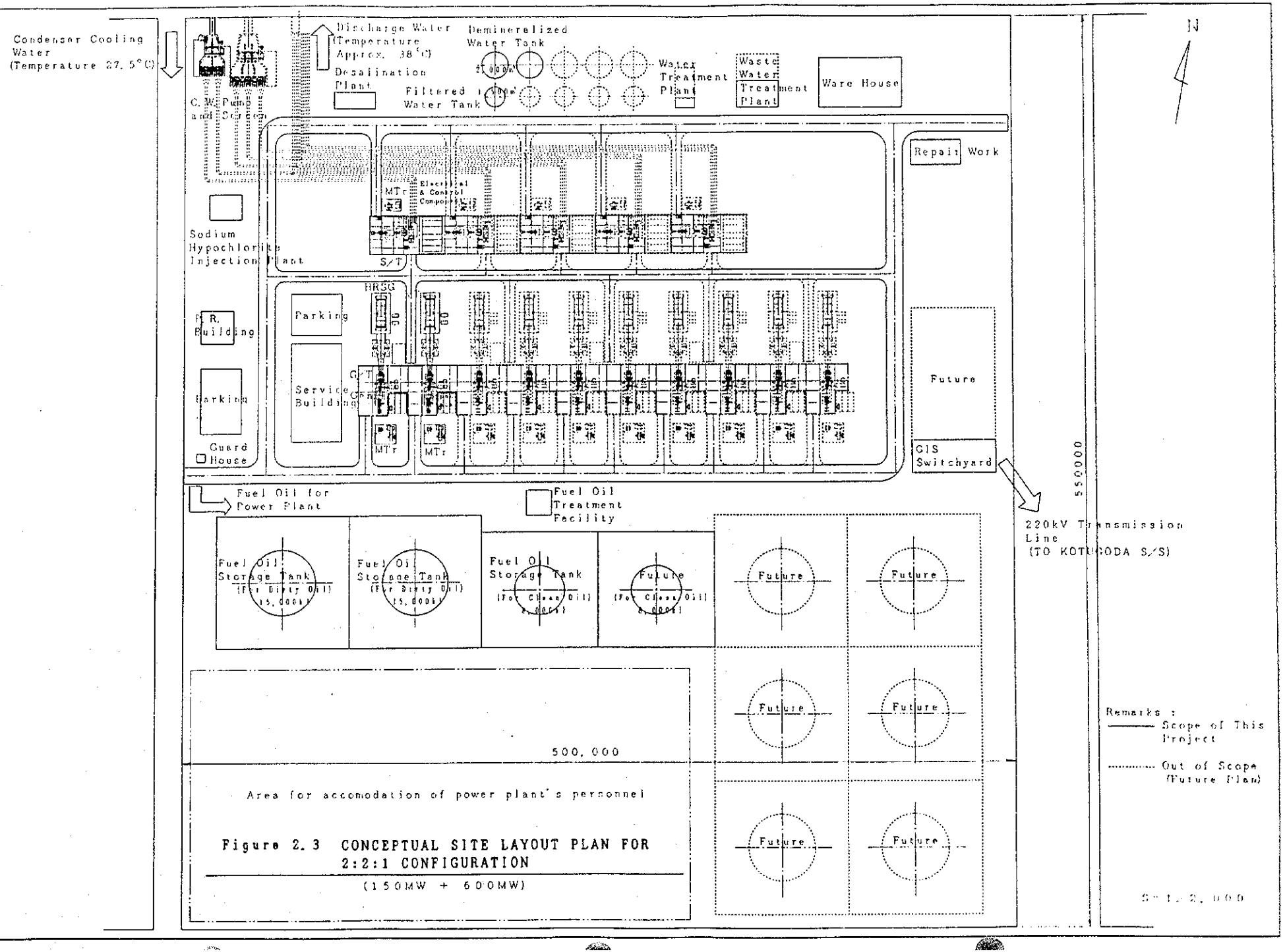


Figure 2.3 CONCEPTUAL SITE LAYOUT PLAN FOR 2:2:1 CONFIGURATION

(150MW + 600MW)

