3. DESCRIPTION OF THE PROPOSED PROJECT

3.1 Aim and Scope of the Project

3.1.1 Reasons for Project

The project is within the Western Province, which comprises of 03 districts, namely Colombo, Gampaha and Kalutara. This is the most densely populated province and due to the presence of the capital of Sri Lanka, the province is more advanced with respect to all other provinces with respect to socio-economics, infrastructure, education, health facilities and development The road network is the highest with respect to road km per sq. m of land area, with respect to other provinces.

As Colombo is the capital of Sri Lanka, most major roads, A Class, originated from Colombo and as Colombo is situated on the West Coast, the above major roads radiate from West to North, East and South.

Colombo Port is a key factor in the import and export of commodities to and from Sri Lanka. These commodities have to be transported to their destinations without any delay in transport Most tourists travel to a hotel in Colombo before embarking on tours away from Colombo. Road infrastructure is a key factor for tourists on tight time schedules. Business and leaders or VIP's from foreign countries visiting Sri Lanka need to get the maximum during their stay in Sri Lanka and as such the road network is important to quick, efficient and time saving transport system, as there are no luxury railway service for these delegates.

Due to the above reasons, the major roads radiating from Colombo has become a national asset and the road network structure has to be given prime importance and priority.

3.1.2 Existing Road Network

All major A Class or B Class roads that originate from Colombo are:
A3, A1, A110, A4, B84 and A2 [see section 2.3]. Small sections of A Class roads near Colombo have more than 02 lanes per carriageway.

The optimum capacity for 3.65m-lane width, with satisfactory level of service is 2,000 passenger car units per hour per lane, for the A Class roads. However, the existing capacities are approximately 1,200 PCU per hour per lane, which is inadequate for the existing traffic capacities near Colombo.

This in turn causes traffic congestion, more fuel consumption, more pollution and increased travel time.

Due to an absence of any highway to by-pass Colombo City, with exception of the Baseline Road Improvement and Extension Project [under construction], the through traffic causes unnecessary traffic congestion within the city.

Many bus commuters have to come to Colombo on one of the A Class roads to obtain a connecting service to another A Class road.

3.1.3 Aim and Scope

As per the requirements discussed above in sections 3.1.1 and 3.1.2 above, the aim of the project is to provide a major orbital road to connect the A and B Class roads that originates from Colombo to achieve the following:

- By-pass Colombo for through traffic
- To ease traffic congestion in and around Colombo City.
- For quick and efficient movement of container transport to and from Port of Colombo
- To reduce travel time for Colombo City traffic
- For quick efficient transport facilities for tourists and other foreign delegates/businessmen
- For bus commuters to by-pass Colombo and reach their destination at less cost and save travel time
- To serve commuters who do not live along the major radial roads

3.2 Justification of the Project

3.2.1 Existing Roads

The existing road system, at a radius of 05 to 10 km from the city center, is congested to full capacity during peak hours, causing traffic jams which results in high vehicle operating costs, increased travel time, accidents, pollution etc. The trunk roads radiating from the city viz. Colombo to Galle, Colombo to Puttalam, Colombo through Avissawella to Ratnapura, which form the major traffic corridors, is already approaching capacity. In addition, the ribbon development along the road verges and poor road geometrics tend to reduce their capacity and level of service while precluding capacity enhancement.

Inasmuch as the Colombo-Katunayake Expressway and the Inner Circular Road (Baseline Road Development) is expected to ease a major part of the traffic congestion within the city, these two roads by themselves will neither alleviate congestion within the city nor will they provide the connectivity required between the corridors. The proposed Outer Circular Highway would provide inter connectivity from the major corridors. Moreover, the consideration for railway transport was mainly low-cost improvements and minimization of costs.

Hence, the only alternative for highway traffic is to provide an orbital or outer ring road.

3.2.2 Traffic Impact

Benefits from the construction of the OCH in terms of transportation for the year 2010 are as follows:

- travel distance [PCU km] will reduce by 0.5%
- travel time [PCU hour] will reduce by 9.2%
- traffic congestion would decrease by about 12%
- average vehicle speed would increase by about 9.4%

Through traffic [which does not necessarily have to pass through Colombo City], will be diverted on to the OCH and this in turn would enhance the above figures.

3.2.3 Economic Development

The other main justification of the project is that it will promote new regional development centers away from the present uncontrolled urban sprawl in Colombo City. The development and expansion of the Colombo Metropolitan Area thus far has been on a North-South axis along the Galle Road with restricted development towards the interior. The OCH is expected to facilitate the development of the outer areas around the city of Colombo.

Further the OCH is also expected to create employment opportunities in the Greater Colombo area outside the inner zone of Colombo. In addition, it will improve the accessibility to development projects resulting from both Government and private sector initiatives in and around the proposed area served by the road.

3.3 Nature of the Project

The location of the selected trace is given as figure 3.3.
As per the identified objectives of the OCH, the proposed highway would be controlled access four lane joining Negambo road around Wattala and Galle road around Panadura. The road will have provisions for expanding it to 6 lanes.

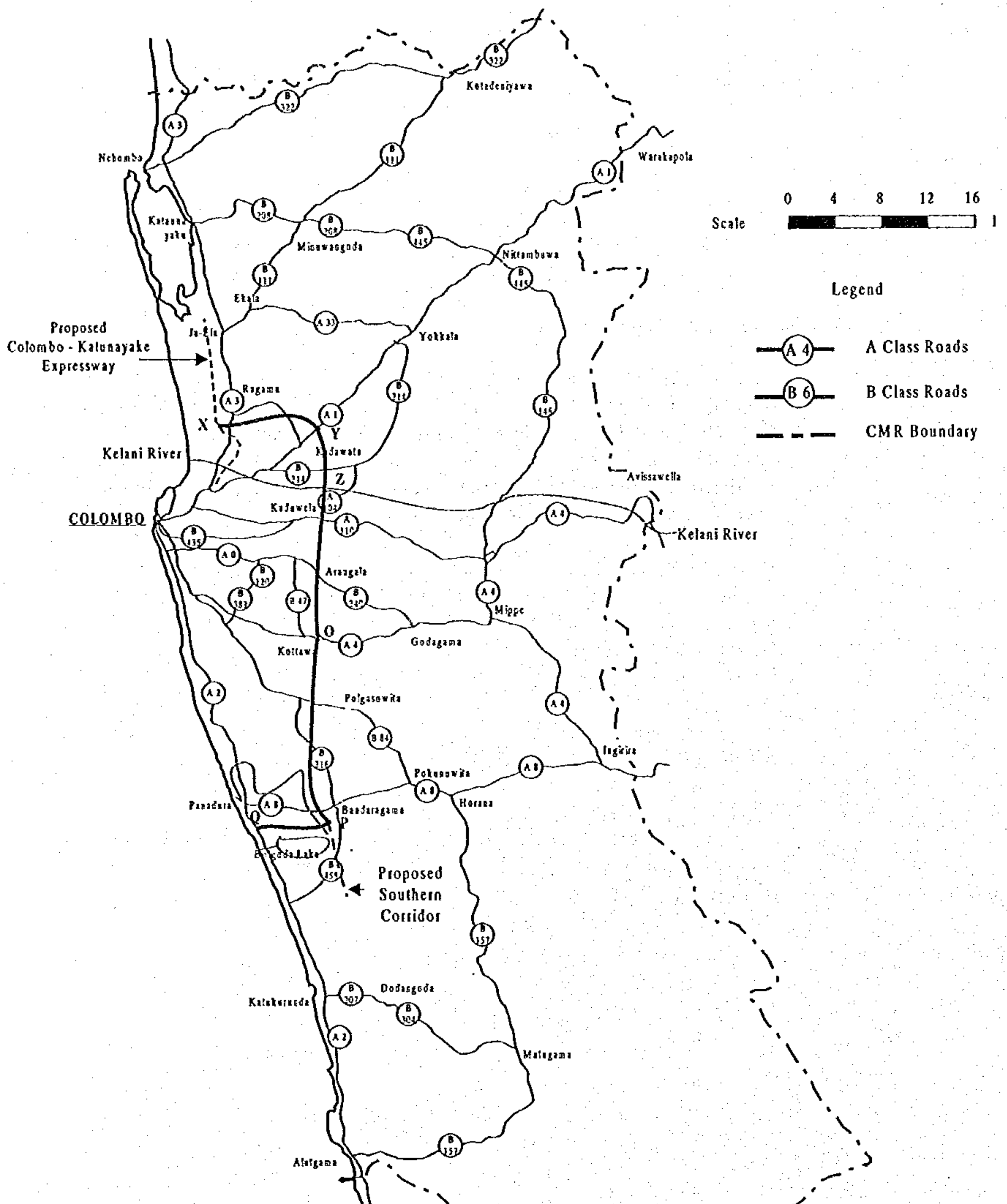

Figure 3-3 Location Map

Frontage roads on either side of the proposed road will function as service roads and will be connected to the OCH at the intersection.

While the A class roads will be connected at the intersections, B & C class roads will be provided underpasses where possible or connected to the frontage roads.

The proposed road will also have fences on either side.

The surrounding area of the road is of mixed land use and the details are provided in Map 5-3-6 and section 5.3 of the report.

3.4 Construction Program

3.4.1 Construction Schedule

The construction program is scheduled on the following guidelines as per RDA Planning and Programming Division:

	Commencement	End
Feasibility Study/Preliminary Design		Mar 2000
Environment Impact Assessment approval	Mar 2000	May 2000
Funding	July 2000	
Detail Engineering/Tender Documents	Mar 2002	Jun 2003
Land Acquisition/Resettlement	Jun 2001	Dec 2003
Tender/Bid Documents/Tender Evaluation	Jan 2003	Dec 2003
Construction Period	Jan 2004	Dec 2009
Operation & Maintenance	2005	-

3.4.2 Construction Methodology

The sequence of construction by the successful contractor will consist of the following main tasks:

- Mobilization
- Site clearance
- Earthworks
- Viaducts, river bridges and culverts construction
- Intersections with major junctions with other Class and future road projects
- Over-passes or under-passes for B, C & D Class roads
- Soil, sub-base sources
- Sand sources
- Aggregate sources
- Batching plant locations [concrete and asphalt]
- Highway and other frontage roads
- Landscaping, tree planting etc.
- Rest areas [telephone/toilet facilities]

The general method of construction of these tasks is outlined below, with approximate quantities derived from the Interim Report at Oriental consultants Co Limited.

Site Clearance

In normal ground, this will involve removing grass and vegetation of organic material, removal and grubbing of trees, removal of existing temporary and permanent buildings/houses, removal of existing culverts and drains. In areas where there is marshland, 10m depth from existing ground level will be excavated and vertical drains installed upto original ground level prior to normal road construction. The quantity of vertical drain will be 1,468,880m^3 approximately.

Earthworks

This will consist of excavation [cut] or filling [embankment] after site clearance.

As per the typical cross-sections, the quantity of cutting is 7,528,031m^3 of solid and the quantity of embankment is 10,427,444m^3. Normally all cut material are not suitable for use in embankment construction. Assuming that 25% of cut material is unsuitable, the available suitable soil from cut areas will be 5,646,000m^3. Hence, there will be a deficit of 4,781,000m^3 of suitable soil to be obtained from available nearby soil sources. The hauling of cut material to embankment areas will cause social and environmental impact.

The extraction of soil from soil sources has to be controlled so as not to cause soil stability or erosion.

Structures

Pipe culverts of 900 mm dia and 1,200 mm dia and box culverts will be founded on soil of sufficient bearing capacity.

Viaducts, river bridges and over-passes will be founded on pre-cast concrete driven piles or bored insitu concrete piles to bedrock. Pile driving and sheet pile driving [for temporary works] will cause noise and vibration to nearby buildings and both impacts have to be controlled.