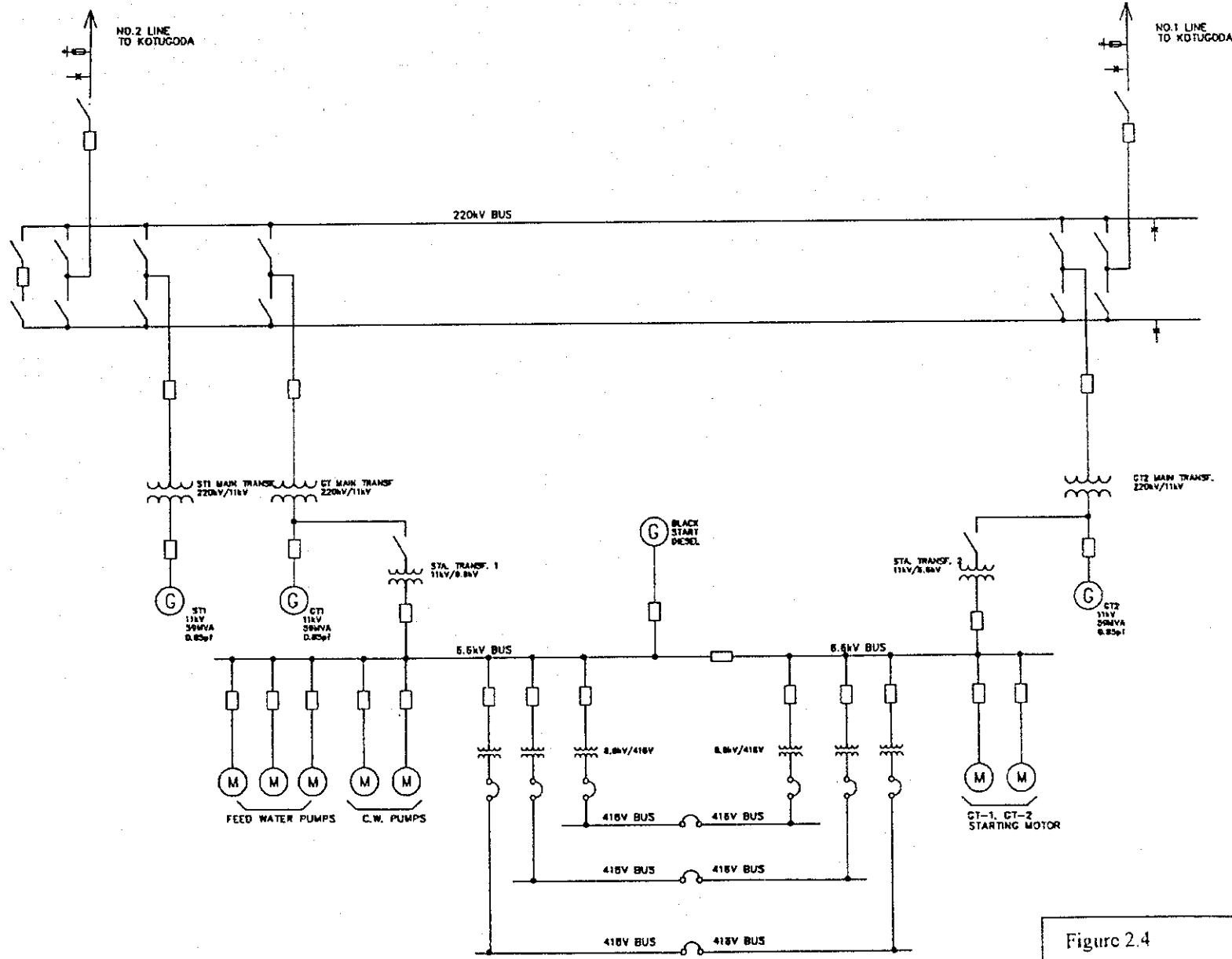


Figure 2.4

Kerawalapitiya Combinesd Cycle Power Plant

Single line Diagram

2GT/1ST

Figure 2.5 Construction Schedule of Kerawalapitiya Combined Cycle Power PLant

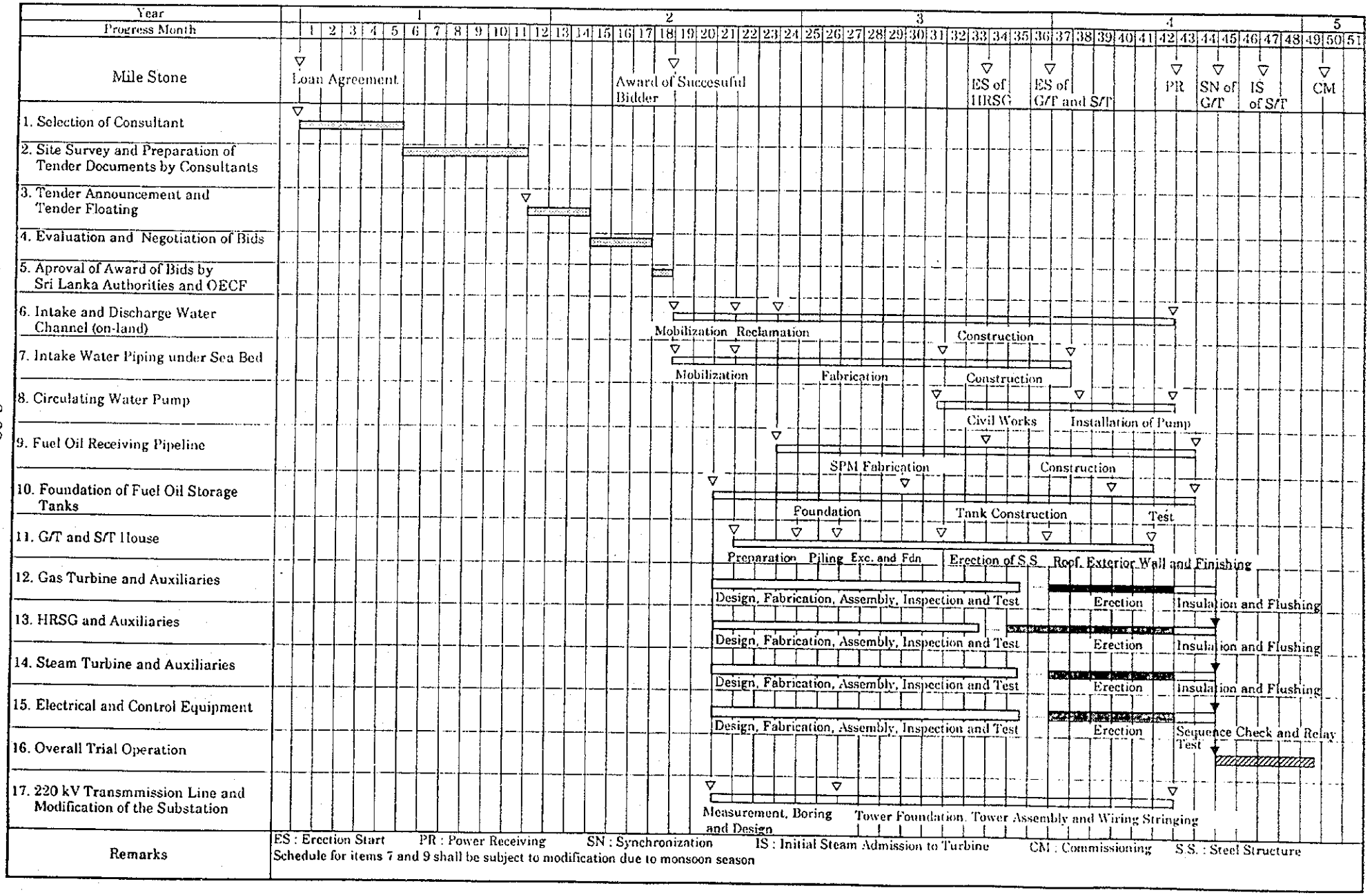
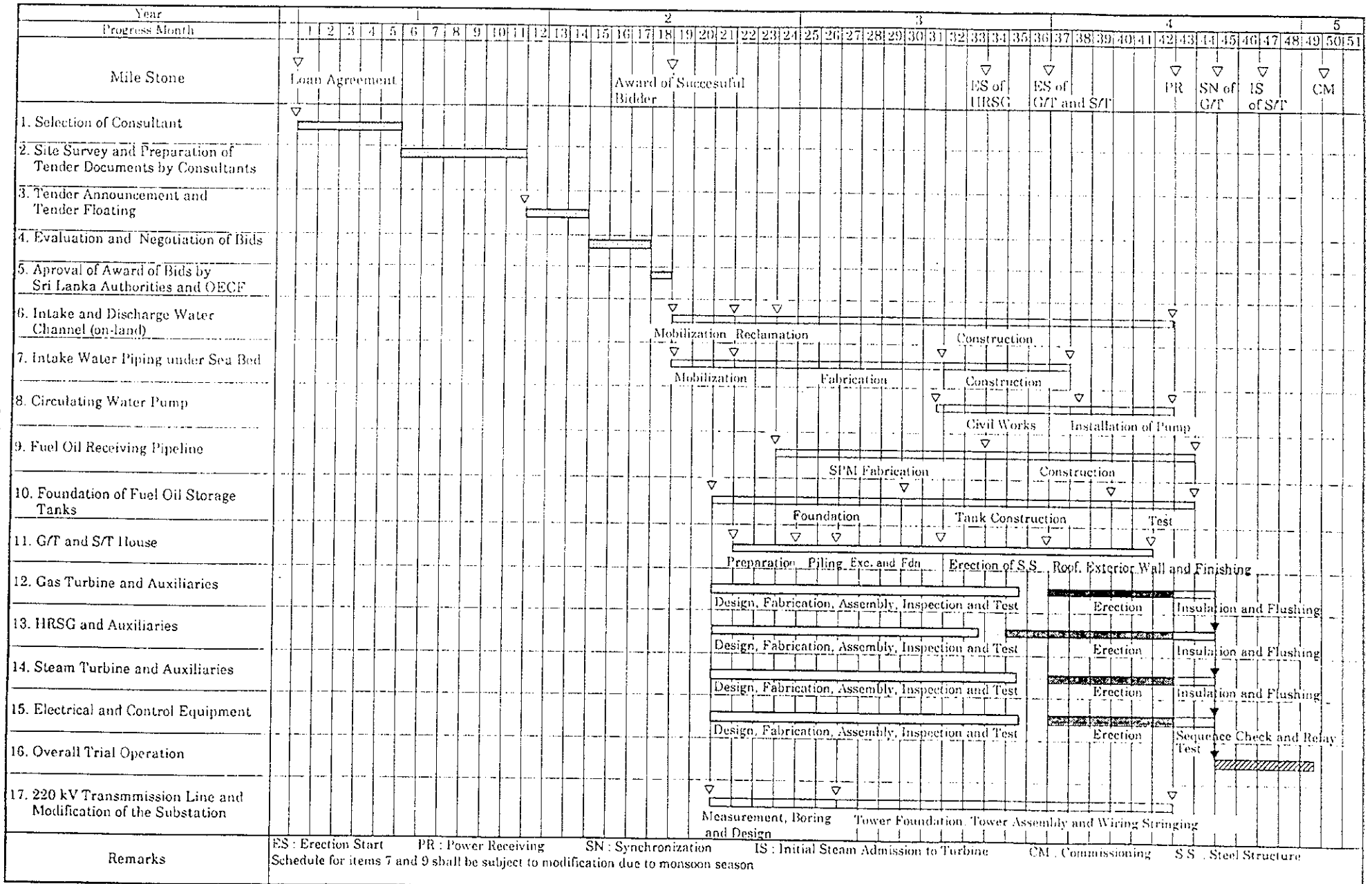


Figure 2.5 Construction Schedule of Kerawalapitiya Combined Cycle Power Plant



CHAPTER 3 DESCRIPTION OF THE EXISTING ENVIRONMENT

CHAPTER 3: DESCRIPTION OF THE EXISTING ENVIRONMENT

3.1 Physical features

3.1.1 Topography and Drainage

The proposed power plant site belongs to Gampaha District in Western Province. It is a part of the land of 160 ha filled up to become industrial and residential districts located in the southern part of a marsh area named Muthurajawela along the coast. A mountainous district exists more than 30 km to the east of this area, and both the northern and southern parts of this area are plains and the western part faces the Indian Ocean.

Muthurajawela is a marsh area where a residential district, a pond of fresh water, a canal, waterways, coconut fields, and the land covered with trees and bush, grass and sedge intermingled. Being near Colombo City, waterways and paddy fields have been continuously developed there since the colonial period. Even now, there is a district where traces of paddy fields used in the period from 1935 to 1960s are found. Since it has been worried recently that development would have harmful effects on many kinds of wildlife and their environment, a master plan has been prepared on protection and development of the district in 1991.

According to the master plan [1], Negombo Lagoon in the northern part and a part of the marsh area adjacent to it are now designated as environmental protection areas as shown in Fig. 3.1, and Kerawalapitiya, the thouthernmost district, is to be developed as industrial and residential districts. Land reclamation work of Kerawalapitiya district was completed in accordance with this master plan, and approximately 30 ha is reserved as the proposed power plant site.

While Muthurajawela marsh area is a flat land approximately 30 cm above the sea level on the average, Kerawalapitiya district developed by filling up with the sea sand is approximately 1.50 to 1.80 m higher than mean sea level (M.S.L.).

On the west side of the proposed power plant site, Hamilton Canal flowing from north to south along the coast connects Kelani River and Negombo Lagoon. On its east side is Old Dutch Canal connected to Hamilton Canal by small waterways.

The coast runs approximately 1 km to the west of the proposed site, where the sea is shallow for some distance with seabed inclination of 1/120. Narrow reefs of approx. 20 m and 800 m from the coast are both running from north to south. The mouth of Kelani River is approximately 3 km south to this coast, and Colombo Port is located approximately 2 km south to the mouth of the river.

3.1.2 Climatic & Meteorological Conditions

3.1.2.1 Rainfall Data

According to Fernando (1990) [8], the climate of Sri Lanka is defined by South Asian monsoons. The proposed plant site is located in the wet zone of Sri Lanka where annual precipitation is 2,000 to 2,500mm there and significant precipitation is observed in April and May, and October and November. (Figure 3.2). The maximum daily precipitation is 290mm (May, 1936). Table 3.1 shows the record of rainfall as observed in the year 1996 – 1997 at Katunayaka Airport. Large amounts of rainfall are marked in the periods from April to June and October to November.

3.1.2.2 Relative Humidity and Temperature

1) Humidity:

The high temperatures and rainfall lead to relative humidity between 70 and 84 % during the day time (Table 3.2). At night, humidity can range from 87 to 93 %.

2) Temperature:

According to the past 30 years record (1994) [8], annual average temperature is almost same as 27 ℃ for whole year through, and April, May and June are the period showing rather high temperature.

The highest temperature recorded in Colombo is 36.2 ℃ over 65 years (in February, 1915) and the lowest temperature is 15.2 ℃ (in January, 1950). For the period from 1945-1975 the highest temperature recorded are 37.2 ℃ in 20th February 1974 and 37.1 ℃ in 6th March 1973 in Katunayaka (Source: Meteorological Department). This year, extreme records in Katunayaka are 38.3 ℃ in 4th March 1998、37.3 ℃ in 9th and 10th February 1998 and 37.4 ℃ in 31st January 1998.

The temperature record from 1996 to 1997 at Katunayaka Airport is shown in Table 3.3. The average temperature of 1996 and 1997 are 27.3, 27.4 ℃, respectively and the maximum temperature is 35.2 ℃ in February 1996 and 35.8 ℃ in March 1997.

3.1.2.3 Wind Speed, Direction

According to the recent observation record (from 1996 to 1997) from the observatory in Katunayaka Airport, the wind direction and wind velocity are as shown in Tables 3.4. The wind rose is shown as Figure 3.3. The annual wind rose and wind velocity are featured by predominant WSW wind of 5 to 8m/sec., occupying 14.4% in the record of 1996, and also the

same predominant wind occupying 10.2% in the record of 1997. The frequency of calm, wind velocity is 1.5m/sec. or less, occupies 18.5% for whole day long and 27.5% for night time. In 1997, the former is 27.1% and the latter is 39.7%. The annual frequency of calm in 1997 is higher than 1996.

There observed some seasonal difference of the frequency of calm between the pre-monsoon period and the conventional cyclonic period in both the years, and the frequency of calm in 1997 is double of that in 1996.

In the record from 1974 to 1990 (1994) [8], the frequency of calm occupies 31.7% in March, 27.5% in April, 6.3% in August, 27.9% in October and 24.0% in December. This tendency is common to both the years of 1996 and 1997.

3.1.2.4 Atmospheric Stability

According to the record observed in 1996 and 1997 at the observatory in Katunayake Airport, frequency in appearance of each the atmospheric stability category nearby the proposed plant site is shown as the following list. The most frequently appearing atmospheric stability category and its frequency are the type D (neutral) and about 60%, respectively(Table 3.5).

Also, according to the report on the appearance rate in the past (1994) [8], it is concluded that the most frequently appearing category during the period from 1974 to 1990 is the type D, as well.

Category of Pasquill Stability	Frequency in Appearance (%)		
	1974 - 1990	1996	1997
A	0.38	0.05	0.10
A/B	1.55	-	-
B	5.46	0.57	1.39
B/C	5.45	-	-
C	18.05	8.74	13.86
C/D	5.86	-	-
D	31.98	53.51	60.07
D/E	0.00	-	-
E	8.12	5.51	12.05
E/F	0.00	-	-
F	0.00	6.76	12.52
F/G	23.15	-	-
G	0.00	-	-

3.1.3 Geology/Soil

3.1.3.1 General Geology of the Area

The proposed power plant site is in the southernmost tip of Muthurajawela marsh area. Including Negombo Lagoon in its northern part, this area, was formed in Holocene Era. The location of this project was filled up with the sea sand existing in its west based on Kerawalapitiya Land Reclamation Project and now it is the land developed for industrial and residential districts. The thickness of the sea sand is 2 to 3 m on the stratum.

The upper layer of the conventional marsh area includes three types of peat: red and sedge-type peat, shrub and tree-type peat, and humus-type peat.

The geological feature of the part of the proposed transmission line route laid parallel to the Old Dutch Canal seems to be unstable superficial strata to depths possibly greater than 3 m in most of the area. On the contrary, a part of the route between A3 road and Kotugoda Sub-station has much stable superficial.