Large amount of concrete will require many trips of concrete truck mixers to transport concrete from concrete batching plants to structure location on proposed roads and will cause damage to some roads in poor condition as well as cause traffic holdups to nearby residents and commuters.

The project has total length of viaducts of approximately 1,890m, river bridges of approximately 382m, 65 box culverts and 192 pipe culverts. Total concrete volume is estimated at approximately 150,000m^3.

Highway and Frontage Roads

The road construction consists of sand layer sub-base, base course, wearing course and shoulder construction. The quantities of the above are:

Sand Layer	-	1,148,500m^3
Sub-base	-	250,000m^3
Base Course	-	152,150m^3 [365,000 Tonnes]
Wearing Course	-	731,120m^3 [70,200 Tonnes]
Shoulder	-	222,300m^3

Sand has to be obtained from the coastal areas as the quantity is large and due to salinity problems, the sea sand has to be subjected to a washing process to ensure salinity is extracted prior to transporting. Accordingly, sea sand may have to be replaced by granule.

Sub-base is a readily available material and some cut material may have the specification requirements for sub-base.

Base-course and wearing course consists of river sand, crushed aggregate, filler [quarry dust] and bitumen.

Shoulder material is similar to sub-base but the specification requirements are less stringent.

The asphalt concrete batching plant or plants have to be located to reduce haul distance and be in an area away from built-up areas.

Aggregate Sources

Crushed aggregate is required for concrete, base course and wearing course.

The quarry industry study for Sri Lanka was carried out by Wardell Armstrong in association with Engineering Consultants Limited in 1996.

According to the study, the western province accounts for around half of the country's consumption and also has around half the country's quarry capacity.

Nominal rated production capacity of district quarries [in million tons] is shown in Figure 9.1 of the above study as of year 2005. The total requirement of crushed aggregate would be approximately 800,000 tons. From the above Figure 9.1, there is sufficient quarry sites available for the project requirements, within the Western Province.

4. DEVELOPMENT OF ALTERNATIVES

4.1 Alternative Traces

The pre-feasibility study carried out in 1992 evaluated five traces. Trace No. 1was 36.05 km in length and starts south of Panadura at Nalluruwa, crosses the High Level road close to Pannipitiya and the Kelani river at Hattigala and Kandy road and proposed Katunayake Expressway at Dalugama and ends on the Colombo-Puttalam road at Telangapatha. The trace traverses level paddy/marsh lands and hillocks in the southand in the northwith high ground/rolling terrain in the central section from Kesbewa to Malabe. There are 18 bridges over waterways, 45 flyovers and 19 interchanges on this route.

Trace No. 2, 38.25 km in length, consists of a part of Trace No. 1 from its start at Nalluruwa up to the bridge over the Bolgoda river at Kitulgahawatte ferry. Thereafter it traverses marsh and paddy lands and rolling high ground through terrain similar to Trace No. 1. It crosses the Kelani river about 1 km upstream of Trace No. 1 and intersects the Colombo-Kandy road near the 12^{th} km before intersecting the Colombo-Katunayake Expressway at Hunupitiya South. It ends at Wattala on the Colombo-Puttalam road and there are 16 bridges over waterways, 67 flyovers and 9 interchanges.

Trace No. 3 is 43.65 km long and from its start upto Morahena it coincides with Trace Nos. 1 and 2. After Morahena it passes through highland paddy areas before crossing the Kelani River at a point about 1 km downstream of the existing Kaduwela Bridge. North of the river it traverse through hillocks and rock outcrops and rolling highlands on towards Ihala Biyanwila where it joins the common path of Trace Nos. 4 and 5and crosses Colombo-Kandy road north of Kadawatha. Intersecting the Colombo-Katunayake Expressway at Ragama the trace terminates at Welisara on the Colombo-Puttalam road. There are 19 bridges, 73 flyovers and 12 inter changes on this trace.

Trace No 4, 47.75 km in length, commences just north of Thalpitiya bridge at Pinwatte on the 19^{th} mile of the Colombo-Galle road and proceeds northwest of Bolgoda lake on high ground prior to crossing the Bolgoda river at Rukgaha ferry. Then it traverses rolling terrain and paddy lands skirting the Diyagama transmitting station of Sri Lanka Broadcasting Corporation and proceeds to Kaduwela bridge cutting across the High Level road on the 24^{th} km east of Homagama. Crossing the Kelani river over the existing Kaduwela bridge it proceeds northwest to the west of Sapugaskande Oil Refinery intersecting the Spugaskande-BiyagamaFTZ road and meets Trace No. 3 at Ihala Biyanwila and follows the same route through Ragama and ends at Welisara. There are 15 bridges, 13 interchanges and 73 flyovers.

Trace No. 5, 54.40 km in length is the most outermost of the five traces and starts from Kudawaskaduwa on the 24^{th} mile of Colombo-Galle road and traverses low lying land. Running parallel to the Waskaduwa-Bandaragama road for a short distance and after crossing the Bolgoda flood plain it goes over highland and paddy land and proceeds northward intersecting the High Level road east of Homagama. It then skirts the Panagoda Army Camp and the Oruwala Steel Factory and Joins Trace No. 4 at Kaduwela bridge and follows the same route as Trace No. 4 from Kaduwela

up to its termination at Welisara. There are 19 bridges, 57 flyovers and 10 interchanges on this trace.
Several alternative alignments including these five traces were examined and reported in their Progress Report, March 1999, by the JICA Study Team.

In the Interim Report submitted in May, 1999, 09 preferred possible highway alignments were evaluated and the most appropriate highway has been selected. The IEE, which was incorporated as an integral part of the Interim Report, assessed the environmental impact of these nine traces and compared the traces to recommend the most appropriate alignment.

The nine alignments shown below are illustrated in figure 4-1.

ALIGNMENT	PATH OF THE ALIGNMENT	TOTAL LENGTH
A1	a_1-c_1-e-f_1-g-h_2	49.37 km
A2	a_2-b-c_1-e-f1-g-h_2	46.51 km
A3	a_2-b-c_2-e-f1-g-h_2	43.71 km
A4	a_1-c_1-e-f_3-h_2	52.46 km
A5	a_2-b-c_1-e-f_3-h_2	49.60 km
A6	a_2-b-c_2-e-f_3-h_2	46.80 km
A7	a_1-c_1-e-f_2-g-h_1	52.58 km
A8	a_2-b-c_1-e-f_2-g-h_1	49.72 km
A9	a_2-b-c_2-e-f_2-g-h_1	46.92 km

4.2 Engineering Impact of Alternative Trace

Engineering impact of nine alternative traces has been compared, which is shown in the attached table (Preliminary Project Cost Estimation for OCH). It has revealed that the Alignment A5 is the most feasible in terms of engineering impact since its earthwork is the least among the nine alternatives, and also the position of interchanges is most appropriate.

4.3 Option of an Alternative Railway System

As per the finding of the Transport Sector Planning Study, various options for improvement of railways have been evaluated:

- Base Case — Option 1
- Freight Oriented Inter City Rail Service — Option 1A
- Deletion of Rail Service — Option 2
- Low Cost Improvements — Option 3A
- Intermediate Cost Improvements — Option 4
- Major Rehabilitation — Option 5

1 : 120,000
0 0.5 1 2 3km

JICA
THE STUDY ON THE OUTER CIRCULAR HIGHWAY TO THE CITY OF COLOMBO
MOST APPROPRIATE HIGHWAY ALIGNMENT
ORIENTAL CONSULTANTS CO.,Ltd.
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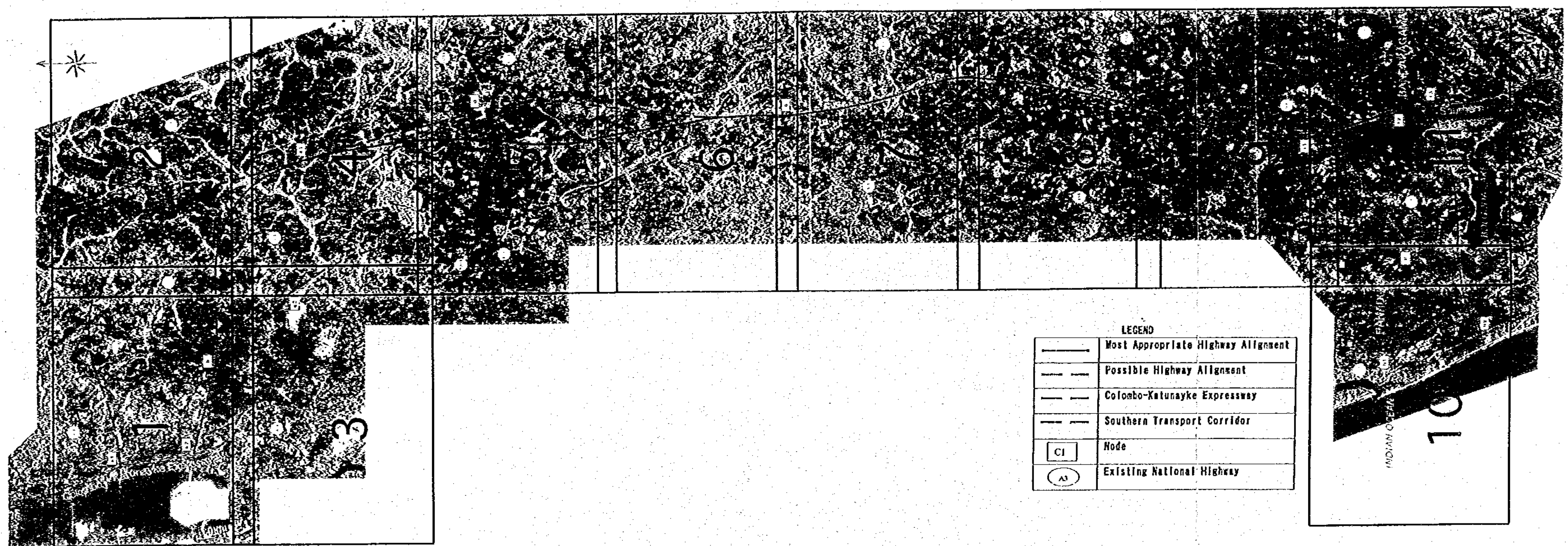