3.1.3.2 Soil Type/s and Distribution, Land Use Capabilities, Soil Profile

"Environmental Profile of Muthurajawela and Negombo Lagoon" (1991) [2] reports that soil in Muthurajawela marsh area is basically classified into three types. The types of soil most frequently seen there is "poorly drained organic soil, bog soils," "dark brown waterlogged mineral subsoil," and "mineral soil with large amount of organic matters, bog soils," and "Humus soil." Much sulfur and salt are contained in these types of soil. The soil distribution in this area before embankment is shown as Figure 3.4. According to the result of drilling survey (1998) [3], embedded sea sand stays at 2.7 to 4.9m depth from the ground surface and the peat stratum stays at 3 to 9m underground. Underneath thereof, the stratum containing plenty of organic substances and sand stratum exist.

The rock formation even weathered a little bit, stays at 10 to 15 m underground.

3.1.3.3 Erosion Trends

According to the report on the movement of inland water in the marsh area: "Environmental Profile of Muthurajawela and Negombo Lagoon (1991)" [2], in the rainy season the proposed power plant site is under the influence of inland water moving from the marsh area to Hamilton Canal and flowing into Kelani River. In the dry season, however, although the condition of inland water movement is like that of rainy season, some time it flows out in the directions of both Hamilton Canal and Old Dutch Canal.

The proposed plant site is a marsh area in general accumulated with soil of relatively small

specific gravity, and the land is said to be easily eroded by flowing water. In other words, soil may be washed out at the time of flood caused by much rainfall.

On the other hand, ground surface of the proposed power plant site was already embanked to the height of 2 to 3m by sea sand, and the specific weight is 1.74. The median diameter of the material at ground surface north to the site is around 0.35mm.

3.1.4 Hydrology

3.1.4.1 Surface Drainage

The main waterways surrounding the proposed power plant site are Hamilton Canal, Old Dutch Canal, and many small waterways connecting the two canals (see Fig. 2.1). Flow velocities of Hamilton and Old Dutch canals are not constant and they are much influenced by rainfall on land and tidal movement of the open sea through the mouth of Kelani River and Negombo Lagoon.

According to "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991) [2], water flows diverge to the north and south directions near the center of Muthurajawela marsh area, and both canals flow in the direction of Kelani River near the proposed site (see Fig. 3.5). Hamilton Canal is a canal with the total length of 14.2 km, width of 16 to 18 m, and depth of 1.5 to 1.75 m.

3.1.4.2 Surface Water Availability, Quality

According to "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991) [2], water quality at points (shown in Fig. 3.6) surrounding the proposed power plant site are as indicated in Table 3.6. According to the survey result, the data of water quality in Hamilton Canal are: pH = 7.0 - 8.3, coliform group = 23,000, BOD_3 = 8 - 30 mg/l, and the entire amount of phosphorus = 0.04 - 1.02 mg/l. Relatively high values of coliform groups and BOD shows the fact that water quality here has been deteriorated by contaminant inflows. In some cases pH value is low in acidic side, and this is caused by soil containing peat. Relatively high value of Hg has been also detected in some districts.

According to the result of quality survey of water in Hamilton Canal (see Annex 6 and Table 3.7), flow direction in dry season is towards river mouth of Kelani river, and dissolved oxygen is as low as 2.8 to 4.0 mg/l, COD is 18 to 44 mg/l, BOD_3 is less than 15 to 20 mg/l, and oil and grease is 3 mg/l at the maximum. Its water quality is comparatively polluted.

In the rainy season of June, dissolved oxygen is 2-4.8 mg/l, COD is 6-9.4 mg/l and BOD_3 is <1

mg/l. Water quality of this season is comparatively clean though oxygen content is low. However, high concentration of oil and grease was found in the surface water of the canal. Although a part of water in the canal is used by residents in the neighborhood for their daily life, such as bathing and washing, it is not used as industrial water, drinking water or fishing.

3.1.4.3 Availability of Ground Water, Safe Extraction Limits

According to "Environmental Profile of Muthurajawela and Negombo Lagoon (1991)" [2], although the underground water is available in relatively shallow points, its source is said to be limited. The source of the underground water derived from rainfall is considered to exist in the sand near Bopitiya approximately 15 km from the proposed power plant site. Although little is known on its water quality, it is considered to be much influenced by invasion of seawater.

According to the drilling survey (1998) [3], the groundwater table exists 1.34 to 2.78 m deep in underground of the proposed site.

3.1.5 Air Quality

3.1.5.1 Inventory of Existing Emission Sources

The sphere of 10 km from the proposed plant site mainly consists of marsh area, farms, and a residential district. According to the record on the types of energy materials used by manufacturers registered in CEA, existing air pollution sources are found only about fifty small-scale plants using diesel oil as their fuel except Kelanitissa Power Plant.

With regard to the streets in the district surrounding the proposed power plant site (see Fig. 3.7), there are many small roads including a local road running along Hamilton Canal. In general, the roads are narrow and they usually consist of a single traffic lane with few traffic density. The road running on the west side of the proposed site is paved, but it has only a single lane on one side. The result of the survey on traffic density of national highway Route A3 which runs 2.2 km to the east of the proposed plant site (Table 3.8) indicates that trucks and buses account for about 7% to the total traffic density a day of 40,000 vehicles. On the other hand, in the sphere of 10 km to the south of the proposed site includes Colombo City and Colombo Port where approximately 3,000 large ships are moored annually.

According to the monitoring data by NBRO(1998), following air quality data can be obtained for Colombo City.

Location	Period	Maximum level (mg/m3)		
		SO2	NO2	SPM
Fort Railway Station	15 Feb. - 14 Mar.1998.	0.129	0.089	-
(Peak station)	01 Jun. - 30 Jun.1998.	0.311	0.144	0.070-0.117
Meteorological Department	15 Feb. - 14 Mar.1998.	0.095	0.107	-
(Background Station)	13 Jun. - 21 Jun.1998.	-	-	0.039-0.067

3.1.5.2 Ambient Air Quality Measurements

At four points in a sphere of 10 km from the proposed site of this project as its center in respect of the TOR established by the CEA, monitoring was conducted for a period of 15 days during the seasons of both northeast and southwest monsoons.

The current status of the values per hour of NO_2, NO, NOx, SO_2, CO, O_3 and the values per 24 hour of suspended particulate matters (SPM) is stated below. The measurement points are shown in Annex 7, and the details of measurement results are shown in Table 3.9.

The average values per 1 hour of SO_2, NOx, and NO_2 obtained for February to March (the season of northeast monsoon) were <0.002-0.051 mg/m^3, <0.001-0.051 mg/m^3, and 0.001-0.043 mg/m^3 respectively. The values of SPM per 24 hour were 0.080-0.136 mg/m^3 for holidays and 0.074-0.121 mg/m^3 for weekdays. The average value per 8 hours of SO_2, NOx, and NO_2 were 0.003-0.250 mg/m^3, 0.004-0.031 mg/m^3, and 0.003-0.024 mg/m^3 respectively, while the average values per 24 hour of SO_2, NOx, and NO_2 were 0.004-0.015 mg/m^3, 0.012-0.019 mg/m^3, and 0.009-0.016 mg/m^3 respectively. ND (limit of determination or less) applied in the average calculation of SO_2 was 0.002 mg/m^3, and ND applied in the average calculation of both NOx and NO_2 was 0.001 mg/m^3.

According to survey at June during the Southwest monsoon season, average values per 1 hour of SO_2, NOx and NO_2 obtained were <0.002-0.046 mg/m^3, < 0.001- 0.059 mg/m^3 and < 0.001-0.031 mg/m^3 respectively. The values of 8 hour were 0.002-0.034 mg/m^3 ,0.003-0.048 mg/m^3 and 0.001-0.025 mg/m^3, respectively. The SPM of 8 hour average was 0.052-0.103 mg/m^3 for weekday and 0.062-0.110 mg/m^3 for the day of weekend. The 24 hour average for SO_2, NOx and NO_2 were 0.003-0.018 mg/m^3, 0.004-0.030 mg/m^3 and 0.002-0.017 mg/m^3, respectively. SPM of 24 hour average was 0.227-0.266 mg/m^3 for weekday and 0.232-0.287 mg/m^3 for the day of weekend.

3.1.6 Noise

3.1.6.1 Inventory of Existing Noise Sources

The sphere 2 km from the proposed power plant site mainly consists of marsh area, farmland and residential districts, and there are no plants as sources of large noises, and existence of only five plants of extremely small sizes were confirmed. There are no roads to cause large noises.

3.1.6.2 Existing Noise Levels

A survey was conducted at four points on the boundary of the proposed power plant site (see Table 3.10 and annex 8). The survey shows that the proposed site usually has lower noise levels of around 44 dB(A) except for the occasional noises like those from airplanes. In general, the noise level at weekend is slightly higher than its in weekday.

3.1.7 Oceanography

3.1.7.1 Sea Water Quality

Quality of water in the southern part of the relevant ocean area is reported as follows in "Study on the Development of New Port of Colombo (1996)" [4] prepared by Japan International Cooperation Agency. The investigation was conducted in the ocean area near Colombo Port in September and from January to February when southwest and northeast monsoons blew respectively. The results obtained indicate the outline of water quality as follows:

Water temperatures in the above two seasons were almost constant with only a slight difference between them; water temperatures in the surface of the port ranged from 28.4 to 28.8 ℃ with the average being 28.6 ℃. Little difference was noted between the temperatures in the higher and lower layers.

COD of the surface within the port ranged from 2.71 to 12.26 mg/l, the average being 7.23 mg/l, and COD of northern surface outside the port ranged from 3.43 to 7.93 mg/l, the average being 6.10 mg/l. During this survey, water quality in the coastal area was predicted to change accompanying the Colombo Port Construction Program. Based on the results obtained, it was reported that COD of southern water area along the proposed site would not change much upon completion of the port construction.

According to the results of the survey conducted during the season of southwest monsoon in 1995, T-P values were 0.05-0.44 mg/l and T-N values were 0.01-0.09 mg/l. COD values as the results of the survey conducted during the season of northeast monsoon were reported as 0.07-0.14 mg/l and 0.03-0.05 mg/l respectively.

On the other hand, the guideline on quality of water along the site (SLS 1987) includes: pH: 6.5-9.0; BOD: 5mg/l or less; oil and grease: 10 mg/l or less; DO: 3 mg/l or more; and Coliforms: 2500MPM/100 ml or less. Specific values of other items are not indicated in it.

The following results were obtained from the survey on temperatures and salinity of water in the coastal area:

According to the survey in April and May when the air temperatures rise sharply as indicated in the past monthly records, vertical water temperature difference is quite small, and water temperatures are almost the same as the highest air temperature. This relation between air and water temperatures is also noted in the temperature variation within a single day. The fact that water temperatures change diurnally reflects the influences of heat radiation of the sun and tidal action.

Sufficient measurement of salinity was unavailable. However, the highest salinity of the surrounding ocean was 34, and as indicated in the result of measurement conducted in June, salinity is lowered in case influenced by Kelani River.

Survey for this project was conducted to acquire the data of water quality for the seashore west to the proposed power plant site on water temperature, salinity, DO, BOD, COD, transparency, pH, oil and grease, and TSS (see Annex 6).