Figure 4-1 LOCATION MAP: HIGHWAY ALIGNMENT

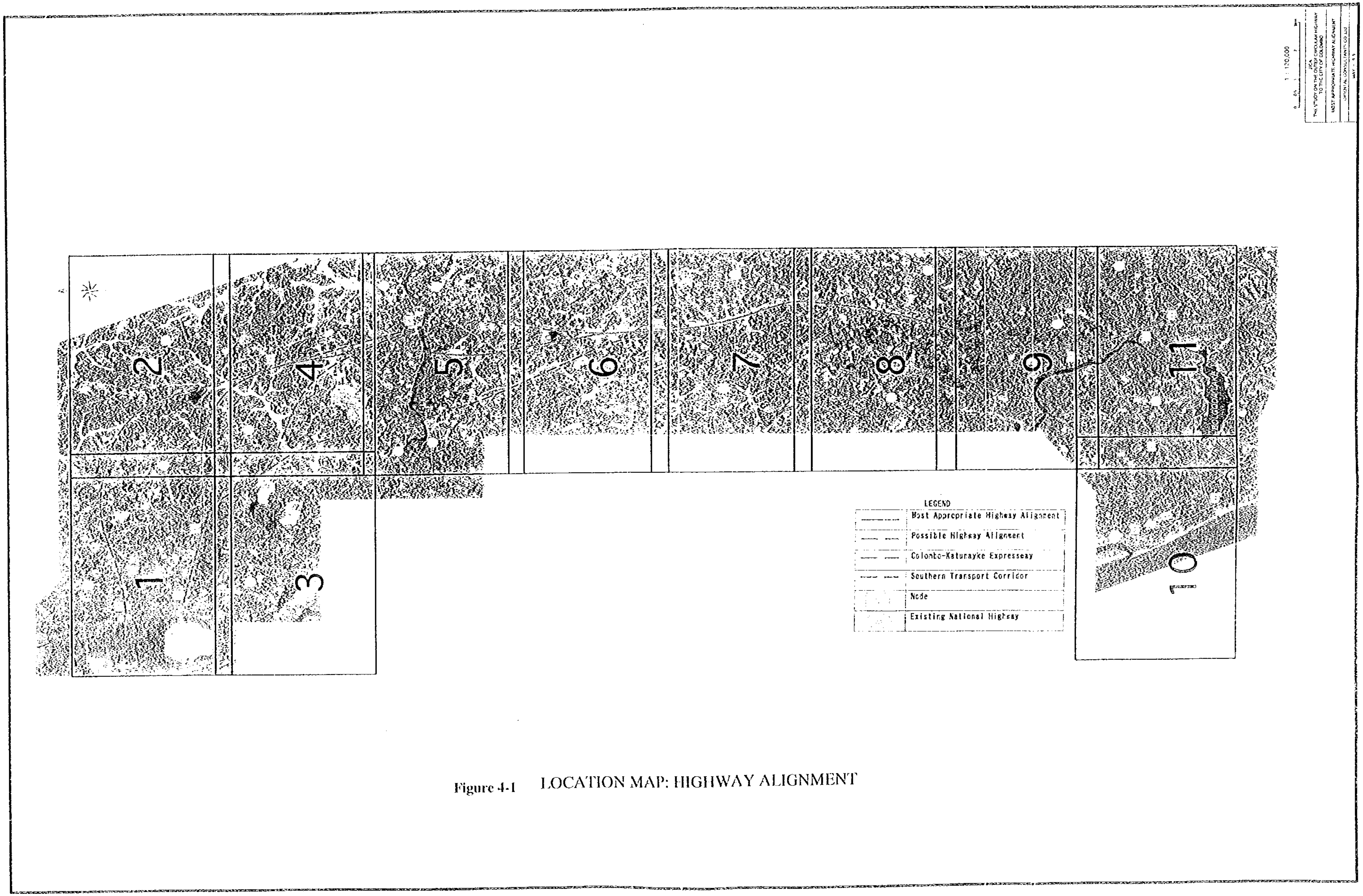

Figure 4-1 LOCATION MAP: HIGHWAY ALIGNMENT

From the economic evaluation of options 3A, 4 and 5 in comparison with option 1A, option 3A was established as the most viable.

The final recommended railway programs and policies were to maintain a viable economic role, if the Railway could revamp its operations to:

- Increase productivity
- Re-orient toward Option 3 in freight transport and commuter services
- Attract freight and passenger traffic where it has been an economic advantage
- Increase revenues to cover costs

As such, a train service would not be viable alternative to the outer circular road as it is even more costly than even major rehabilitation. Furthermore, it would not relieve traffic congestion on the existing highway system, particularly for this project. In addition, the adverse environmental impacts of constructing a new railway, though lesser than that of a 100 m right of way highway, would also be considerable.

4.4 No Action Alternatives

The no action alternative is the situation where no development activity with regard to transport improvement is implemented. The OCH or other transport improvement as providing a railway system will not be carried out under this option and therefore no environmental impacts are envisaged.

5. EXISTING ENVIRONMENT & SITE DESCRIPTION

5.1 Physical Environment

5.1.1. Climatic Conditions in the Study Area

Sri Lanka's varied climates have been studied in detail and the country has been divided into 24 regions called Agro-Ecological regions. Under this classification the study area can be identified as being in the Region WL4 as shown in Fig 5-1-1(A), Volume II. Furthermore, the Department of Meteorology has published climatological data as observed in different meteorological stations located in different parts of the country. Considering that the Study area consists of a 02 km wide corridor commencing from Mattumagala in the north and extending southwards to the coast at Pinwatte, the 03 number typical meteorological stations that represent the climatological features of the Study area are, Katunayake, Colombo and Ratmalana. The climatological data of these 03 stations is presented in Table 5.1.1(A), 5.1.1(B) and 5.1.1(C), in volume II. A comparison of the climatological features given in these three tables confirms that the entire study area experiences similar climatological characteristics especially in rainfall evaporation temperature and humidity with slight variation in mean wind speeds. Histograms depicting these climatological parameters are given in Fig 5-1-1(B) to Fig 5-1-1(M) and Tables 5.1.1(D) to 5.1.1(I), in volume II. Figure 5-1-1(N) is a map showing locations of the meteorological stations and other stations where hydro-meteorological data has been observed.

5.1.2 Drainage Pattern Along Proposed Road Alignment

The selected road alignment of Trace A5 commences at the Negombo Dutch Canal near Mattumagala and proceeds in an easterly direction for about 11km and then turns right and proceeds in a southerly direction for about 30 km. It then turns right again and proceeds in a westerly direction to meet the present Colombo – Galle A2 road at Pinwatte. Along this 48 km trace the OCH intercepts 26 No. sub catchments of which 12 No. are in the Kelani Ganga Basin and 14 No. are in the Bolgoda Basin. Table 51.1(J) in volume II indicates these 26 No. sub catchments as well as their respective catchment areas. It can be seen that the smallest sub catchment intercepted is 0.365 sq. km. while the largest is that of the main Kelani Ganga itself viz. sub catchment – 10 with a catchment area of 2009.8 sq. km. at the Kaduwela crossing. Hence the total area drained by the entire OCH is 2,347.1 sq. km. As can be expected, the drainage is always directed towards the western coast. Since the entire trace is confined within the flood plains of the Kelani Ganga and Bolgoda Ganga Basins, the terrain traversed by the OCH is low lying in most parts except in intermittent stretches. A characteristic hydrological feature of the proposed OCH is that, during intense rainstorms, flood levels will be mitigated by the available detention areas on both upstream and downstream of the OCH. Table 5.1.1(D) in volume II also gives the catchment areas of the sub catchments intercepted by proposed OCH. Figure 5-1-1(O) in volume II shows the sub catchments identified. Figure 5-1-1(P) in volume II is a schematic diagram showing these sub catchments.

5.1.3 Flood Peak Values, Inundation Levels and Detention Areas

From flood studies carried out on Kalu Ela [a part of Kelani Ganga Basin] it is possible to estimate flood peak values for streams within the Kalu Ela Basin for different Return Periods. The same coefficients can be applied for minor sub catchments in Bolgoda Ganga too as they have hydrologically similar parameters. Accordingly the annual flood peak of 50 year, 100 year and 200 year Return Periods have been estimated for sub catchments 01, 02, 03, 04, 05, 06, 07, 08, 09, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, and 26. In the case of sub catchment 10 which is the main Kelani Ganga at the Kaduwela crossing the peaks were determined by extrapolating from the peak flows estimated from Kelani Ganga at Hanwella. The following relationship can be applied:

$$\text{Flood Peak at Kaduwela crossing} = \frac{\text{Catchment Area at Kaduwela X Estimated Flood Peak at Hanwella}}{\text{Catchment area at Hanwella}}$$

$$= \frac{\text{2010 X Estimated Flood Peak at Hanwella}}{1782}$$

On this basis the Estimated Annual Flood Peak at Kaduwela crossing for Return Periods of 50 years, 100 years, and 200 years were computed. Furthermore, in the case of the main Bolgoda Ganga from the south-sub catchment 22 the annual peak flow estimated for a similar catchment viz. Ja Ela was selected as representative of the Bolgoda sub-catchment 20. The Peak flows for Bolgoda Ganga for Return Periods of 50 years, 100 years and 200 years have been estimated as 190.6, 209.6 and 224.9 Cumecs respectively.

The peak floods estimated for Return Periods of 50 years, 100 years and 200 years for the26 No. sub catchments are given in Table 5.1.1(J) in volume II

<u>Inundation Levels</u>

The inundation levels discussed below are:

- For Kalu Ela Basin - 100 year Return Period Flood
- For Kelani Ganga Basin - Highest Flood Level recorded in the last 30 years
- For Bolgoda Ganga Basin - Highest Flood Level recorded in the last 30 years

<u>Kalu Ela Sub-Basin [part of Kelani Ganga Basin]</u>

The OCH intercepts tributaries within this sub-basin in 05 No. Locations. By extrapolating flood levels determined for Kalu Ela at the A3 road crossing, inundation levels at these locations can be estimated as:

Sub Catchment 01 3.50 m MSL

Sub Catchment 02 4.50 m MSL

Sub Catchment 03	5.00 m MSL
Sub Catchment 04	9.00 m MSL
Sub Catchment 05	9.50 m MSL

Kelani Ganga Basin

Similarly sub catchments 06, 07, 08, 09, 10, 11 and 12 are in the main Kelani Ganga Basin. By comparing flood levels recorded at Hanwella and Nagalagam Street, inundation levels at proposed Kaduwela crossing [sub catchment – 10] and at the other crossings can be estimated as:

Sub Catchment 06	9.5 m MSL
Sub Catchment 07	8.5 m MSL
Sub Catchment 08	7.5 m MSL
Sub Catchment 09	6.5 m MSL
Sub Catchment 10	6.5 m MSL
Sub Catchment 11	6.5 m MSL
Sub Catchment 12	9.5 m MSL

Bolgoda Ganga Basin

There is no documented data on observed flood levels within Bolgoda Basin. However, this basin is extremely low lying and is characterized by the presence of natural lakes, marshes, and 05 No. man made lakes and very low gradients. In order to estimate inundation levels along the proposed OCH trace the following procedure was adopted:

- Carried out field visits and checked inundation levels observed by residents at known locations within the basin [especially at bridges].
- Ensured that inspection was done during a long dry spell, so that the basin is not under any influence of surface run-off or flood flows.
- Did field measurements at different locations to estimate the inundation levels above the approximate existing natural lake levels and also noted their locations in relation to the Panadura outfall.
- Applied hydraulic principals to cross check very approximately the field data collected.

- Estimated inundation levels at the locations where the proposed OCH intercepts the sub catchments 13 to 26, all of which lie within the Bolgoda Basin.

On this basis the estimated inundation levels at the respective sub catchments intercepted by the OCR are:

Sub Catchment 13	9.50 m MSL
Sub Catchment 14	8.50 m MSL
Sub Catchment 15	6.50 m MSL
Sub Catchment 16	3.50 m MSL
Sub Catchment 17	2.50 m MSL
Sub Catchment 18	2.50 m MSL
Sub Catchment 19	1.60 m MSL
Sub Catchment 20	1.55 m MSL
Sub Catchment 21	1.60 m MSL
Sub Catchment 22	1.60 m MSL
Sub Catchment 23	1.60 m MSL
Sub Catchment 24	1.60 m MSL
Sub Catchment 25	1.60 m MSL
Sub Catchment 26	1.60 m MSL

Detention Areas

A study of the proposed OCH trace reveals the presence of large tracts of paddy or marsh in every sub catchment identified. These features confirm the availability of Detention Capacity in the respective sub catchment. The greater the percentage of paddy or marsh in each sub catchment, the greater will be the available detention capacity. Hence during intense rainstorms this detention will help to mitigate the peak flow of floodwaters as compared to other catchments with similar hydrological characteristics but with lesser Detention Capacity. The detention areas in each sub-catchment were accordingly assessed and the Detention capacity of each sub catchment estimated on the basis that the average maximum depth of inundation is 1.0 meter. The detention capacity available in each sub catchment has accordingly been estimated and given in Table 5-1-1(J). Similarly a qualitative statement on the availability of detention capacity downstream of each sub catchment has also been included.