The results of the survey conducted in February to March (see Table 3.7) shows that water temperatures at water depth of approximately 9 m were 29.4 - 30.2 ℃ and no remarkable difference was noted in water temperatures between the upper and lower layers (Table 3.11). According to the water temperature measurement, maximum water temperature was 32.7 ℃, which was recorded in April 1998. Meanwhile, daily maximum water temperature of surface water is 31.6 ℃ which was recorded in March 4, 1998 and maximum air temperature of the day is 38.3 ℃ according to the data of Katunayaka Airport. In this year of 1998, extreme records of air temperature at Katunayaka are :

38.3 ℃ in March 4, 1998
37.3 ℃ in February 9 and 10, 1998
37.4 ℃ in January 31, 1998

Although oil and grease were once detected as 6 mg/l, most of the cases were 2 mg/l or less. The data of pH and dissolved oxygen were found normal. Transparencies at water depths of 10 m and 5 m were 7.3-9 m and 4.4-4.5 m respectively, with low degrees of turbidity. However

measurement of COD was not available, in view of DO concentration and transparency, the level of pollution is presumed to be exceedingly low.

According to the results of survey at June, oil and grease is less than 0.5 mg/l and TSS is 4-10 mg/l.

3.1.7.2 Data on Tidal Level

According to the observation records of Sri Lanka Port Authority, the sea levels of Colombo Port are as stated below, indicating little difference in the sea level of this area:

MHWS (Mean High Water Spring Tide)	:	+ 0.72 m
MHWN (Mean High Water Neap Tide)	:	+ 0.48 m
MSL (Mean Sea Level)	:	+ 0.38 m
MLWN (Mean Low Water Neap Tide)	:	+ 0.30 m
MLWS (Mean Low Water Spring Tide)	:	+ 0.06 m
MLLWS (Mean Lowest Low Water Spring Tide)	:	+ 0.02 m

3.1.7.3 Wave Height and Direction

According to "Study on the Development of New Port of Colombo (1996)"[4] prepared on this sea area by Japan International Cooperation Agency (JICA), the wave direction and wave height in the relevant coastal area are as follows:

Measurements were conducted from October, 1995 to February, 1996 at the points off the coast in the northern part of Colombo Port where water depth was 15 m, using a wave recorder combined with an ultrasonic wave recorder and an electromagnetic current meter. The wave direction and height obtained in this study are as follows:

Wave heights of 1.0 m and up revealed a high frequency of 45.8%. As to the results per month, the number of days when wave height was 1.0 m and up was 24 days or more in the months from June to September.

As to wave directions, SW direction was found excellent, and next was SSW direction. The frequencies of appearance in total of the two directions was 90% and up. The frequency of appearance in the northwardly direction was small being approximately 5%. The frequency of appearance for north direction was around 2%, and this seems to have been caused by northeast monsoon.

3.1.7.4 Current Characteristics

According to "Study on the Development of New Port of Colombo (1996)" [4], the features of flow duration in the relevant sea area are as follows:

Flow duration was observed at the same points and times as the observation of waves using an electromagnetic current meter and a day-and-night observation (spot observation) of flow duration was conducted at nine points in the sea area on the northern side of Colombo Port using a current meter of direct reading type. Also, long shore current was observed through floating chase in the season of southwest monsoon blowing from September to October and that of northeast monsoon blowing from January to February for the distance of 3 km along the northern coast of Colombo Port. The flow duration obtained through these investigations are as follows:

Flow direction is excellent in N direction. The frequency of appearance for flow velocity of 0.1 m/sec. and under was around 95%, indicating that flow velocity was relatively low in most cases. Flow to N direction was confirmed in the seashore on the northern side of the mouth of Kelani River also through floating chase.

For the purpose of acquiring oceanographic phenomena for the area surrounding the proposed power plant site, tidal currents were observed within the range of the survey for the proposed power plant. [5]

The results of the tidal current surveys conducted in February to March, 1998 are stated below. The current rose is presented in Fig. 3.8.

The current rose shows that most of currents are principally polarised in the south, southwest and northeast directions.

Currents of smaller magnitudes, such as from 0 to 5 cm/sec are distributed in all directions.

According to the survey result in February to March, current in the 24 cm/sec are oriented in a southern direction.

As shown in the current diagram [5], periodical existence of tidal current in the north to south direction in February to March and June were confirmed at a cycle of 12 hours.

Residual current was determined from the total current. Maximum velocity of residual current is 20.2 cm/sec and average velocity is 5 cm/sec to south direction in the period of February to March.(Table 3.12)

3.1.7.5 Nearshore Bathymetry

According to the chart, the seabed is shallow with a gradient of 1/120. Water depth as a result of sounding conducted at a distance of 4 km off the coast is from 14 m to 16 m. However, there is a shallow of approximately 9 m in depth 3.8 km off the coast in the southern part of the coastal area. Also, there is a shallow of approximately 4 m in depth lying from the point of 1100 m off the coast in the southern part to the point of 800 m off the coast in the northern part of the coastal area. In addition, a reef in the form of a belt lies from the point approximately 200 m from the coast in the southern part to the point approximately 50 m from the coast in the northern part of the coastal area. Excluding the portion of the reef belt, the area is a flat sea bed. [5]

3.1.7.6 Coastal Erosion Trend

According to "Study on the Development of New Port of Colombo (1996)" [4], conducted by JICA, outflows of soil and sand were investigated at the mouth of Kelani River in October and February when southwest and northeast monsoons blow respectively and the following conditions of soil and sand outflows were discovered: The outflows of soil and sand ranged from 0.3 to 1.4 kg/sec. The flow was approximately 130 m^3/sec in the season of southwest monsoon, and approximately 30 m^3/sec in the season of northeast monsoon. Outflows of soil and sand is proportionate to the flows of the river.

M.M. Bandara (1989) who analyzed aerial photographs on erosion of northern and southern coasts centering on the mouth of Kelani River clarified how the sand bar at the river mouth disappeared and how both southern and northern coasts were eroded. Noting the changes in coast lines from 1990 onward (see Fig. 3.9), the degree of erosion in the southern part of the coast on the west side of the proposed power plant site was relatively small, and its condition was stabler than that at the mouth of the river.

Coastal Conservation Department (CCD) told us in response to our hearing that 70% at range of approximately 30 km of north from the mouth of Kelani River was under the influence of coastal erosion. The coast for approximately 3 km on the northern side of the mouth of Kelani River was conventionally influenced by erosion. However, as it is protected with artificial structures, the coastal area just in front of the proposed site is in a relatively stable condition at present.

3.2 Ecological Resources

3.2.1 Terrestrial Ecology

3.2.1.1 Terrestrial Flora

Various aquatic plants live in Muthurajawela marsh area. Their distributions are different depending on the conditions of their eutrophication, the degree of salinity, and water depth. The area occupied by sedges and grasses constitutes a large portion of the area, and shrub-like tree *Annona Glabra* grows on bank gradients. Shallow pools and canals covered by Salvinia and Duckweeed are also found. Large number of phytoplankton and algae which has important roles in ecosystem are contained in canal water.

According to "Environmental Profile of Muthurajawela and Negombo Lagoon (1991)" [2], the conditions of terrestrial plants appearing near Muthurajawela marsh area and the proposed power plant site are as follows:

1) Aquatic Vegetation

The list of aquatic vegetation found in Muthurajawela marsh area is in Table A9.1 of annex 9. Major flora found in the southern part of Old Dutch Canal are *Annona Glabra*, *Carex Indica*, *Ischaemum Rugosum Salisb*, *Osbeckia Aspera Blume*, and *Panicum Repens*. Although the number of aquatic flora types appearing in Hamilton Canal is relatively small, waterlily and water hyacinth (*Eichhornia crassipes*) are occasionally found there. In shallow pools and canals where water is stagnant because of high nutritious contents, Salvinia, and duckweed (*Lemna* spp.) are distributed, while in the deeper place with less eutrophic water, water lilies and *Nymphoides* spp. are distributed.

Phytoplanktons found in Muthurajawela marsh area are as indicated in Table A9.2. Aquatic macrophytes are as indicated in Table A9.3.

2) Marsh Vegetation

The list of the marsh vegetation found in Muthurajawela marsh area is shown in Table A9.4 of annex 9. The major flora found in the southern part of the marsh area are *Annona glabra*, *Lygodium micophyllum*, *Panicum repens*, *Ischaemum rugosum*, *Isachne globosa*, *Flagellaria indica*, *Carex indica*, *Polygonum barbatum*, *Fimbristylis* sp., and *Cyclosorus* sp. Mangrove forest is distributed only in brackish-water area in Negombo Lagoon and it is not found near the proposed power plant site located in the southern part of the marsh area.

Since the proposed power plant site is the land newly filled up, no plant is distributed there. According to "Environmental Profile of Muthurajawela and Negombo Lagoon (1991)" [2], wild date palm of *Phoenix zeylanica*, sedges of *Eleocharis lankana* and *Fimbristylis zeylanica* are distributed in the marsh area as endemic species. It is reported that since these floras are of species growing anywhere there, they are not considered as endangered.

3) Flora Found Along the Proposed Transmission line route

A local consultant surveyed shrub, herb and climbing species along the proposed transmission line route [ANNEX 13]. All species found at the survey are listed in Table A9.5 of annex 9. In this table 81 species including 5 endemics and 3 introduced are listed. The endemic species are *Ardisia willisii*, *Eleocharis lankana*, *Fimbristylis zeylanica*, *Lucas zeylanica* and *Walidda antidysent*. None of these species are considered as threatened species.

3.2.1.2 Terrestrial Fauna

According to "Environmental Profile of Muthurajawela and Negombo Lagoon (1991)" [2] and "Proposed LPG Import Terminal - Sri Lanka at Kerawalapitiya EIA Report (1996)" [6], the following terrestrial fauna found in Muthurajawela marsh area and near the proposed power plant site:

1) Mammals

34 species of 14 families of mammals are recorded in Muthurajawela-Negombo Lagoon (see Table A9.6 of annex 9). Out of these 34 species, 2 species, i.e. fruit bat of *Rousettes seminudes* and toque macaque of *Macaca sinica* are endemics. Also, 6 species, i.e. painted bat *Kerivoula picta*, slender loris *Loris tardigradus*, the otter *Lutra lutra*, the wild cat *Felis viverrina* and *F. rubiginosa* and mouse-deer *Tragulus meminna* are threatened species, and the loris family and the two cat species are protected under Schedule III of Sri Lanka's Wildlife Ordinance of 1979. *Felis rubiginosa* is also included in the IUCN Red List of Threatened Animals, 1998.

2) Birds

(1) Resident Birds

126 species of resident birds are recorded in Muthurajawela-Negombo Lagoon. The list of indigenous species out of them is shown in Table A9.7. No existence of endemic species are found among these residential birds. However, four species, the reef heron of *Egretta gularis schistacea*, the grey-headed fishing eagle of *Ichthyophaga ichthyactus plumbeiceps*, the blue-breasted banded quail of *Rallus striatus*, and the black-capped kingfisher of *Halcyon pileata* are registered as threatened species in the National Status

Report of 1989. According to "Proposed LPG Import Terminal - Sri Lanka at Kerawalapitiya EIA Report" (1996) [6], these four threatened species live in the northern part of the marsh area, and this is attributable mainly to their food distribution. The fact that many resident birds live there tells us that the marsh area has an important role for these species.

(2) Migrant Birds

40 species of migrant birds are recorded in Muthurajawela-Negombo Lagoon. Table A9.8 shows their list and Fig. A9.1 shows their distribution conditions. Most migrant species fly to Sri Lanka around the end of August and leave there around April to May of next year. Of these species, Indian cormorant *Phalacrocorax carbo sinensis* and Common Tern *Sterna hirundo tibetana* are listed as threatened species.

As a result of observing their number, food and breeding, it is reported that the northern part of Negombo Lagoon, the border between the lagoon and the marsh area, and the central part of the marsh area (Bopitiya and Uswetkeiyawa) especially has important roles for these species.

3) Reptiles

In Muthurajawela marsh area, 15 species of tetrapods and 22 species of serpentoids, totalling 37 species of reptiles are recorded. Table A9.9 shows their list.

Out of the 15 species of tetrapods, two are endemic, *Msbuya macularia* and *Sphenomorphus fallax*, and seven are threatened in Sri Lanka, the fresh water terrapins *Melanochelys trijuga*, the soft-shelled turtle *Lissemys punctata*, the estuarine crocodile *Crocodylus porosus*, the green garden lizard *Calotes calotes*, and the lizard *Typhlina bramina*. In addition, the estuarine crocodile *Crocodylus porosus* is listed as endangered species in IUCN Red Data Book.

Out of 22 snake species found in Muthurajawela marsh area, 3 are endemic, and 6 are listed as threatened in National Status Report of 1989. The Guenther's roughside (*Aspidura guentheri*: genus and species endemic) and *Gerada prevositana* are very rare species in the marsh area. The largest type of snake in Sri Lanka which is also considered threatened, *Python molurus*, is occasionally found at the Muthurajawela marsh. Sri Lankan pipe snake of *Cylindrophis maculatus* is endemic.

4) Amphibians

Amphibians found in Muthurajawela marsh area are in four families: 6 species of Ranidae family, 3 species of Bufonidae family, 3 species of Rhacophoridae family, and 3 species of Microhylidae family. Their list is shown in Table A9.10. The Atukorale's dwarf toad *Bufo atukoralei* and the Greater hourglass tree frog *Rhacophorus* (*Polypedates*) *cruciger* are listed not only as endemics but also as threatened species. However, these two species are frequently observed in this marsh area.

5) Fishes

In Muthrajawela marsh area, 21 species of fish are collected as indicated in Table A9.11. Rare endemic species including the Smooth breasted snake-head *Channa orientalis*, the Leaf lates *Belontia signata*, the Cuming's two-banded barb *Barbus cumingii*, and the De Kretser's fish *Malpulutta Kretseri* may exist in the marsh water, although their existence has not been confirmed.

Abundant species of fish confirmed to live in Hamilton Canal are *Ambassis dayi*, *Oligolepis acutipennis*, *Panchax melastigma*, *Gerres abbrebiaus*, *Etroplus suratensis*, and *Scatophagus argus*.

6) Insects

Major insects found in Muthurajawela marsh area are numerous dragonfly, mayfly larvae, the Diving beetle *Cybister confusus* and their larvas, and the Creeping water bug *Holeocaris bengalensis*.

Butterflies and dragonflies found in Muthurajawela marsh area are listed in Tables A9.12 and A9.13.

Molluscan fauna found in Muthurajawela marsh area are the gastropods *Pila globosa*, the open-bill stork *Indoplanorbis* sp., *Faunus ater* and *Melanoides* sp. No endemic species are found in these molluscan fauna.

7) Zooplankton

Zooplankton found in Muthrajawela marsh area are as indicated in Table A9.14.

3.2.2 Aquatic Ecology

According to "Proposed LPG Import Terminal - Sri Lanka at Kerawalapitiya EIA Report (1996)" [6], the conditions of appearance of aquatic flora and fauna in coastal area just in front of the proposed power plant site are as follows:

3.2.2.1 Aquatic Flora

No distribution of algae is found on the seabed in front of Modara to Dickovita area. The dune at the west side of the proposed power plant site is covered by *Pandanus* sp. and *Ipomoea* sp.

Moreover, Kaduru *Cerebera manghas* and Wetakeiya *Pandanus cooratissimus* are also observed.

Many dwellings were found in the area between the dune and Pamunugama Road because it has already been developed as a residential district. Grasses grow and coconut plantation scatter among dwellings like threading their way.

3.2.2.2 Aquatic Fauna

In the coastal area near the proposed power plant site, near shore reefs run from north to south along the coast approximately 20 m and 800 m from the coast. Other parts are covered by sand. Major aquatic fauna found in pelagic marine environment outside of near reefs are as shown in Table A9.15. In addition to the species, 5 species of turtles and several species of dolphins including two rare species seem to exist there. Phytoplankton found in this coastal area is shown in Table A9.16.

The organisms found on the offshore reef are star fishes, lobsters, and groupers. Existence of endemic and threatened species have not been recognized.

From the seashells collected in the sandy beach, many kinds of Mollusc live are presumed to live in the seabed. The list of these molluscs is shown in Table A9.17. In addition, the lobster *Panulirus homarus* exists there. It is reported that they are of the type generally seen and that endemic and threatened species are not included.

As a result of the biological survey on the coastal area in front of Modarta to Dickovita area and hearing from fishermen, no existence of living coral was confirmed.

Aquatic species living on near shore reef in Dickovita area are as shown in Table A9.18. From the records of coastal fishery stated in "Natural Resources of Sri Lanka, Conditions and Trends (1991)" [7], existence of Spanish Mackerel, Tuna, Barracuda; small pelagics including Sardines, Indian Mackerel, Herrings; demersal species as prawns, silver bellies, moonfish, ribbonfish, breams, snappers, and groupers are observed.

The species living on near shore reefs are general species and no endemic and threatened species are included.

On the sand dune at Dickovita area, several kinds of marine crabs of general species in Sri Lanka are observed.

Hearing from fishermen and residents revealed that this side of the coastline is a place for sea turtles to lay their eggs.

3.3 Human Settlement and Land Use

The proposed power plant site is located in the southern part of Wattala Division approximately 12 km to the north of Colombo City. Wattala Division consists of 46 local government districts with the total population of approximately 150,000. With respect to racial composition of the residents, those of Sinhala origin accounts for approximately 83% of the population. With respect to their religion, the ratio of Catholic believers is relatively large.

The area covered by the survey on social and economic environments was the section within a radius of 2 km from the proposed power plant site as indicated in Figure 3.10 (hereinafter referred to as "the area around the proposed power plant site"). 17 local government districts were covered by the area around the proposed power plant site, and social/economic situations of the individual districts are as shown in Table 3.13. The outline of social and economic environments of the area around the proposed power plant site is as follows:

3.3.1 Present Land Use Pattern

The proposed power plant site was developed from the marsh area by filling up the land with the sea sand in front of the coastal area to make industrial and residential districts based on Kerawalapitiya Land Reclamation Project. Since CEB has already reserved approximately 30 ha for the site to construct a power plant out of the developed land of approximately 160 ha, no further development will take place.

Relatively many residents live in the area around the proposed power plant site where only a small number of trees scatter. The coast of approximately 1 km to the west of the proposed site is used as a recreation zone for swimming, etc. The land use pattern along the route of proposed transmission line is through mash land in large portions. Some area especially after crossing A3 road to Kotugoda Sus-station has residential area and coconut field.

3.3.2 Population Characteristics Such As Population Distribution by Age Groups, Education, Health Conditions, Employment and Income Profiles

Approximately 66,000 people live in the area around the proposed power plant site. The number accounts for approximately 44% of the total population of Wattala Division, indicating that population is rather concentrated in this section. The number of households in the area is approximately 13,000, and a family consists of around 5 members.

With respect to racial composition of residents, as in the case of the entire area of Wattala, the number of people of Sinhala origin are the largest in number accounting for approximately 80% of the total residents. The next largest ratio is for those of Tamil origin accounting for approximately 12%. With respect to their religion, Catholic believers and Buddhism believers account for approximately 54% and 31% of the total respectively.

Approximately 85% of residents are graduates of middle school or higher, and those who received only primary school education accounts for 10% of the total residents. Out of the working people there, approximately 25%, 15%, 15%and 30% of them are engaged in fishery, agriculture, poultry and hog raising, business trades respectively, and others are laborers. The average monthly income of fishermen is said to be Rs 5,000 (¥10,000) or less. In particular, the proposed area for cooling water intake and discharge pipeline and fuel pipeline is dominated by households whose total monthly income are Rs. 3,000 to 17,000 with an average of Rs. 5,500. The average monthly income in households along the proposed access road called Gunasekara Mawatha is range from Rs.1,000 to 15,000.

According to "Environmental Profile of Muthurajawela and Negombo Lagoon (1991)" [2], annual increase in the ratio of population living in Muthurajawela marsh area was approximately 2.3% for the period from 1981 to 1990. This ratio is higher than 1.6% as the ratio of population increase for the entire country, and the main reason for this is reported as immigration.

With respect to the composition of residents per sex and age, as indicated in Fig. 3.11, the number of school pupils who are 5 to 14 years old accounts for approximately 23% of the total population. The ratio of the people from 15 to 59 years old who constitute labor force is large being 62%.

Two thirds of the households in the marsh area are those who immigrated from neighboring areas during the period of 1960 to 1989. It is reported that the ratio of the households moved in from places other than Gampaha District to which Muthurajawela belong accounts for only 8% of the total number of households.

3.3.3 Income Generating Sources,

Working population consists of approximately 26,000 persons, and about 38% and 41% of them work for government offices and private companies respectively. Approximately 4,800 households in the area around the proposed power plant site are under financial support of the Government by means of food stamps, etc. which means that approximately 37% of the total households belong to the category of the poor who need public help. In particular, the major income generating source at the proposed area for cooling water intake and discharge pipeline and fuel pipeline is fishery. More than 60 % of households in this area indicated that they are supported by poverty alleviation program. Small number of households along the proposed access road receive the poverty alleviation assistance while there are no income from farm or livestock.

3.3.4 Existing Infrastructure Facilities

There are 6 post offices and 2 banks in the area around the proposed power plant site.

Based on the "Master Plan of Muthhurajawela and Negombo Lagoon (1991)" [1], conditions of preparing the main infrastructure in Gampaha District are shown in Fig. 3.12.

3.3.5 Transportation

As access to the proposed power plant site, vehicles related to this project may use two local roads: one is along the canal on the west side of the proposed power plant site and a local road from Route A3 on the east side to connect Colombo and Negombo. The width of both local roads is about 6 to 8 m, causing hindrance to the movement of large-scale transprtation vehicles. Colombo-Negombo Road is a relatively wide road where buses to Bopitiya Via Wattala town are runs, with private houses and shops standing on both sides. The result of traffic density survey conducted in 1997 at Welisara on this road is indicated in Table 3.8. According to the results, the traffic density per day for going up and down the road was approximately 40,000 vehicles in total.

According to "Master Plan of Muthurajawela and Negombo Lagoon (1991)" [1], a highway to connect Colombo City and Katunayake Airport and a road along Old Dutch Canal to connect Wattala and Seeduwa area as a bypass will be constructed. However, there is no knowing as of present how to raise money for constructing them.

Katunayake International Airport is approximately 20 km north of the proposed power plant site, and Colombo Port is approximately 10 km to its south.

3.3.6 Communication

Out of approximately 13,000 households in the area around the proposed power plant site, those with a telephone installed accounts for approximately 2 to 3% of the total number.