5.1.4 Irrigation Schemes and Flood Protection Works

No irrigation structures such as anicuts, sluices, falls, turnouts, etc. were identified along the study trace. However, minor irrigation canals at various locations either traversed along the trace for short distances or crossed the centre line alignment A5. These details were indicated by the land Use Specialist by interpreting the Aerial Photographs covering the entire trace.

While allowance has to be made for loss of productive land due to the ROW of the OCH, engineering solutions need to be evolved for the irrigation and drainage canals which will be affected but will be needed to service the remaining irrigation system or to drain an area.

Based on the 26 No. sub catchments identified, the possible solutions to the rehabilitation of the affected irrigation systems are discussed below:

<u>Sub Catchment 01 – Kalu Ela Basin</u>

There is a 600-meter canal, crossing at 1.8 km and draining a built up area north of the alignment A5, through the existing marsh. The construction of the highway will be obliterating the upper 50 – 75 m of this drainage canal. The drainage waters from the built up area affected can be led along the toe drain of the proposed road into the major drainage undercrossing for sub-catchment 01.

Another 200-meter canal draining a built up area north of the Alignment A5 crosses the centre line at 3,6 km. A nominal culvert will have to be provided at this location [say 900 mm diameter], as there is no possibility of economically diverting this drainage flow to any other drainage undercrossing nearby.
Another canal commences near the 4.1 km point at Heenkenda but South of the A5 alignment and connects with the natural drainage system of Kalu Ela further downstream and traverses through marsh. Although it drains built up areas and homesteads located north of the Alignment A5, it may not be necessary to locate another canal undercrossing, as the drainage from this area can be directed through the toe drain of the proposed highway to the drainage undercrossing located at 3.6 km.

<u>Sub Catchment 02 – Kalu Ela Basin</u>

No additional canal crossing will be needed.

<u>Sub Catchment 03 – Kalu Ela Basin</u>

A canal runs along the proposed Alignment A5 from 6.2 – 6.7 km and on the northern side. Here too this canal is draining homesteads and built up areas. However this canal is connected to an existing natural stream and the drainage flow can be drained through the major drainage undercrossing for sub catchment 03.

<u>Sub Catchment 04 – Kalu Ela Basin</u>

Two irrigation canals are encountered, each at close proximity to main natural drainage lines. A large paddy tract is bifurcated by the proposed roadway and in order to ensure satisfactory operation of the irrigation system canal crossings have to be provided at 7.75 km and 8.10 km of the roadway. The main drainage undercrossing for sub catchment o4 will be located at 8.0 km.

Sub Catchment 05 – Kalu Ela Basin

An irrigation canal crosses the trace at 9.0 km and hence a canal crossing has to be provided.

Another canal, draining built up areas and coconut plantation crosses the Alignment A5 at 9.7 km. It will be economically necessary to provide a canal drainage crossing at this location.

Sub Catchment 06 – Kelani Ganga Basin

A thin 500-meter long paddy tract will be acquired as it comes within the ROW between 10.7 km and 11.2 km. Hence the irrigation canal alongside this tract in this same reach will also be obliterated. All efforts will be made to shift the trace more westwards, so that it will now traverse a coconut plantation – depending however on which alternative is more economical. Similarly an irrigation cum drainage canal crosses the trace at 11.55 km and 11.95 km. Hence 03 No. canal crossings will be needed at 11. Km, 11.55 km and 11.95 km within sub catchment 06.

Sub Catchment 07 – Kelani Ganga Basin

This sub catchment is a lower portion of sub catchment 06 and the trace is crossed by irrigation canals at 12.5 km, 12.9 km and 13.0 km. suitable canal crossings need to be provided at these locations.

Sub Catchment 08 – Kelani Ganga Basin

An irrigation cum drainage canal crosses at 13.9 km. Since the paddy land is now abandoned, the drainage canal can be led along the toe drain into the main drainage undercrossing to be provided at 14.05 km. Hence no canal crossing will be needed.

Similarly another canal crossing the trace at 14.10 km can be led into the drainage undercrossing without providing an additional canal crossing.

Sub Catchment 09 – Kelani Ganga Basin

The trace is crossed at 14.90 km by a major tributary of the Kelani Ganga. No other canal crossings can be identified.

Sub Catchment 10 – Main Kelani Ganga Crossing at Kaduwela

The main Kelani Ganga crosses the trace at 15.2 km about 1.25 km downstream of the present bridge at Kaduwela. No other canal crossings are needed.

Sub Catchment 11 – Kelani Ganga Basin

No additional canal crossings needed.

Sub Catchment 12 – Kelani Ganga Basin

An irrigation canal crosses at 20.8 km and a suitable canal crossing has to be provided. Another canal [draining rubber plantations and built up areas] crosses the trace at 21.2 km, but no additional undercrossing is needed, as the drainage could be directed to the canal crossing at 20.8 km.

Another irrigation cum drainage canal meets the trace at 21.9 km, but no canal crossing will be needed.

Sub Catchment 13 – Bolgoda Ganga Basin

No canal crossings necessary.

Sub Catchment 14 – Bolgoda Ganga Basin

Although 02 No. canals are encountered at 25.0 km and 25.7 km, no canal crossings will be provided, as the flow can be led into the nearest toe drain and then into the nearest natural drainage.

Sub Catchment 15 – Bolgoda Ganga Basin

No irrigation canals are encountered.

Sub Catchment No. 16 – Bolgoda Ganga Basin

No irrigation canals are encountered.

Sub Catchment No. 18 – Bolgoda Ganga Basin

No irrigation canals are encountered.

Sub Catchments No. 19, 20 and 21 – Bolgoda Ganga Basin

No irrigation canals are encountered.

Sub Catchment 22 – Bolgoda Ganga

Three irrigation cum drainage canals can be identified. One canal crossing will be necessary at approximately 41.0 km.

A canal draining the areas around Bandaragama crosses the trace at 41.30 km, 42.3 km and 42.8 km and traverses marsh, before draining into Bolgoda Ganga. However, canal crossings at 41.3 km and 42.8 km only are necessary.

Sub Catchments 23, 24 and 25 – Bolgoda Ganga Basin

No canal crossings are necessary.

Sub Catchments 26 – Bolgoda Ganga Basin

A canal draining built up areas around Pinwatte crosses the trace at 47.6 km and drains into Talpitiya Canal. A canal crossing is needed at this location.

5.1.5 Existing Ground Water Levels Along the Alignment & Hydrology

Ground Water Levels

The geo-technical investigation carried out by the Study Team also included a groundwater study, done in May/June 1999. Although normal monsoon rains were experienced, no severe storm conditions prevailed during this period. The ground water levels recorded during this study provide useful information in assessing the ground water levels prevailing along the Alignment A5. The following figures are available:

Table 5.1.1 Ground Water Levels

BH NO.	DATE OF DRILLING	CHAINAGE ALONG ALIGNMENT [KM]	GROUND LEVEL [GL] m MSL	GROUND WATER LEVEL - METERS BELOW GL	REMARKS
01	11, 12 Jun 99	00.70	00.20	00.20	Kerawalapitiya end – Negombo Dutch Canal
02	15, 16 Jun 99	00.90	00.00	00.00	Galudupita Marsh
03	13, 14 Jun 99	08.80	00.60	00.60	Kadawata[near A1]
04	03, 04 Jun 99	05.40	03.40	03.40	RB of Kelani River
05	21 Jun 99	-05.60	-05.50	-05.50	Kelani River Bed & Water Level
06	19, 20 Jun 99	-04.10	-04.00	-04.00	Kelani River Bed & Water Level
07	02, 03 Jun 99	05.40	03.40	03.40	LB of Kelani river
08	07, 08 Jun 99	26.20	00.25	10.50	Paddy Tract near Munchee at Makumbura
09	26, 27 May 99	40.70	00.00	00.70	8.75 km from Panadura on A8 Road near Bandaragama
10	11, 12 Jun 99	42.50	-01.00	-00.47	Bolgoda Ganga river Bed [LB Side]
11	06, 07 Jun 99	42.50	-03.00	-02.47	Bolgoda Ganga River Bed
12	08, 09 Jun 99	42.50	-01.00	-00.47	Bolgoda Ganga River Bed [RB Side]
13	27, 28 May 99	42.60	00.20	00.73	RB of Bolgoda Ganga & River Level
14	08, 09 Jun 99	45.50	00.00	00.43	Near Urannagoda off A8 Road
15	22, 23 May 99	48.20	00.60	03.30	At Pinnawala end of OCR

The details above reveal that a high water table prevails along the entire alignment. While in the marshy areas, the ground water table is almost at the surface, even in the comparatively higher elevation areas, like the paddy tract at Kadawatha [BH No. 03], and the paddy tract at Makumbura [BH No. 08], the ground water table is only 0.6 m and 0.25 m below ground level respectively. However, this pattern can be attributed to a 'wet season ' scenario. During the 'dry season', say January to March, the low lying marshes and the areas around Bolgoda lake will continue to have a high water table, but the water table in the higher elevation areas such as at boreholes 03, 04, 07, 08 and 15 can be expected to drop significantly.

Hydrogeology

There are two hydrogeological units, which are closely associated with the underlying geology:

- The low-lying ground underlain primarily by alluvium and represented by the broad, flood plains of the Kelani Ganga and Bolgoda Ganga and the numerous small narrow flat-bottomed valleys occupied by paddy or swamp.

- The intermediate hilly land with underlying crystalline bedrock largely covered by densely vegetated laterite.

- Both units have potential hydro-geological significance for the project in different ways.

The alluvial clays of the Kelani Ganga as far out as Kaduwela have long been used for the manufacture of bricks and tiles. Nowadays, it is seasonal small-scale operators who use the local clay, with large-scale manufacturers bringing clay from far away locations North of Colombo. The worked-out areas, which occur both north and south of the river have their drainage impeded on account of the flat topography, presence of degraded bunds between plots and the generally low permeability of the surrounding materials. Similarly, in the minor valleys, low gradients encourage swamp or paddy and provide significant areas for flood storage in the wet seasons.

The laterite-covered hills form the main areas of habitation in the residential and rural settlement within the study area. Generally, laterites have a high porosity but variable permeability depending upon the content of clay. In these areas the formation serves as an aquifer meeting household requirements capable of being provided from dug-wells and a few deeper boreholes.

Some of the more important hydrogeological constraints governing road construction are:

- Prevention of increased flooding by surface water
- Availability of fill material
- Prevention of contamination of adjacent water supplies during construction

By comparison with sites on hills, the risk of flooding is naturally greater in low-lying and valley sites. In the latter cases, the use of bunds and peripheral drainage channels is necessary to exclude surface water and de-watering will be necessary for ground water control.

The most commonly used fill material during construction is laterite so that its characteristics are of relevance to road construction. 'In-situ' exposures of the material can carry high bearing loads without settlement, whereas excavation to reveal the lower part of the profile produces lower bearing capacity and a tendency to settlement. The crushing strength of the hard, cellular variety ranges from 100 to150 lb/in^2 with the soft, vericular material having only one-third of these values.

Laterites [and the associated lateritic soils] usually show little or no swelling and need thorough compaction if they are to be used as fill material.

5.1.6 Present Uses of Surface Water

The surface water in the river and lakes in and around the Alignment A5 are used for:

- Drinking Water
- Irrigation

Drinking Water

Major drinking water intakes are located along the Kelani main river. They are:

SUPPLY TO	INTAKE SOURCE	DISTANCE FROM A5 ALIGNMENT CROSSING
Sapugaskanda Industrial Estate	Bollegala	03 km
Colombo & Greater Colombo	Ambatale Left Bank	02 km
Other Projects	Further Downstream	Greater than 03 km

No such water supply intakes can be identified in the lakes and streams in the Bolgoda Basin in the vicinity of the A5 alignments

Irrigation

This has been discussed in para 5.1.4.