3.3.7 Power

Out of approximately 13,000 households in the area around the proposed power plant site, approximately 60 to 70% of them have installed electricity. However, the proposed area for cooling water intake and discharge pipeline and fuel pipeline in particular is occupied by households who do not have connection of electricity. While large number of households along the proposed access road has electricity.

Based on "Master Plan of Muthurajawela and Negombo Lagoon (1991)" [1], the conditions of installing transmission line of 11kv to 220 kV are as indicated in Fig. 3.12.

3.3.8 Housing and Sanitation

Among the houses in the area around the proposed power plant site, most of them, accounting for 74% of the total number, are of the permanent type, and approximately 11% of them are of semi-permanent type. Many of the houses there are made of wood. In the proposed area for cooling water intake and discharge pipeline and fuel pipeline in particular, more than 40 % of houses are semi-permanent type, and none of the houses have a drainage system. The large portion of houses along the proposed access road are permanent, but almost none have a drainage system as well as the houses in the pipeline area.

As fuel for cooking, they mainly use biomass fuel either purchased or gathered. Some of the households use propane gas.

Garbage from general households is dumped out in the open at several points and wastes processing facilities have not been disseminated. As sewage disposal facilities have not been established, sewage flows directly into canals and damp area.

3.3.9 Health Care (Hospitals)

There are 4 hospitals in the area around the proposed power plant site.

3.3.10 Schools

There are 10 public schools and a private school in the area near the proposed power plant site. Educational facilities have been disseminated at places where students go on foot. Education is given in Sunday schools open in some churches. The nearest school is approximately 1 km from the proposed power plant site.

3.3.11 Water Supply

Approximately 60% of about 13,000 households use wells as their main sources of water for main living purposes, and about 40% of them use water supply for drinking and living. Although water supply facilities are laid to individual houses in some cases, in most cases water supply facilities are laid to open places to be used jointly by several households. The proposed area for cooling water intake and discharge pipeline and fuel pipeline in particular is occupied by residence who are depended on pipe born water on street tap. On the contrary, households along the proposed access road use dug well or ordinarily well for source of drinking water. In some cases canal is used as a source of water for livelihood such as washing and bathing.

According to "Master Plan of Muthurajawela and Negombo Lagoon (1991)" [1], new water supply facilities will be laid along the road connecting Colombo and Negombo. The points in Gampaha District where water supply facilities are laid are as indicated in Fig. 3.12.

3.3.12 Main Economic Activities

The main industries in the area around the proposed power plant site are fishery, agriculture mainly composed of coconut farms, hog and poultry raising, and small-scale industrial works.

Three fishery cooperate societies exist in Wattala Division. Among them Wattala and Uswetakeiyawa Fishery Cooperate Societies are those existing in the area surrounding the proposed power plant site. According to the Fishery Inspector in Wattala Fishery Cooperate Society, fishermen in the area are to be registered in the cooperate society. However, the fishermen actually registered in the cooperate society is smaller in number than those who are not registered. Although it seems difficult to grasp the accurate number of fishermen, the number of them in these two areas is around 1,200 in total including 500 registered fishermen. Methods of fishery are gill-net, stick, trawling by a power boat, etc. The main fishing place is 5 to 15 km off shore from the coast. Approximately 10% of fishermen are said to earn Rs 5,000 to 10,000 (¥10,000 to 20,000) a month, and monthly income of the rest (90%) of them is said to be Rs 5,000 (¥10,000) or less. Many of their fishing boats are anchored in Hamilton Canal and go out into the sea through the mouth of Kelani River.

Farming is not actively done in Muthurajawela marsh area because of the influence of salt, acid soil and shortage in nutrition. The main agricultural work is to grow coconuts in the farms surrounding the marsh area and those made by filling up of the marsh area. In some part bananas and vegetables are grown but not actively.
Some households raise poultry and hog though in a small scale.

3.3.13 Archaeological, Cultural Components

No important cultural properties exist in Wattala Division.

3.3.14 Religious Places

In the area around the proposed power plant site, 17 religious facilities exist including temples, mosques, and churches; their breakdowns are: Buddhist - 8, Islam - 1, and Catholic - 8. A temple and a church are situated near the proposed transmission line route, but these are avoidable from the route.

3.4 Environmental Consideration/Problems/Issues in the Area

3.4.1 Physical (Water, Air)

The proposed site is situated in the southern part of Muthurajawera marsh area. In the western part of the marsh area, Hamilton Canal runs connecting Kelani River and Negombo Lagoon, and an old Dutch canal runs through the eastern part of the marsh area. Although there are no large sources of pollution in the surrounding districts, water in the canal is polluted more or less, which is considered as attributable to sewage of general households. On the other hand, the pollution level is relatively low in the coastal area approximately 1.5 km to the west of the proposed plant site. It is also reported that out of the area approximately 30 km to the north from the mouth of the Kelani River including the coast of approximately 1.5 km from the proposed site, approximately 70% of the coast is under the influence of erosion. Consequently, organizations concerned are now taking countermeasures using artificial structures.

From the viewpoints that the area surrounding the proposed site mainly consists of marsh areas and residential districts and that no large pollution sources exist there to cause air pollution, it can be concluded that air pollution level is low in the area.

3.4.2 Ecological

Since the proposed site situated in the southern part of Muthurajawera marsh area is near Colombo city, land development has been progressed since the days of Dutch reign. A power plant is to be constructed on the site developed as land for industrial and residential area based on the master plan prepared for effective land use while preserving abundant natural environment. Various plants and wildlife inhabit the marsh area located to the north of the power plant. Along the shore of the Indian Ocean situated to its west, precious natural environment remains for sea turtles to visit there for laying their legs. Therefore, it is important to proceed with the development of the area paying attention, at the same time, to the protection of animals and plants growing there.

3.4.3 Social & Cultural

With regard to social environment of the area surrounding the proposed site, population density is relatively high there, and a large proportion of residents are Catholics. The rate of population increase in the area exceeds that of the entire country, and this is attributable to the growth in number of immigrants from other places. Residents here are engaged in fishery, and agricultural and commercial activities for their living. Many of them are supported by the country. Sewage and waste water treatment facilities have not been diffused much and places scatter around where household garbage is piled up out in the open.

3.4.4 Economical

Kerawalapitiya district near the proposed site situated near Colombo City (only approximately 10 km from the city) has been developed as commercial, industrial, and residential districts. A lot of stores are lined up along Colombo-Negombo Road (A3 Road) and population density there is relatively high. The site as proposed this time to construct a power plant has many advantages as a site for power plant construction including the facts that there is a reclaimed land for industrial and residential districts and that it is near Colombo Port.

Table 3.1 Rainfall Data at Katunayaka

Station Name : Katunayaka

Lat.: 7.17N, Lon.: 79.88E, Elev.: 8.5M

Flag : T for trace rainfall etc.

(mm)

	1991	1992	1993	1994	1995	1996	1997
Jan.	83.2	5.0	8.2	59.9	51.6	105.0	2.0
Feb.	10.9	0.3	12.1	66.9	12.0	64.6	99.0
Mar.	213.8	T	87.6	57.3	52.7	2.7	30.7
Apr.	97.1	98.9	200.3	86.4	226.6	232.9	126.2
May	92.1	495.0	379.8	264.5	464.2	94.2	254.2
Jun.	279.5	140.9	76.2	90.1	207.9	61.2	117.2
Jul.	98.1	95.6	56.7	97.0	79.9	111.8	184.1
Aug.	28.8	59.4	26.5	29.5	49.8	287.5	25.5
Sep.	20.2	308.8	145.6	202.9	67.7	209.8	307.9
Oct.	190.5	309.5	759.1	411.6	115.7	240.5	311.7
Nov.	143.2	259.1	283.2	311.9	422.7	124.2	426.5
Dec.	79.4	58.6	182.8	9.6	34.7	164.6	121.9
Total	1336.8	1831.1	2218.1	1687.6	1785.5	1699.0	2006.9

Source : Record from the Department of Meteorology, Sri Lanka

Table 3.2 Relative Humidity Data at Colombo

	Hour Recorded (Local Standard Time)	
	08:30 (percent)	17:30 (percent)
Jan.	81	70
Feb.	82	72
Mar.	83	72
Apr.	84	74
May	83	78
Jun.	82	78
Jul.	82	78
Aug.	81	77
Sep.	81	77
Oct.	83	78
Nov.	83	77
Dec.	81	74
Annual	82	75
Total	25	25

Source : "Combined Cycle Power Plant Project at Kelanitissa, Environmental Impact Assessment Report" [8]

Table 3.3 Atmospheric Temperature Data at Katunayaka

	1996			1997		
	Max.	Min.	Av.	Max.	Min.	Av.
Jan.	34.0	20.0	26.2	34.6	19.4	26.4
Feb.	35.2	20.0	26.7	35.6	17.6	26.4
Mar.	34.9	20.2	28.1	35.8	20.0	27.8
Apr.	33.8	20.2	28.0	34.8	21.2	28.1
May	33.0	20.0	29.0	32.6	20.0	28.3
Jun.	31.7	22.0	27.8	32.0	20.4	28.2
Jul.	31.2	20.0	27.4	31.2	20.0	27.9
Aug.	30.6	20.0	27.5	32.0	22.0	28.3
Sep.	30.6	20.2	27.5	33.4	23.0	27.3
Oct.	31.6	20.0	27.1	32.0	21.0	26.8
Nov.	33.2	20.4	26.7	33.0	20.0	26.8
Dec.	32.2	18.8	26.0	33.0	20.0	26.9
Total	35.2	18.8	27.3	35.8	23.0	27.4

Source : Record from the Department of Meteorology, Sri Lanka

Table 3.4 (1) Frequency of Wind Direction and Speed (Yearly, 1996)

1996	(m/s)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	calm	
Night	1.54-	0.37%	2.76%	2.29%	1.32%	2.09%	2.73%	2.46%	2.31%	1.29%	0.82%	1.64%	1.86%	1.12%	0.20%	0.02%	0.10%		23.37%
	3.09-	0.25%	2.76%	1.84%	0.55%	0.22%	0.35%	0.10%	0.30%	0.30%	0.79%	2.51%	3.48%	1.17%	0.17%	0.00%	0.05%		14.83%
	5.14-	0.40%	4.84%	2.78%	0.37%	0.10%	0.00%	0.05%	0.10%	0.15%	1.09%	4.55%	11.43%	5.24%	0.17%	0.10%	0.02%		31.40%
	8.23-	0.00%	0.55%	0.15%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.15%	0.99%	0.62%	0.02%	0.05%	0.00%		2.56%
	10.8-	0.02%	0.07%	0.02%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.07%	0.07%	0.00%	0.00%		0.30%
	calm																	27.47%	
	sum	1.04%	10.98%	7.08%	2.24%	2.43%	3.08%	2.61%	2.71%	1.74%	2.73%	8.84%	17.76%	8.22%	0.65%	0.17%	0.17%	27.47%	0.9993
Day Time	1.54-	0.86%	1.47%	0.55%	0.90%	0.84%	0.97%	1.03%	1.11%	1.14%	1.72%	2.10%	2.40%	1.81%	0.63%	0.40%	0.59%		18.52%
	3.09-	0.69%	0.71%	0.48%	0.19%	0.19%	0.11%	0.11%	0.04%	0.38%	1.32%	3.55%	3.89%	2.10%	0.44%	0.32%	0.55%		15.07%
	5.14-	1.18%	4.75%	2.06%	0.36%	0.11%	0.13%	0.13%	0.04%	0.08%	1.91%	8.66%	16.94%	9.96%	1.41%	0.99%	1.39%		50.09%
	8.23-	0.19%	1.18%	0.57%	0.08%	0.08%	0.00%	0.00%	0.00%	0.04%	0.04%	0.29%	0.95%	0.76%	0.17%	0.17%	0.55%		5.07%
	10.8-	0.00%	0.04%	0.04%	0.02%	0.02%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.06%	0.08%	0.00%	0.02%	0.02%		0.34%
	calm																	10.91%	
	sum	2.92%	8.16%	3.70%	1.56%	1.24%	1.20%	1.26%	1.20%	1.66%	5.00%	14.61%	24.24%	14.72%	2.65%	1.89%	3.09%	10.91%	1
All Day	1.54-	0.64%	2.06%	1.34%	1.09%	1.41%	1.78%	1.69%	1.66%	1.21%	1.31%	1.89%	2.15%	1.49%	0.43%	0.23%	0.36%		20.74%
	3.09-	0.49%	1.65%	1.10%	0.35%	0.20%	0.22%	0.10%	0.16%	0.34%	1.08%	3.07%	3.70%	1.67%	0.32%	0.17%	0.32%		14.96%
	5.14-	0.82%	4.79%	2.39%	0.36%	0.10%	0.07%	0.09%	0.07%	0.11%	1.54%	6.77%	14.41%	7.80%	0.84%	0.58%	0.76%		41.52%
	8.23-	0.10%	0.89%	0.38%	0.05%	0.05%	0.00%	0.00%	0.00%	0.02%	0.03%	0.23%	0.97%	0.69%	0.10%	0.11%	0.30%		3.92%
	10.8-	0.01%	0.06%	0.03%	0.01%	0.02%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.03%	0.08%	0.03%	0.01%	0.01%		0.32%
	calm																	18.50%	
	sum	2.06%	9.45%	5.25%	1.87%	1.79%	2.06%	1.88%	1.89%	1.70%	3.96%	11.97%	21.27%	11.74%	1.73%	1.10%	1.75%	18.50%	0.9997

Table 3.4 (2) Frequency of Wind Direction and Speed (Yearly, 1997)

1997	(m/s)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	calm	
Night	1.54–	0.32%	3.59%	3.39%	2.81%	3.89%	5.08%	1.94%	3.19%	1.92%	1.27%	1.25%	1.62%	1.15%	0.27%	0.05%	0.17%		31.91%
	3.09–	0.02%	1.54%	1.22%	0.42%	0.35%	0.20%	0.10%	0.22%	0.27%	0.72%	1.12%	2.49%	1.10%	0.07%	0.02%	0.05%		9.94%
	5.14–	0.02%	1.57%	0.92%	0.32%	0.07%	0.02%	0.00%	0.07%	0.20%	0.82%	2.91%	6.90%	3.06%	0.22%	0.02%	0.00%		17.16%
	8.23–	0.00%	0.00%	0.02%	0.02%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.02%	0.42%	0.50%	0.07%	0.00%	0.00%		1.10%
	10.8–	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%	0.00%	0.00%	0.00%		0.15%
	calm																	39.70%	
	sum	0.37%	6.72%	5.55%	3.59%	4.31%	5.31%	2.07%	3.51%	2.39%	2.84%	5.33%	11.46%	5.83%	0.65%	0.10%	0.22%	39.70%	0.9995
Day Time	1.54–	0.44%	1.58%	0.74%	0.74%	2.19%	2.34%	0.91%	1.22%	1.79%	2.09%	1.85%	1.79%	1.88%	0.70%	0.32%	0.27%		20.85%
	3.09–	0.53%	1.10%	0.67%	0.32%	0.34%	0.27%	0.06%	0.23%	0.42%	1.75%	2.47%	4.11%	3.46%	0.59%	0.19%	0.27%		16.78%
	5.14–	0.76%	2.53%	0.78%	0.40%	0.48%	0.11%	0.13%	0.06%	0.19%	1.75%	6.56%	13.03%	11.45%	2.34%	1.33%	1.24%		43.13%
	8.23–	0.08%	0.15%	0.04%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.02%	0.13%	0.80%	0.72%	0.17%	0.21%	0.25%		2.59%
	10.8–	0.00%	0.02%	0.02%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.02%	0.00%	0.00%	0.02%	0.02%	0.02%	0.00%		0.15%
	calm																	16.48%	
	sum	1.81%	5.38%	2.26%	1.45%	3.04%	2.72%	1.12%	1.52%	2.40%	5.63%	11.00%	19.73%	17.52%	3.82%	2.07%	2.04%	16.48%	0.9998
All Day	1.54–	0.39%	2.50%	1.95%	1.69%	2.97%	3.60%	1.38%	2.12%	1.85%	1.71%	1.58%	1.71%	1.54%	0.50%	0.19%	0.23%		25.92%
	3.09–	0.30%	1.30%	0.92%	0.37%	0.34%	0.24%	0.08%	0.23%	0.35%	1.28%	1.85%	3.37%	2.37%	0.35%	0.11%	0.17%		13.64%
	5.14–	0.42%	2.09%	0.84%	0.37%	0.30%	0.07%	0.07%	0.07%	0.19%	1.32%	4.89%	10.22%	7.60%	1.37%	0.73%	0.67%		31.23%
	8.23–	0.05%	0.08%	0.03%	0.01%	0.01%	0.00%	0.00%	0.01%	0.00%	0.01%	0.08%	0.63%	0.62%	0.13%	0.11%	0.14%		1.91%
	10.8–	0.00%	0.02%	0.01%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.02%	0.01%	0.01%	0.02%	0.01%	0.01%	0.00%		0.15%
	calm																	27.13%	
	sum	1.15%	5.99%	3.77%	2.43%	3.62%	3.90%	1.55%	2.43%	2.40%	4.35%	8.40%	15.94%	12.16%	2.36%	1.16%	1.21%	27.13%	0.9997

Table 3.5 Frequency of Ambient Stability at Katunayaka

Ambient Stability Class	1996							1997						
	A	B	C	D	E	F	Total	A	B	C	D	E	F	Total
Jan.	*	*	*	*	*	*	*	0.00	0.22	1.21	6.43	0.38	0.26	8.49
Feb.	*	*	*	*	*	*	*	0.00	0.07	1.13	5.27	0.75	0.45	7.67
Mar.	*	*	*	*	*	*	*	0.00	0.06	1.42	4.91	1.27	0.84	8.49
Apr.	0.02	0.07	0.97	4.92	1.14	1.08	8.20	0.00	0.09	1.39	4.13	1.86	0.74	8.22
May.	0.00	0.02	1.17	6.08	0.46	0.74	8.47	0.05	0.07	0.96	5.06	1.42	0.95	8.49
Jun.	0.00	0.03	0.77	6.23	0.48	0.68	8.20	0.00	0.06	1.34	4.67	1.08	1.07	8.22
Jul.	0.00	0.05	0.71	6.90	0.32	0.50	8.47	0.00	0.07	1.05	6.12	0.47	0.79	8.49
Aug.	0.01	0.00	0.92	7.00	0.25	0.28	8.47	0.01	0.01	1.13	6.32	0.39	0.63	8.49
Sep.	0.00	0.00	0.87	6.52	0.30	0.51	8.20	0.00	0.07	1.00	4.90	0.88	1.37	8.22
Oct.	0.00	0.15	1.04	5.33	0.77	1.18	8.47	0.01	0.24	1.13	3.81	1.61	1.69	8.49
Nov.	0.01	0.05	1.20	4.92	1.06	0.97	8.20	0.01	0.19	1.08	3.92	0.48	2.53	8.22
Dec.	0.00	0.20	1.10	5.61	0.74	0.81	8.47	0.02	0.25	1.02	4.53	1.47	1.20	8.49
Total	0.05	0.57	8.74	53.51	5.51	6.76	75.14	0.10	1.39	13.86	60.07	12.05	12.52	100.00

Source : Record from the Department of Meteorology, Sri Lanka

Table 3.6 Minimum and Maximum Values Recorded for Selected Water Quality Indicators

Indicators \ Sampling Site	15	17	18	19	20	21	22
pH at 25℃	7.0 8.3	7.1 8.1	8.8 8.1	8.5 8.1	8.5 5.8	7.2 5.8	8.2 5.6
Turbidity (NTU)	8.0 2.0	20.0 3.0	33.0 3.0	41.0 10.0	30.0 6.0	7.0 3.0	97.0 9.0
Conductivity (ms/cm)	4.0	1.58	1.38	0.39	0.2	0.2	0.5
Salinity (g/1)	14.2	<5.85	<5.85	<5.85	<5.85	<5.85	<5.85
Total Coliforms per ml	23000	25000	6000	24000	15000	20000	15000
Fecal Coliforms per 100ml	3000 450 70	4700 5000 200	4000 850	30 1500 20	500 170	3840 500 50	300 3000 40
BOD 3 days at 30℃	30 8	40 10	50 10	80 20	32 10	40 12	50 35
Total Phosphate (mg/l)	1.02 0.04	2.15 0.11	1.78 0.02	1.29 0.09	3.44 0.11	1.23 0.05	0.96 0.02
Zinc (mg/l)	 0.01	0.15 0.02	 0.01	 0.11	 0.1	 0.01	 0.02
Chromium (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper (mg/l)	0.01	0.02	0.01	<0.01	<0.01	0.01	0.01
Ammonia (mg/L)	<1.0	<1.0	<1.0	<0.1	<1.0	<1.0	<1.0
Nitrate (mg/l)	0.11	0.12	0.03	0.12	0.10	0.10	0.01
Nitrite (mg/l)	0.001	0.002	0.003	0.002	0.001	0.001	0.002
Cadmium (mg/l)	0.02	0.01	0.01	0.01	<0.01	<0.01	<0.01
Mercury (mg/l)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" [2]

Table 3.7 Water Quality at the Hamilton Canal and the Sea

Location		C1		C2		S_A		S_B	S_C	
		Surf.	Mid.	Surf.	Mid.	Surf.	Mid	Surf.	Surf.	Mid.
Distance from the beach		-		-		1 km		250 m	1 km	
Depth (m)		0.75		0.75		10		8	10	
Atmospheric Temperature (℃)	Jan.	29.2		29.7		27.7		30.2	30.1	
	Feb.	29.7		29.7		28.7		30.2	30.1	
	Jun.	32		30		-		31	-	
Water Temperature (℃)	Jan.	30.1	30.1	30.2	29.2	29.5	29.4	30.2	30.2	29.2
	Feb.	30.3	30.3	30.1	30.1	29.8	29.2	29.9	29.8	29.2
	Jun.	30.8	31.1	27.0	27.8	-	-	30.0	-	-
Salinity* (‰)	Apr.	3.1	3.2	0.6	0.6	34.7	34.8	34.6	34.5	34.7
	Jun.	0.5	0.5	<0.1	<0.1	31.5	34.1	31.3	31.4	34.1
pH	Jan.	6.8	6.9	6.9	7.3	7.8	8.0	8.0	8.0	8.0
	Feb.	7.0	7.1	7.0	7.2	8.0	7.9	8.0	8.0	8.0
	Jun.	6.7	6.6	7.7	7.3	8.2	8.2	8.4	8.3	8.3
DO (mg/l)	Jan.	4.0	4.0	3.4	3.5	7.2	6.1	6.9	6.8	7.1
	Feb.	2.8	3.2	3.1	3.6	7.3	6.5	6.9	7.3	6.3
	Jun.	2.0	2.0	4.8	4.7	5.2	5.1	5.1	5.1	4.4
Transparency (m)	Jan.	-	-	-	-	7.5	-	4.4	9.0	-
	Feb.	-	-	-	-	7.3	-	4.5	8.5	-
	Jun.	-	-	-	-	-	-	-	-	-
COD (mg/l)	Jan.	23	18	32	23	-	-	-	-	-
	Feb.	25	22	44	40	-	-	-	-	-
	Jun.	6	9.4	7.2	8.3	-	-	-	-	-
BOD_3 (mg/l)	Jan.	20	<15	20	20	-	-	-	-	-
	Feb.	<15	<15	<15	<15	-	-	-	-	-
	Jun.	<1	<1	<1	1	-	-	-	-	-
Oil and Grease (mg/l)	Jan.	<2	<2	<2	<2	6	<2	<2	<2	<2
	Feb.	<2	<2	3	<2	<2	<2	<2	<2	<2
	Jun.	1.3	<0.5	0.8	<0.5	-	-	<0.5	-	-
TSS (mg/l)	Jan.	11	14	<5	12	<25	<2.5	<5	<2.5	<2.5
	Feb.	<10	<10	21	20	<10	<10	<10	<10	<10
	Jun.	15	39	2	3	9	8	4	5	10

C1, C2 : Measurement points in the Hamilton Canal.