5.1.7 Land Form

- Sri Lanka could be recognized as three types of well marked plains of erosion or peneplains described as follows:

- The central mountainous highest peneplain which has an elevation range of 750 to 2500 m above mean sea level.

- The middle peneplain of central highlands which has an elevation range of 125 to 750 m above mean sea level.

- Generally undulating to rolling lowest peneplain which has an elevation range of 0-125 m.

- The lowest peneplain is considered to be the result of millions of years of subaerial weathering of the ancient, intensively folded landmasses of crystalline rocks.

- The proposed road trace of the outer circular highway lies entirely within the lowest peneplain.

5.1.8 Soils

Generally the study area could be divided into four types of landscape facets.

- **Gently undulating to undulating and rolling terrain**

  Generally this area consists of soft and hard laterite soil which is the sub group of the red yellow podzolic (RYP) soils.

- **Flat or nearly level plain**

  Generally this area consists of low humic glay (LHG) soils, associated with alluvial soils.

- **Concave valley bottoms, depressions or low lying flat lands**

  Generally this area consists of the bog, half bog soils and gleyic alluvial soils. This type of soils mainly occurs in the north western and southern areas of the road trace, which are generally closer to the coast.

- **Flood plains**

  These areas mainly consist of alluvial soils of variable textures. Alluvial soils mainly occur along the flood plains of Kelani Ganga, Bolgoda Ganga and other tributaries within the study area.

- Sub Group with Soft or Hard Laterite of the Great Soil Group of Red

- Yellow Podzolic Soils

Soils of this group should have hard laterite formed in situ within the depth of 125 cm and soft laterite within the depth of 250 cm.

The soils of this sub group are well developed and the weathered zone is deeper. The deeper subsoil of this category contains soft laterite, which gets hardened massively or gravelly. In locations, which were subjected to erosion activities, laterite gravels could be seen on the surface.

The colour of the surface soil is dark brown to dark grayish brown or dark yellowish brown and surface soil varies in thickness from upper (5-15 cm) to lower (15-25 cm) aspect. The textures of most soils are sandy clay loam while in some locations textures are lighter with sandy loam.

The sub surface soils are brown to strong brown or brown to dark yellowish brown or yellowish red in colour. The texture is sandy clay loam to clay loam. The clay content increases with the depth. There is an iron stone gravel layer in the sub

surface in some locations. The ironstone content varies from 10-12 percent in less gravelly soils to 30-60 percent or more in extremely gravelly soils.
The pH of the soil is around 4.5. The soils in the mid to upper aspects are generally well drained while soils in the lower aspects are moderately well to imperfectly drained.

54% of the land area of the OCH road trace consists of RYP soils. The major land use categories which exist within the RYP region are built up areas, homestead gardens, coconut plantations and rubber plantations. RYP soils are suitable for road construction work.

Low Humic Gley (LHG) Soils

LHG soils could be located within valleys adjoining the RYP landscape, as it is a lower member of the drainage catena.

The surface soils of LHG are usually dark gray to dark grayish brown in colour. The textures are either sandy loam or sandy clay loam. The sub surface horizons have heavier textures than the surface horizon such as sandy clay, clay loam or clay and colours are grayish to yellowish. Water movement through these soils is very slow.

Generally, these soils remain in a saturated condition with water, for a greater part of the year.

Paddy is the main land use category found in the LHG region. LHG soils occur over 18% of the OCH road trace.

Bog and Half Bog Soils

The bog and half bog soils could be located within the tidal marshes, back swamps of the river systems, filled up lagoons and also narrow valleys of the coastal in-lands which have narrowed draining outlets in the study area.

The major soil forming processes are accumulation of parent materials, basically organic matter and mineral alluvium, processes of reduction with the formation of a gley horizon and also processes of leaching, giving rise to the acid soils poor in bases.

The bog soils have more than 30 percent organic matter, consisting of black to brownish or grayish black muck, mucky peat or peat. The half bog soils are also similar to the bog soils and have less organic matter than the bog soils but more than 15% of organic matter. The half bog soils generally occur at a slightly higher elevation than the bog soils.

Land use types such as paddy, abandoned paddy, marshes and low scrubs could be found within this region. Bog and half bog soils occur over 17% of the OCH road trace.

Alluvial Soils

The alluvial soils usually occur within the flood plains of the rivers and tributaries. With the overflowing process coarser material is deposited on levees and finer textured material in back swamps and basins. Within the same valley, texture may vary according to the physiographic positions.

Better drained, coarser textured soils usually brownish or yellowish brown in colour generally could be located within the levee. Poorly drained, fine textured or clay, grayish coloured soils, usually could be located within back swamps or basins.

These alluvial soils occur mainly within flood plains of Kelani Ganga and Bolgoda Ganga of the study area.

Alluvial soils occur over 8% of the OCH road trace.

Table 5.1.8 Soil Composition within the Road Trace of OCH

Soil Category	Percentage (%)
Red Yellow Podzolic Soils	54
Low Humic Gley Soils	18
Bog and Halg Bog Soils	17
Alluvial Soils	08
Other Soils	03

5.1.9 General Geology of the Study Area

The geology in the study area essentially consists of unconsolidated deposits of Quaternary age overlying metamorphic bedrock of Precambrian age. The tabulation below shows the main types of deposits and rocks and their relative age:

AGE	LITHOLOGY
Quaternary	Laterite Alluvium Littoral Sands Sand Stone
Palaeozoic	Banded gneiss
Precambrian	Charnockite

Metamorphic rocks [gneiss] form the most extensive rock type in the study area. They appear light in colour [shades of black and white] with noticeable banding and veins of granite and quartz.

The collective sequence has been penetrated some 25m at many localities without bedrock being encountered. The alluvium consists of recent detrital material [clay, silt and sand] carried by rivers and streams deposited in the numerous valleys, large and small, which traverse the area.

Lastly, but not less importantly, is the secondary product called laterite and represents the 'in-situ' weathering of the underlying metamorphic rocks. Due to the nature of these bedrocks and the variability of the alternation process as the laterite is extensive but non-uniform in both nature and thickness. The typical laterite material grades downward from a hard brown ironstone crust at the surface, via a hard cellular red zone containing noticeable cavities, to a soft, variegated clayey mass which overlies the crystalline parent material. This profile may attain thicknesses in excess of 25m, but has suffered considerable erosion.

Structural features of direct geological significance to the project is the availability of laterite, while river alluvium and peat would necessitate special engineering considerations for the design of highways/roads.

More details are available in the report on the Geotechnical Investigations carried out by the Consultants in May/June 1999.

5.1.10 Mineral Resources in the Study Area

Figure 5-1-1(O) in Volume II, indicates the mineral resources in and around the Alignment A5 as presented in the 'National Atlas of Sri Lanka' Survey Department – 1988. This confirms that no minerals of any significant value are encountered along the 48 km trace of the Alignment A5. However, in the initial 05 km of the trace [commencing from the northern end], the mineral peat is encountered, while further south, clay is also encountered on the banks of the Kelani Ganga. The other minerals identified like kaolin and graphite cannot be associated with the OCR trace as such, but are available at distances greater than 05 km from the trace.

Although not highlighted in the National Atlas, the other mineral resources encountered along the Alignment A5 are river sand and laterite [or gravel]. Inquiries carried out at the Kelani Ganga crossing location of the Alignment A5, revealed that sand mining activities are carried out both upstream and downstream, although no sand mining is done at the crossing location itself. The availability of laterite is discussed more in para 5.1.8

5.1.11 Water Quality of the Water Bodies along the Trace:

The Southern section of the study area is drained by the Bolgoda basin whereas the Kelani basin s the North section is drained by mainly the Kelani basin and also Kalu Ela which is a part of the Kelani basin. The bimodal rainfall feeds both basins during the two monsoons - Southwest and Northeast. Conventional rainfall of the country during the two inter-monsoon seasons (March – April and October – November) also contribute to the surface water bodies in the area. When rainfall exceeds the rate of infiltration into the ground, phenomena such as increased surface run-off and flood flows are frequent in the study area.

The OCH traverses through two major catchments- Bolgoda and Kelani and the sub catchment of Kalu Ela. Surface water quality of the Bolgoda and Kelani hydrological catchments as well as the Kalu Ela sub catchment was examined to establish the existing water quality and the monitoring results are given in table 5.1.16(A) in volume II and monitoring locations in figure 5-1-1(O), volume II.

Water quality is within the quality standards for potable water in Sri Lanka except in the tributary of Kelani river, just north of the crossing at Kaduwela, in the Kelani river catchment. At this location (water quality monitoring location 9) the ammonia nitrogen and nitrate and nitrite nitrogen levels are higher indicating organic pollution. Further northwards, in the tributary of the Old Negombo Canal within the Kalu Ela sub catchment (water quality monitoring location 11) the Biochemical Oxygen Demand and ammonia nitrogen levels are comparatively high.

Conductivity is high in the samples collected from the Bolgoda wetland system, in the Bolgoda catchment, (monitoring locations 1,2,3 and 5) indicating salinity.

High coliform levels were observed in the tributaries of Kelani River (monitoring locations 8 and 9) and at locations close to Batuwandara and Diyagama (locations 6 and 7). At monitoring location 10 in the Kalu Ela sub catchment, close to Pahala Biyanwela, coliform levels were excessively high.

Water quality in the Kelani river have also been measured at the National Water Supply and Drainage Board (NWS&DB) intake by the NWS&DB itself and National Building Research Organization (NBRO). Among the many water quality parameters that have been measured, the most significant parameters for Kelani River are organic matter from the large Volumes of sewage, organic and industrial effluent, nitrate from sewage and fertilizer smell and bacterial contamination from the community along the banks. Heavy metal contamination from tanning effluent is also a major contributor to the pollution load. Pesticide contamination is comparatively low as the Kelani drains through plantations where pesticide use is much lower than in irrigated agriculture. A survey conducted in 1973/74 shows a marked decrease down the river. Water quality data for Kelani River are given in Table 5.1.16(B) in Volume II.

The Bolgoda basin consists of Bolgoda canal, Weras Ganga, Bolgoda North Lake and its outfall, Panadura river, Bologoda river and Bolgoda South Lake and its outfall. Being close to Colombo, the upper catchment areas are densely populated with substantial industrial activity.

Earlier water quality monitoring results (NBRO:1987/88) indicates that salinity values are very high even at 15km upstream from the Panadura outfall Salinity values are high up to the South lake, about 22 km upstream from the Panadura outfall. The major contributor to the salinity in the South lake is probably the seawater.

Previous water quality monitoring results of the Bolgoda wetlands are tabulated as Table 5.1.16(C) in Volume II.

Groundwater: Groundwater resides mainly in unconsolidated deposits overlying the hard rock, in the weathered portion and in fractures and cavities of hard rock.

Groundwater in the Kelani basin is utilized in small scale from point sources for drinking and domestic water supply purposes. Access to drinking and domestic water supply are through dug wells, protected dug wells, tube wells and pipe borne supplies Groundwater is also extracted in large scale for industrial purposes through deep tube wells in hard rock aquifers and shallow screened tube wells, radial wells and large diameter wells.

In the Kelani basin the ground water quality varies spatially. Electrical conductivity ranges from 90 to 1400. Total Alkalinity from 14 to 268 mg/l and Total Hardness form 12 to 420 mg/l. Fluoride, Nitrate and Total Iron vary from 0.4 to 8 mg/l, 0.1 to 1.6 mg/l and 0.08 to 44 mg/l respectively. Average ground water quality is shown in Table 5.1.16(D), Volume II.