S_A, S_B, S_C : Measurement points in the sea.

* : Salinity measurement was re-implemented on April 1998 due to damage of equipment.

Table 3.8 Current Traffic Volume at Welisara on the Colombo-Negombo Road

	Car	Goods Vehicle			Bus	Mid. Bus	Motor Cycle	Total or Large Vehicle	Total of Other	Grand Total
		Light	Medium	Heavy						
to Colombo	5,223	5,885	2,957	408	1,131	1,875	3,523	21,002	1,539	19,463
to Puttalam	5,327	5,300	3,060	382	1,066	2,414	2,892	20,441	1,448	18,993
Total	10,550	11,185	6,017	790	2,197	4,289	6,415	41,443	2,987	38,456

Data is based on RDA records.

Table 3.9 (1) Ambient Air Quality

Location		Indivitiya, Mahara (Location B)		Ragama, North (Location C)		Polwatta, Mahara (Location D)		Hunupitiya, South (Location E)	
Measurement Date		Mar.1.1998 - Mar.5.1998	Jun.25.1998 - Jun.27.1998^	Feb.22.1998 - Feb.28.1998	Jun.15.1998 - Jun.20.1998	Feb.18.1998 - Feb.21.1998	Jun.11.1998 - Jun.13.1998	Mar.6.1998 - Mar.9.1998	Jun.22.1998 - Jun.24.1998
Averaging Time : 1hour									
SO_2 (mg/m^3)	Max.	0.031	0.039	0.036	0.036	0.036	0.008	0.051	0.046 (0.123*)
	Min.	0.003	<0.002	<0.002	0.003	<0.002	<0.002	<0.002	<0.002
NO_X (mg/m^3)	Max.	0.048	0.055	0.040	0.059	0.039	0.014	0.051	0.041
	Min.	0.002	<0.001	<0.001	0.003	0.003	<0.001	0.004	<0.001
NO (mg/m^3)	Max.	0.023	0.031	0.022	0.031	0.014	0.010	0.014	0.011
	Min.	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001
NO_2 (mg/m^3)	Max.	0.043	0.024	0.030	0.031	0.031	0.006	0.037	0.022
	Min.	0.002	0.002	<0.001	0.002	0.004	<0.001	0.004	<0.001
CO (mg/m^3)	Max.	2.11	0.592	1.42	0.881	1.70	0.154	1.65	0.947
	Min.	0.124	<0.001	<0.001	0.002	0.228	<0.001	0.167	<0.001
O_3 (mg/m^3)	Max.	0.064	0.124	0.220	0.154	0.104	0.091	0.567	0.151
	Min.	0.017	<0.001	0.002	<0.001	0.002	<0.001	0.010	<0.001
Averaging Time : 8 hours									
SO_2 (mg/m^3)	Max.	0.013	0.007	0.015	0.034	0.013	0.004	0.025	0.022*
	Min.	0.005	0.004	0.003	0.003	0.003	0.002	0.005	0.002
NO_X (mg/m^3)	Max.	0.031	0.021	0.022	0.048	0.023	0.008	0.023	0.028
	Min.	0.005	0.003	0.009	0.010	0.013	0.003	0.008	0.009
NO (mg/m^3)	Max.	0.031	0.008	0.006	0.023	0.005	0.005	0.004	0.010
	Min.	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.001
NO_2 (mg/m^3)	Max.	0.013	0.015	0.018	0.025	0.020	0.006	0.020	0.018
	Min.	0.001	0.002	0.006	0.004	0.009	0.002	0.007	0.001
SPM (mg/m^3)	W.D** Max.		0.078 (8.1)		0.096 (8.6)		0.093 (8.1)		0.103 (8.0)
	Min.		0.072 (8.1)		0.052 (7.5)		0.081 (8.0)		0.066 (8.0)
	W.E** Max		0.084 (8.0)		0.110 (8.1)		0.098 (8.0)		0.109 (8.0)
	Min.		0.068 (8.0)		0.062 (7.5)		0.094 (8.0)		0.073 (8.3)

* : 0.123 mg/m^3 for SO_2 was found one as a 1 hour average. Second Maximum data is 0.046 mg/m^3. 8 hour average and 24 hour average value are calculated considering these situations

** : W.D refers to Week day and W.E refers to Week end.

Table 3.9 (2) Ambient Air Quality

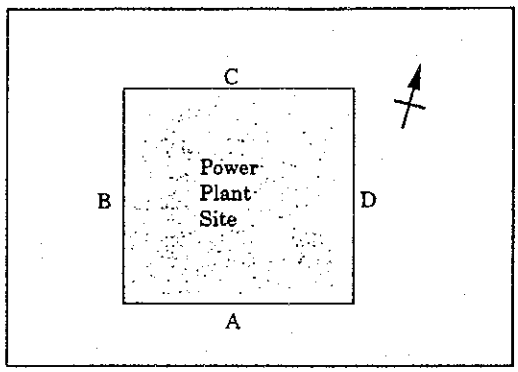
Location		Indivitiya, Mahara (Location B)		Ragama, North (Location C)		Polwatta, Mahara (Location D)		Hunupitiya, South (Location E)	
Measurement Date		Mar.1.1998 - Mar.5.1998	Jun.25.1998 - Jun.27.1998	Feb.22.1998 - Feb.28.1998	Jun.15.1998 - Jun.20.1998	Feb.18.1998 - Feb.21.1998	Jun.11.1998 - Jun.13.1998	Mar.6.1998 - Mar.9.1998	Jun.22.1998 - Jun.24.1998
Averaging Time : 24 hours									
SO_2 (mg/m^3)	Max.	0.008	0.007	0.011	0.018	0.009	0.004	0.015	0.017
	Min.	0.006	0.003	0.004	0.007	0.006	0.003	0.007	0.012
NO_X (mg/m^3)	Max.	0.017	0.013	0.018	0.030	0.017	0.006	0.019	0.020
	Min.	0.015	0.004	0.013	0.013	0.015	0.006	0.012	0.011
NO (mg/m^3)	Max.	0.005	0.005	0.004	0.012	0.004	0.004	0.003	0.007
	Min.	0.003	0.002	0.003	0.003	0.003	0.003	0.001	0.002
NO_2 (mg/m^3)	Max.	0.014	0.008	0.014	0.017	0.013	0.004	0.016	0.013
	Min.	0.011	0.002	0.009	0.009	0.012	0.003	0.011	0.009
SPM (mg/m^3)	W.D**	0.120 (22)	0.227 (24)	0.080 (16) - 0.088 (23)	0.238 (24.1)	0.098 (19)	0.266 (24.1)	0.136 (24)	0.252 (24.3)
	W.E**	0.115(28) - 0.121 (22)	0.232 (24.3)	0.074(24) - 0.088 (23)	0.254 (23.3)	0.095 (20) - 0.102 (22)	0.287 (24.3)	0.112 (25)	0.279 (24.3)

** : W.D refers to Week day and W.E refers to Week end.

Table 3.10 Ambient Noise Level at Boundary of the Site

Location		A	B	C	D
Sampling Time : From 9:00 a.m on Jan.7.1998 to 10:00 a.m on Jan.8.1998 (A Week Day)					
Noise Leq. dB(A)	Max.	44.2	51.7	46.1	67.1*
	Min.	33.6	34.6	34.6	34.1
Sampling Time : From 9:00 a.m on Jun.6.1998 to 10:00 a.m on Jun.7.1998 (A Week End)					
Noise Leq. dB(A)	Max.	70.6*	57.2	67.1*	56.9*
	Min.	38.7	35.7	37.0	36.6

* : Higher noise due to airplane.



Location of Survey Points

Table 3.11 Sea Water Temperature and Salinity

	Temperature (℃)			Salinity (‰)	
	Max.	Min.	Av.	Max.	Min.
Measurement Period : Jan.21.1998 (One day measurement)					
Atmospheric Temp.	30.2	27.7	29.3	-	-
Surface Water Temp.	30.2	29.5	30.0	-	-
Mid. Layer Water Temp.	29.4		29.4	-	-
Measurement Period : Feb.17.1998 (One day measurement)					
Atmospheric Temp.	30.2	-	28.7	-	-
Surface Water Temp.	29.9	-	29.8	-	-
Mid. Layer Water Temp.	29.2	-	29.2	-	-
Measurement Period : From Feb.19. to Mar. 17.1998 (Continuous measurement)					
Atmospheric Temp.	-	-	-	-	-
Surface Water Temp. (1 - 2 m from surface)	32.1	29.9	31.9	32.5	31.5
Mid. and Bottom Layer Water Temp.	-	-	-	-	-
Measurement Period : From Apr.20. to May. 7.1998 (Continuous measurement)					
Atmospheric Temp.	-	-	-	-	-
Surface Water Temp.	32.7	-	-	-	-
Mid. Layer Water Temp. (5 m from the bottom)	32.4	31.5	31.8	33.5	32.1
Bottom Layer Water Temp. (Bottom)	32.0	31.5	31.7	-	-
Measurement Period : From Jun. 18 to Jun.26 1998 (Continuous measurement)					
Atmospheric Temp.	-	-	-	-	-
Surface Water Temp.	31.9	28.7	30.0	33.0	23.1
Mid. Layer Water Temp.	30.9	28.9	29.2	32.6	29.4
Bottom Layer Water Temperature (Bottom)	31.4	28.9	29.3	33.5	31.3

Table 3.12 Current Characteristics of the Sea in front of the Site

		Total Current			Residual Component		
		Max.	Min.	Av.	Max.	Min.	Av.
28 Feb - 17 Mar. 1998	Speed (cm/sec)	25.6	0	6.3	20.2	0.3	5.1
	Direction (°)	191			200		