In the Bolgoda Basin, aquifers of superficial deposits are heavily used for abstraction of potable water. Fractured hard rock aquifers are also important in that in some locations they are the only source for ground water abstraction.

Ground water abstraction for drinking purposes is by shallow dug wells and tube wells and also water supply schemes.

Notwithstanding the ready availability of pipe borne water, some industries in the area directly abstract large quantities of ground water in order to reduce production costs. Groundwater quality in most areas of the basin is acceptable for drinking and relatively constant throughout the year.

In analyzing the groundwater quality of the basin, it was observed that about 30% of tube wells contain high iron concentrations. However, the shallow dug well water shows low iron levels. Other water quality parameters are depicted in Table 5.1.16(E); Volume II and it can be seen that whereas pH values are low Nitrate levels are high in industrial area

5.1.12 Existing Air Quality and Noise Levels

<u>Air Quality</u>

The ambient air quality was monitored through 09 locations along the trace by the Environmental Division of the NBRO. Levels of primary air pollutants as Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2) and Suspended Particulate Matter (SPM) were monitored and these were found to be very low in comparison with the Ambient Air Quality Standards stipulated by the Central Environmental Authority (CEA).

The NO_2 and SO_2 levels in particular are very low, except at the air quality monitoring location close to Makumbura at the High Level Road crossing (location 9). Even here the NO_2 and SO_2 levels at this location are also much lower, 44.69 and 47.8 ug/m^2 respectively, in comparison with the CEA Standards-150 and 120 ug/m^2.

The SPM levels though lower than the standards are somewhat higher in locations close to the existing busy roads (peak stations).

Sampling has been carried out in peak and non-peak hours and at the two locations at Sapugaskande the results of an earlier survey conducted for the CEA, has been used. Monitoring results are attached as Tables 5.1.17(A) and 5.1.17(B) and the locations in figure 5-1-1(O), Volume II.

CEA has not yet enforced any standards for vehicular emissions though it has embarked on a survey to collect information on roadside ambient air quality in the City of Colombo.

Noise Levels

Locations for noise level monitoring have been selected to represent both background noise levels and peak levels. Location B, D, G, H, I, L and M represent the residential areas whereas the other locations represent commercial/industrial areas besides busy roads.

At present there are no stipulated standards for noise levels emitted by vehicular traffic. However, a standard for noise level in general has been gazetted.

The noise levels recorded in the residential areas along the trace are below the limits stipulated for Mixed Residential Areas while those recorded from commercial/industrial areas are around and sometimes exceed the limit for industrial areas. The monitoring results are summarized in Table 5.1.17(C) and locations in Figure 5-1-1(O), Volume II.

5.2 Ecological Resources

5.2.1 Existing Habitats

In the project area and its vicinity within 1km range on either side of the proposed highway trace, seven types of ecological habitats were identified. These are as follows:

- Marshes
- Homestead gardens
- Paddy lands
- Plantation crop habitats

- Scrub lands
- Rivers and streams
- Lakes

Distribution of these habitats in the study area is shown in Map 5-3-1 in Volume II.

According to RAMSAR Convention 1987, "an area of marsh, fen, peat land or water, whether natural or artificial, temporary or permanent with water that is static, flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tides does not exceed six meters" is considered as a wetland. According to this classification, the marshes, streams, rivers, lakes and paddy lands in the area concerned can be considered as wetlands. The Directory of Asian Wetlands lists 947 important wetlands in South and South East Asian region of which 41 are present in Sri Lanka (Scott 1989). Of these, the Muthurajawela marsh wetland is present in the project area. In 1990, Sri Lanka signed the RAMSAR convention and therefore is committed to preserve ecological values and functions of the wetlands present in the country.

Along the proposed highway trace, about 7% of the land within 1 km range on either side are marshy land. Of the 100 m wide highway route, about 12% pass through marshes. The major marshy land present within this area is the Muthurajawela marsh. Marshes are also present in the flood plains of Kelani and Bolgoda rivers and around the Bolgoda lake. In the Muthurajawela marsh, the zones identified as the mixed urban zone and the buffer zone in the Conservation Management Plan (Anon. 1994 a) fall within this area. In fact, the proposed highway route runs through mixed urban zone, and the southern boarder of the buffer zone falls within 1 km range.

The marshes are of significant ecological importance due to many reasons. They absorb and retain pollutants, sediments and nutrients in the surface run-off. Therefore, they play a significant role in water quality regulation. Because of the retention of nutrients they are highly productive and are rich in faunal and floral diversity. They serve as breeding grounds and nursing areas for many species of fish. Marshes also serve as habitats for wildlife and provide areas for feeding, breeding and resting for many species of amphibians, reptiles, birds and mammals.

Marshes are also important for the control of storm water. They serve as storage areas of water and thus regulate the flow of water. The marshes also act as silt traps and therefore contribute to the control of erosion.

The marsh vegetation is utilized by the local communities for various purposes, i.e. sedges are used for weaving mats and food container covers, some plant species such as *Lasia spinosa* (Kohila) *Ipomoea aquatica* (Kankun) and *Centella asiatica* (Gotukola) are used as vegetables and *Annona glabra* (Wel aaththa) and *Cerbera* *manghas* (Gon Kaduru) are used to obtain poles for various purposes including fencing. The marshes are also important sites for research and education.

Some regions of the marshes in the project area and its vicinity especially those near the milk food factory at Welisara are used as dumping sites for solid waste.

Homestead gardens comprise about 21% of the land within 1 km range on either side of the proposed highway route. About 24% the entire length of the highway route runs through homestead gardens. Most of the homestead gardens are dominated with coconut. The vegetation includes some species, which are of medicinal value too. These include *Centella asiatica* (Gotukola), *Asparagus falcans* (Hathawariya) and *Osbeckia octandra* (Heen bovitiya). Some species in the homestead gardens are important either as fruit plants or vegetables. None of the plants in the homestead gardens are considered to be rare, threatened or endangered. These homestead gardens are ecologically important as feeding, nesting and roosting areas for many species of birds. Few species of amphibians, reptiles and mammals and some invertebrate species inhabit these habitats.

Paddy fields occupy about 13% of the land within 1 km range on either side of the proposed highway route. Of these about 23% are abandoned paddy lands. Of the entire route, about 23% runs through paddy fields of which about 14% are abandoned. The abandoned paddy fields serve as grazing grounds for cattle. The paddy lands, both cultivated and abandoned, harbour some species of amphibians, reptiles and mammals. They also serve as feeding and resting grounds for many species of birds. Small canals, which run through the rice fields, provide habitats for several species of freshwater fish, some of which are endemic.

Rubber and coconut plantations are present mostly in the southern region of the study area. Few are present in the northern region too. These plantations occupy around 13% of the land within 1 km range on either side of the highway route. Of the entire highway route too, about 13% passes through rubber and coconut plantations. The under-crops such as pepper and pineapple are also grown in some coconut lands. These rubber and coconut plantations provide nesting, feeding and roosting grounds for many species of birds. Some amphibians, reptiles and mammals are also present in these habitats. In some regions, vegetables are also grown in low-lying areas.

Only about 3% of the land within 1-km range on either side of the highway route comprise freshwater bodies. The two main rivers, which run through this area, are the Kelani and Bolgoda rivers. Few tributaries, which flow into these rivers, are also present. Only one lake is present within the 1 km range from the proposed highway route. This is the Bolgoda lake. These freshwater bodies provide habitats for many species of fish. A small fishery where few fishermen are involved exists in the Bolgoda lake. These fishermen use cast nets, gill nets and fish kraals in this fishery. These water bodies are used for domestic purposes such as bathing and washing too. Further, these provide irrigation water for vegetable plots and rice paddies. These freshwater bodies, also provide habitats for aquatic birds and amphibians.

Isolated habitats of scrub vegetation are also found in the project area especially in the surroundings of the Bolgoda lake. These constitute about 3% of the land within 1 km range on either side of the proposed highway route. Of the entire length of the highway route too about 3% run through the scrublands. Many species of birds, reptiles, amphibians, mammals and terrestrial invertebrates inhabit these scrub areas.

No forests or protected areas exist within 1 km range on either side of the proposed highway route.

5.2.2 Floral Diversity

Of the large number of plant species recorded in the homestead gardens, majority is highly abundant (Table 5.2.2(A) Volume II). Few species of endemic terrestrial plants, i.e. *Dillenia retusa* (Godapora), *Dipterocarpus zeylanicus* (Hora), *Garcinia quaesita* (Goraka), *Mangifera zeylanica* (Atamba), *Artocarpus nobilis* (Badi del) and *Osbeckia octandra* are also present in the homestead gardens. These species are widely distributed throughout the wet zone of Sri Lanka. None of the plant species present in the homestead gardens are considered to be rare or endangered.

The scrublands in the area are also rich in floral diversity. More than 60 species of vascular plants were recorded from these habitats during the present survey (Table 5.2.2 (B) Volume II). Some endemic plants e.g.: *Canarium zeylanicum* and *Osbeckia octandra* are also present in the scrublands. These endemic species are not confined to the project area and the vicinity but are widely distributed in the wet zone of Sri Lanka. None of the plant species recorded from scrub habitats are considered to be rare or endangered.

In addition to coconut and rubber, many other species of crop plants are also grown in the area concerned. These crop plants are listed in the Table 5.2.2(C), Volume II.

The marshes are rich in floral diversity. Several species of sedges including *Cyperus haspan*, *Fimbristylis miliaceae* and *Schoenoplectus grosus*, and *Pandanus odoratissima* (Wetakeiya) are abundant in the marshes. Isolated patches of mangroves were also recorded in some areas. The commonest mangrove species was Acrosticum *aurium*. The list of plant species recorded from the marshes and paddy fields within 1 km range on either side of the proposed highway route is given in Table 5.2.2(D), Volume II. No endemic, rare or endangered plant species were recorded in these habitats.

Many species of aquatic macrophytes are also present in the study area (Table 5.2.2(E)), volume II. The most abundant species include *Nymphaea lotus* (Olu), *Nymphaea stellata* (Manel), *Linocharis flava* (Diya gowa), *Hydrilla verticillata*, *Eichhornia crassipes* (Japan jabara) and *Salvinia molesta*. None of these species are endemic, rare or endangered.

The waterbodies in the area concerned are rich in phytoplankton. More than 70 species of phytoplankton were recorded in the freshwater habitats of this area (Table 5.2.2(F), volume II). None of these are either endemic or considered to be rare or endangered. These phytoplankton and aquatic macrophytes play a significant role as primary producers in the aquatic ecosystems.

In addition to the plantation crops (Table 5.2.2(C) volume II) many other species of plants in the study area are used for various purposes as stated earlier, i.e., as medicinal plants, vegetables and fruits, and to obtain wood for domestic purposes. In addition, some plant species such as *Nymphaea lotus* and *Nyphaea stellata* are of ornamental and cultural values. Some plant species, both terrestrial and aquatic, which are considered to be weeds are also present in the study area. These include *Salvinia molesta*, *Eichhornea crassipes*, *Eupatorium odoratum*, *Frimbirstylis milliaceae* and *Lantana camera*.

5.2.3 Fauna

Invertebrates

The freshwater habitats in the study area are rich in zooplankton such as rotifers and macro-crustaceans. These are listed in Table 5.2.3(A), volume II. This zooplankton serves as an important source of food for fish and thus play a significant role in the food web of aquatic ecosystems.

Large number of macro-invertebrates was recorded from the study area (Table 5.2.3. (B) Volume II). Eight species of annelid worms, ten species of molluscs, four species of macro-crustaceans and eleven species of insects were recorded from the aquatic habitats in the area.

In the terrestrial habitats within 1 km range of the proposed highway route, two species of earthworms, one species of mollusc, fifteen species of butterflies, two species of dragonflies and several species of beetles were recorded during the present survey.

None of the invertebrate species recorded during the present survey are endemic. No rare or endangered species were also recorded.

Fish

The rivers, streams, lakes and stagnant waters of the marshes provide habitats for many species of fish. These are listed in Table 5.2.3(C) volume II. Few endemic species, namely *Clarias brachysoma* (Magura), *Puntius bimaculatus* (Ipilli kadaya), Horadandiya *atukorali* (Horadandiya), *Belontia signata* (Combtail), *Channa orientalis* (Kolakanaya) and *Aplochielus dayi* (Nalahandaya) are present in the study area. Of these, all species other than *Clarias brachisoma* are considered to be threatened in the national context (Wijesinghe *et al.* 1993). *Belontia signata* is included in the IUCN's red list of threatened animals as a lower risk species whose populations are conservation dependent or likely to become vulnerable.

Clarias brachisoma is distributed throughout the wet zone low lands and the central hill region of the Mahaweli river basin. *Puntius bimaculatus* is distributed throughout the island and are more abundant in the wet zone. *Horadandia atukorali* is found in the coastal region of the wet zone frequenting swamps, rice fields and small water bodies of non-flowing water. *Belontia signata* is distributed in the Kalu and Kelani river basins in the south west region of Sri Lanka and in the mid hill region of the Mahaweli river basin upto 800 m. *Channa orientalis* is found in the southwestern region of the wet zone including the lower southwestern hills. *Aplocheilus dayi* is found to be more or less confined to the Kelani basin and adjacent coastal areas (Pethiyagoda 1991).
Many species of fish are of economic importance either as food fish or ornamental species.

Amphibians

Several species of amphibian are also present in the study area (Table 5.2.3. (D) Volume II). Of the 17 species recorded, only two species namely *Rana gracillis* and *Polypedatus cruciger* are endemic. These two species and *Tomopterna rolandae* are considered to be threatened in the national context (Wijesinghe *et al.* 1993). *Rana gracillis* is a semi-arboreal species distributed in the wet and dry zones of Sri Lanka upto an elevation of 460 m. *Polypedatus cruciger* is entirely an arboreal species found in human occupied habitats and wet forests. It is distributed throughout Sri Lanka in both dry and wet zones upto an elevation of 1525 m. *Tomopterna rolandae* is nocturnal and during the day it often burrows in loose soil. It is distributed in both dry and wet zones of Sri Lanka upto an elevation of 200 m. It is absent in rain forests (Dutta and Manamendra-Arachchi, 1996).

Birds

Many species of birds are also recorded from the study area (Table 5.2.3. (F) Volume II). These include resident species as well as migratory species. Four species of birds which are nationally threatened are found in the area concerned (Wijesinghe *et al.* 1993). Of these four, three species are included in the IUCN red data book as vulnerable or lower risk species. The vulnerable species is *Pelicanus philippensis* (Spot billed pelican) and the two species at lower risk are Threskiornis *melanocephalus* (White ibis) and *Anastomus oscitans* (Open bill). The other species is *Otus sunia*. However, according to Kotagama and Fernando (1995) *Pelicanus philippensis* and *Threskiornis melanocephalus* are very common and *Anastomus oscitans* is common while *Otus sunia* is rare. *Pelicanus philippensis* is a breeding resident distributed throughout the low country dry zone frequenting lagoons and tanks. The individuals of this species seen around Colombo are those released from the zoo, which have established a breeding population. *Threskiornis melanocephalus* is a breeding resident distributed in the low country inhabiting marshes, tank fringes, paddy fields and lagoons. However, in the wet zone, numbers are found to be small. *Anastomas oscitans* is a breeding resident distributed throughout the low country inhabiting marshes, tanks, rivers, lagoons and paddy fields. *Otus sunia* is distributed in both the dry zone and wet zone. It is a breeding resident that inhabits gardens and forests (Kotagama and Fernando, 1995).

Reptiles

Several species of reptiles including some endemic forms are present in the study area (Table 5.2.3(E) volume II). Twelve nationally threatened species are also present in the area studied. These are *Calotes calotes* (Green garden lizard), *Crocodylus porosus* (Estuarine crocodile), *Crocodylus palustris* (Marsh crocodile), *Lissemys punctata* (Soft shelled terrapin), *Melanochelys trijuga* (Hard-shelled terrapin), *Mabuya macularia* (Spotted skink), *Cerberus rhynichops* (dog-faced water snake), *Cylindrophis maculatus* (Pipe snake), *Acrochordus granulatus* (Wart snake), *Hypnale hypnale* (hump nosed viper), *Xenochrophis asperrimus* (checkered keel back) and *Phython morulus* (Phython). Of these, 3 species namely *Mabuya macularia*, *Cylindrophis maculatus* and *Xenochrophis asperrimus* are endemic and two species, namely Crocodylus *porosus* and *Python morulus* are included in the IUCN's red data book as a vulnerable and a lower risk species respectively.

The estuarine crocodile, marsh crocodile, land monitor and the water monitor are protected by the Sri Lanka's Wildlife Ordinance. The former 3 species are hunted for flesh. The danger to the two species of crocodiles is more due to hunting than due to habitat destruction. For all other nationally threatened species, the danger is mainly due to habitat destruction.

All these species are not confined to the project area and its vicinity within 1 km range on either side of the proposed highway route. They are distributed throughout the low country wet zone. Some of them are found in the dry zone too. (Anon, 1993a, b, 1994 b – f, de Silva 1996).

Mammals

Mammal species present in the study area are listed in the Table 5.2.3(G) volume II). These include three endemic species namely *Trachypithecus senex* (Purple faced leaf monkey), *Macaca sinica* (toque monkey) and *Roesettus seminudus* (fruit bat). *Trachypithecus senex* is also considered to be nationally threatened. Other nationally threatened species such as *Felis viverrina* (Fishing cat), *Loris tardigradus* (Slender loris) Tragulus *meminna* (Mouse deer) and *Lutra lutra* (Otter) also inhabit this area. *Felis viverrina* is included in the IUCN Red data book as a lower risk species. The loris and fishing cat are strictly protected under Schedule 14 of Sri Lanka's Wildlife Ordinance of 1979.

Trachypithecus senex inhabits low country wet zone especially Kalutara and Galle Districts. It is primarily a forest species but strays into homestead gardens in search of fruits. *Macaca sinica* is widely distributed throughout the island. *Roesettus seminudus* is distributed sparsely over the greater part of the lowlands in both wet and dry zones. *Felis viverrina* although threatened, is distributed throughout Sri Lanka both in the low country and hill country. It lives close to rivers and swamps and feeds mainly on fish. *Loris tardigradus* is confined to the low country wet zone (Phillips, 1984). It is scattered sparsely throughout this region in scrub jungles and forests. *Tragulus meminna* is distributed throughout the lowlands of Sri Lanka and also at high elevations in the central province. (Phillips 1980 – 1984). *Lutra lutra* is also not confined to the project area and its vicinity but is found in many other regions of the low country (Anon, 1993 b, 1994 e, 1994 f, 1995).

Animal Pathways

No significant animal movement pathways were identified within the project area and its vicinity.

5.3 Land Uses

5.3.1 Land Use Mapping

Base Material and Instruments Used

The base materials used for the land use mapping purposes were approximately 1:20,000 scale black and white, panchromatic aerial photographs with semi-matt surface, flown in 1999.

Aerial photo interpretation was carried out using the Topcon Mirror Stereoscope. The transferring of land use boundaries were done by using a Kargal Reflecting Optical Pantograph.

Methodology

Aerial photographs were selected for the relevant study area. Transparent overlays were covered in each alternate photograph relevant for the total study area. Centerline of Outer Circular Highway (OCH) was marked on the photographs, which were covered with overlaid transparencies. This centerline of OCH was demarcated on the 1:20,000 aerial photo mosaic by the engineers of the JICA Study Team. After demarcation of the centerline 100m wide strip and both sides of the centerline were demarcated, 1 km wide strips were marked along the road trace. Using mirror stereoscope and its 3 x power binocular attachment, systematic aerial photo interpretation and detailed analysis were done and demarcated different types of land use categories along the 100 m wide strip. Semi-detailed analysis was carried out along the 2 km strip. Possible kilometer intervals were also indicated along the proposed road trace of OCH.

The land use boundaries were compiled using field survey data and aerial photographic information. The final maps were compiled on a scale of 1:20,000.

5.3.2 Land Use Categories

Twelve land use categories were identified within the study area and also along the road trace strip of OCH. Total extent of the road trace strip is 484 ha and length is 48.4 kms. The major land use categories within the strip are built up lands, homesteads, paddy and marshes.

5.3.3 Legend of the Mapping Units [Land Use Categories]

Settlement and Associated Non-agricultural Lands

B - Build up areas
N - Metal quarries

Horticulture

H - Homestead gardens

Tree and Other Perennial Crops

C - Coconut plantations
R - Rubber plantations

Croplands

P - Paddy
Pab - Paddy abandoned

Annual Crops

MG - Market gardens

Range lands

SC - Scrub lands

Water Bodies

M - Marshes and swamps
WL - Water logged area
T - Tanks, wewa

5.3.4 Detailed Description of the Present Land Use Categories in the ROW of the Proposed Road Trace

The land use categories described below are depicted in Land Use Map in Volume II.

<u>Built-up Areas</u>

- This mapping unit consists of highly populated residential areas including hotels and places which are used for recreation purposes, commercial, industrial, administrative, institutional, transportation, power plants, cultural sites and urban open sites.

- This land use category mainly exists within Wattala, Mabole, Biyagama and Kaduwela Divisional Secretariat Divisions (DSD) of northern end of the road trace and Panadura Division of the southern area (see table 5.3.6).

- The total extent of this mapping unit is 104.7 hectares and it is 21.4% of the total land area of the road trace.

Metal Quarries

This mapping unit exits within the Biyagama DSD division (see Table 5.3.6) of the road trace. It occupies 0.3% and extent is 1.6 hectares of the land area within the road trace.

Homestead Gardens

- These are family residential units with home gardens and open spaces. Cultivation may include mixed crops like coconut, rubber, jak, breadfruit, aricanut palm, mango, papaw, banana and other plantation crops.

- This mapping unit commonly exists within all the DS Divisions of the road trace (Table 5.3.6).

- The total extent of the mapping unit is 116.3 hectares and it is 24% of the total land area of the road trace.

Coconut

- In this map unit only pure stands of coconut palm areas are included. Areas with regular density of coconut palms are separated and classified as coconut plantations. They occur mainly as smallholdings within the road trace. One large plantation (Limpass Watta) crosses at Pamunugama within the Bandaragama DSD division.

- The mapping unit mainly exists within the Bandaragama and Biyagama DSDs divisions of the road trace (table 5.3.6).

- The total extent of the mapping unit is 22.4 hectares and it is 4.6% of the total land area of the road trace.

Rubber

- Rubber is one of the main export crops in Sri Lanka. Most of the rubber areas lie below 2000 feet elevation of the sea level. Rubber is planted systematically mainly along the contours. Generally this mapping unit also could be seen as smallholdings except within Bandaragama and Homagama DSD division along the road trace.

- This mapping unit mainly exists within Homagama, Bandaragama and Kaduwela DSD division of the road trace (Table 5.3.6).

- The total extent of this mapping unit is 39.7 hectares, which is 8.2% of the total land area of the road trace.

Paddy

- Most of the paddy lands lie in the valleys or valley bottoms of the landscape and some are found on terraced slopes. These paddy lands are generally cultivated during the rainy season. Usually farmers cultivate paddy lands one season of the year.

- This mapping unit mainly exists within Maharagama, Homagama, Mahara, Kaduwela and Biyagama DSD divisions of the road trace (Table 5.3.6).
- The total extent of the unit is 95.3 hectares, which is 19.7% of the total land area of the road trace.

Paddy Abandoned

- These paddy lands were abandoned due to inundation, drainage, saline conditions and uneconomical situations.

- Above mapping unit mainly exists within the Bandaragama and Panadura DSD divisions of the road trace.

- The total extent of the mapping unit is 14.9 hectares, which is 3.1% of the total land use area of the road trace.

Market Gardens

- Lands in this mapping unit are used for cultivating vegetables and green leaves. These lands occur on the lowest part of the upland areas, which is slightly higher than the paddy cultivated areas and marshes.

- This mapping unit mainly exists within Homagama and Maharagama DSD divisions of the road trace.

- The total extent of the mapping unit is 17.2 hectares, which is 3.6% of the total land area of the road trace.

Scrub Lands

- These scrublands are generally found on the edge of the lagoon and marshy lands and also subjected to the flooding and salt-water intrusion.

- Mainly these types of scrublands occur at edges of the Bolgoda Lake and Bolgoda Ganga, Backswamp area of the Kelani Ganga and Galudapita marshes.

- This mapping unit is very prominent within Bandaragama DS division along the road trace.

- The total extent of the mapping unit is 14.4 hectares, which is 3% of the total land area of the road trace.

Marshes

- This mapping unit occurs within the depression closer to the coastal areas, Bolgoda Lake, Bolgoda Ganga and within the flood plains of the Kelani Ganga. These areas are covered with salt tolerant weeds and water loving plants.

- This unit is very prominent within Wattala and Bandaragama DSDs along the road terrace.

- The total extent of the mapping unit is 56.7 hectares, which is 11.7% of the total land area of the road terrace.

Rivers

The proposed road trace crosses two rivers, Kelani River at the boundaries between Kaduwela and Biyagama DS divisions and Bolgoda Ganga within Bandaragama DS division

Power Lines

Eleven high-tension power lines cross over the proposed road trace in the following manner (see the Land Use Maps, Volume II).

1 line within Wattala DS Division
3 lines within Biyagama DS Division
2 lines within Kaduwela DS Division
1 line within Maharagma DS Division
1 line within Homagama DS Division
3 lines within Bandaragama DS Division

Roads

The road trace crosses or affects the existing roads in the following manner:

Within Wattala DS Division

Colombo – Negombo railway line
One (1) A class road – (Colombo–Negombo A3 road)
One (1) B class road
Two (2) C class roads
Ten (10) D class roads

Within Mahara DS Division

One (1) A class road (Colombo–Kandy A1 road)
Two (2) B class roads
One (1) C class road
Two (2) D class roads

Within Biyagama DS Division

Two (2) B class roads
Five (5) C class roads
Twenty eight (28) D class roads

Within Kaduwela DS Division

Three (3) B class roads
Two (2) C class roads
Twenty (20) D class roads

Within Maharagama DS Division

One (1) railway line (Colombo–Avissawella)
One (1) A class road (Colombo–Ratnapura A4 road)
Three (3) C class roads
Three (3) D class roads

Within Homagama DS Division

Two (2) B class roads
Two (2) C class roads
Nine (9) D class roads

Within Bandaragama DS Division

Proposed OCH connects with proposed Matara Express Highway at Maswila.
One (1) A class road (Panadura–Horana A8 road)
One (1) B class road
Twenty (20) D class roads

Panadura DS Division

Road trace ends up with Colombo–Matara A2 road at Pinwatta.
Four (4) D class roads

Industrial Sites Affected by the Road Trace

Wattala DS Division

Two (2) factories

Biyagama DS Division

One (1) metal quarry
Two (2) clay brick ovens

Kaduwela DS Division

One (1) paint factory
One (1) brass equipment manufacturing factory

Maharagama DS Division

One (1) concrete products manufacturing factory

Homagama DSD

30% of a steel factory
One (1) concrete workshop
One (1) weaving center

Panadura DS Division

One (1) garment factory

<u>Educational and Religious Institutes Affected by the Road Trace</u>

Wattala DS Division

One (1) school
One (1) temple
One (1) Christian church

Mahara DS Division

One (1) school

Kaduwela DS Division

One (1) school

Homagama DS Division

15% of a temple

Bandaragama DS Division

One (1) school
Two (2) temples

<u>Burial Grounds Affected by the Road Trace</u>

Wattala DS division - 50% of a cemetery

Panadura DS division - One (1) cemetery

Recreation Areas Affected by the Road Trace

Wattala DS division - 50% of a play ground

Mahara DS division - 50% of a play ground

Present Land Use In the Study Area

The Land Use Planner has worked out the detail land use within the identified road trace (100 m wide belt). It was observed that the land use in the immediate vicinity is also more or less similar to the land use characteristics within the 100 m belt. However, the information provided by the GNs in the GN Divisions within the 2 km road corridor is discussed here. Table 5 provides the details obtained from the GNs in respective GN divisions.

Table 5.3.6 Land Use in 02 KM Wide Corridor

DS Division	Homestead acres	Low land acres	Barren land acres	Highlands acres
Wattala	2057	308	-	-
Mahara	132	55	-	30
Biyagama	2079	328	22	644
Kaduwela	1856	645	94	728
Maharagama	730	236	-	1112
Panadura	74	102	-	25
Homagama	619	436	30	1387
Bandaragama	6879	2075	-	1099

The above table indicates that Maharagama; Homagama and Bandaragama DS divisions have large area of highlands. These highlands are cultivated with rubber mainly. Biyagama, Kaduwela and Homagama D S Divisions contain some barren land. Most of these are wetlands, which may not be used for any development. The low lands are mainly paddy lands. The majority of the paddy lands are located in Kaduwela, Homagama and Bandaragama. But in general all the DS divisions have paddy lands. The community would prefer if the proposed road passes through paddy lands. These land areas especially large highlands will be useful in relocating displaced people.

5.3.5 Present Land Use in the Affected Area

Based on the calculation of the land use planner the land use pattern in the affected area is as follows:

Table : 5.3.7 Land Use in Affected Area [in acres]

DS div.	B	N	H	C	R	P	Pab	MG	Sc	M	Total
Wattala	18.5 (37.1%)	-	9.25 (18.6%)	0.65 (1.3%)	-	1.9 (3.8%)	-	0.6 (1.2%)	0.85 (1.7%)	18.10 (36.3%)	49.8 (100%)
Mahara	4.75 (21.2%)	-	10.5 (47%)	0.6 (2.7%)	-	6.5 (29.1%)	-	-	-	-	22.3 (100%)
Biyagama	22.40 (29.30%)	1.60 (2.10%)	25.05 (32.8%)	5.85 (7.7%)	1.40 (1.8%)	11.95 (15.7%)	2.10 (2.8%)	-	0.10 (0.1%)	5.90 (7.7%)	76.35 (100%)
Kaduwela	30.20 (37.7%)	-	16.25 (20.3%)	2.35 (2.9%)	6.90 (8.6%)	20.70 (25.9%)	0.75 (1.0%)	-	0.9 (1.1%)	2.0 (2.5%)	80.05 (100%)
Maharagama	0.5 (1.7%)	-	4.75 (16.4%)	1.40 (4.8%)	1.75 (6%)	17.85 (61.6%)	-	2.75 (9.5%)	-	-	29 (100%)
Homagama	6.65 (7.2%)	-	16.40 (17.9%)	1.25 (1.3%)	19.10 (20.8%)	30.25 (32.9%)	0.025 (0.3%)	12.20 (13.3%)	-	5,75 (6.3%)	91.85 (100%)
Bandaragama	13.65 (11.9%)	-	27.85 (24.2%)	10.15 (8.8%)	10.30 (9%)	6.10 (5.3%)	9.0 (7.8%)	1.65 (1.4%)	11.45 (10.0%)	24,90 (21.6%)	115.05 (100%)
Panadura	7.00 (40.2%)	-	6.25 (35.9%)	0.10 (0.6%)	.20 (1.2%)	-	2.75 (15.8%)	-	1.10 (6.3%)	-	17.40 (100%)

Key to above table:

B	=	Built-up Land	R	=	Rubber
C	=	Coconut	MG	=	Market garden
Pab	=	Paddy abandoned	H	=	Homestead
N	=	Metal Quarries	P	=	Paddy
SC	=	Scrubs	M	=	Marsh

5.3.6 Current Development Trends in the Study Area and the Road Trace (2 km and 100 m Belt)

The Wattala, Mahara and Biyagama DS Divisions in the northern end of the road corridor falls within the export promotion zone. At present some factories have been set up for this purpose. More development in this area can be expected in the future under the Government's export promotion strategies. However the scope for expansion of human settlement in these three DS divisions is very poor. The reason for limitation of human settlement is as follows:

- Land value is very high
- Private land is scarce to put up houses
- Most of the Government lands are being used for construction of factories

5.3.7 General Socio-Economic Characteristics

The general socio-economic characteristics in the study area are discussed here. Table 5.3.9 below shows the general characteristics in the area.

Table 5.3.9 General Socio-Economic Characteristics

DS Division	General characteristics
Wattala	Wattala area in general is urban and semi-urban. But the road trace runs through most of the rural areas of Wattala. Traditional people live in the rural areas. In some locations the road trace runs through urban and industrial areas. Large industries as the Lakspray Milk Processing Factory are located in the ROW. In urban and semi-urban areas large numbers of migrated population reside. In urban areas land holding size is very small, ranging from 10 to 20 perches. Adequate land for further development in the area is not available.
Mahara	Mahara being a division close to Wattala has more or less similar characteristics as Wattala Division. Main feature observed in the area through which the road trace runs are small parcels of land in which people have built houses. The residences are located as clusters. Sufficient bare land cannot be found for future development.
Biyagama	Biyagama is a main export industrial zone of the country. Garment factories are a main special character in the area. In some areas lands have become fragmented. But in some interior areas (far from the main roads) some lands can be found for future development, still.
Kaduwela	Rural as well as semi-urban areas can be found in Kaduwela. Rubber plantations are a significant land use feature in the interior areas. Far from the semi-urban areas barren land can be found for future development.
Maharagama	Maharagama is a division being rapidly populated. There is a trend for many people to come for residence. In interior areas paddy, rubber and vegetable gardens can be seen. Land holding size in the semi-urban areas are becoming very small.
Homagama	Agricultural land is a main characteristic in this area. Paddy and vegetable are the main crops. Traditional village communities still live in interior places in the division. Significant extents of rubber land also can be seen
Bandaragama	Well-established homesteads are a significant characteristic in the area. Except small town ships the other areas of the division can be categorized as rural. A substantial extent of land is under rubber cultivation.
Panadura	In the areas close to Galle Road the land holding size is small. A significant number of women indicated that communities are not living in harmony. Coconut is the main land use feature in the area. In interior places other crops such as paddy and rubber can be seen. Some unutilized land can be found in interior places.

The situation on other DS divisions located in the middle part of the road corridor and trace is different from the northern end. Still there are sufficient unutilized lands available in Homagama, Kaduwela and Bandaragama DS Divisions. There is a tendency of more people coming into these areas for building residences. The price is still affordable for middle level income earners such as Government and private sector employees. Maharagama is somewhat different from the other DS divisions located in the road corridor. Most of the land that are useable have been blocked out and sold to individuals for housing. In future these individuals will settle in the area. In Panadura DS division the areas close to Galle Road have been fully utilized for residences. In the interior still unutilized lands are available, but such lands have become small in area due to fragmentation.