CHAPTER 13

ENVIRONMENTAL IMPACT ASSESSMENT

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13.1 NATURAL ENVIRONMENTAL IMPACT ASSESSMENT

13.1.1 General Natural Environmental Impact

(1) Natural Hazards

Natural hazards relevant to Grenada include: hurricanes and their associated storm surges and wave action, earthquakes and earthquake-generated ocean waves (tsunamis), volcanic eruptions, landslides and rock-slides, and flooding.

The coastal communities with exposed west-facing harbor, buildings, and roads as well as the town of St. George's, are susceptible to damage from high velocity winds. Grenada's combination of steep mountains and rolling hills with relatively low porosity soils, contribute to rapid run-off and down-stream flooding. There are some near-shore coral reefs along Grand Anse Bay and other beaches on the west coast that act to protect beaches from high wave energy. On the east coast to Grenville, the beach is again protected by an offshore reef.

In Grenada a secondary effect of flooding on steep slopes covered with clay-rich soils is the increased tendency for landslides to occur. Mabouya, in the parish of St. John's, is listed as one of the worst land-slip areas in Grenada. Towns like Victoria, Grenville and Sauteurs are also prone to land-based flooding and landslides. Low bridges and river overpasses along the Grand Etang roads usually flood during periods of heavy rains. The River Road area is vulnerable to flooding which occurs frequently during the rainy season. Most roads, because of the steep terrain through which they are cut, are often damaged by landslides during exceptionally heavy rainfall

(2) Water Management

Annual rainfall in Grenada varies from approximately 1,270 mm (50 in) in dry coastal locations to 4,060 mm (160 in) in the wet central mountains. The length of the dry and wet seasons varies greatly depending on location, but there tends to be a dry season from about January to May and a wet season from about June to December. About 75 percent of annual average rainfall occurs during the wet season. No data are available for evapo-transpiration, but rough

estimates from Grenada and neighboring islands range from 1,000 mm/year to 1,300 mm/year.

Grenada has 71 distinct watersheds according to a map used by the Ministry of Agriculture, Land Use Division. The Study Roads are located within these watersheds, and tend to traverse mainly the valley regions, near the flood plain of rivers. Surface water (streams, rivers and ponds) is the major source of fresh water for human consumption and agriculture in Grenada. There is limited exploitation of groundwater reserves in the south of the island. The road network intersects rivers in many places, therefore consideration for pollution prevention is important given the heavy dependence on these systems for drinking water.

13.1.2 Grand Etang Road (R-1)

(1) Relief and Drainage

Grand Etang Road spans a distance of 20.5 km from St. George's to Grenville. The east-west main road rises from the River Road area which lies below the 25 feet mean sea level (MSL) contour line. This low lying area floods periodically when the St. John's River, which runs parallel to it in many places, overflows its banks during heavy rains. The road winds through the St. John's and Beausejour Watersheds, into the Grand Etang hills which reach a maximum elevation of 1800 feet MSL. From there it descends into the valley of the Great River watershed through St. Margaret, Lower Capitol, Balthazar and Grand Bras. The road ends in the town of Grenville which lies below 25 feet MSL, and is at or below sea level in some places. The town floods periodically due to heave sea swells and heavy rainfall.

The watersheds are drained by a system of rivers which the road crosses, facilitated by bridges, in several places.

(2) Geology and Soils

From River Road up to the foothills of the Grand Etang the geology is characterized as reworked volcanic. The valley of the St. John's River up to Mt. Gay is made up of Plains Clay loam which represents areas of aggregation with slope incline ranging form 2 - 3°. This soil is fine textured and well drained.

From Mt. Gay into Vendome, slopes are 20 - 30° and the soil is eroded with up to 50% of the topsoil removed. The soil is a Concord Clay Loam which is fine textured, imperfectly to moderately well drained, black to dark brown and very

deep. Basalt lava flows underlay the soils from Vendome up to the 1800 contour line. In that area slopes are 20 - 30° and in some places greater than 30°. The Capitol Clay loam which characterizes this area is a very steep shallow phase soil. It is moderately eroded with over 50% of the topsoil removed and is a fine textured, moderately well to well drained reddish soil of variable depth.

The dip between the 1800 contour line and the outer crater of the caldera is made up of andesitic lave flows and domes. The inner cone of the caldera is characterized as Scoria and Ash. The eastern outer fringe of the Grand Etang Caldera is also made up of andesitic lave flows and domes. Following this zone is another band of basalt lava flows which ends between St. Margaret and Mt. Pleasant Estate. The entire valley of the Great River System is made up of reworked volcanics.

In the immediate vicinity of the Great River Flood Plain, there is a band of Plains Sandy Loam soil. This soil type which extends from Birch Grove to the river's confluence with the sea, represents areas of aggregation, and a medium to coarse textured well drained soil. Between Grand Bras and the town of Grenville there are several small pockets of clay loam soil with slopes ranging from 10 - 30°, all slightly eroded with up to 50% of the topsoil removed.

Soils in the Grand Etang Forest Reserve are protected from erosion by the dense vegetative cover. Except for occasional slides of moisture laden chemically weathered topsoil, there is little evidence of soil erosion in the upland areas. Land clearing to plant crops and to build houses contribute to the large amounts of soils that are lost during heavy rainfall.

(3) Climatology

Prevailing weather and seasonal variations in climate observed along the Grand Etang Road is a function of relief features. The Northeast "trade" winds which blow across the island drop most of its moisture over the Grand Etang hills. The Eastern side of the country tends to be warmer than the west and annual rainfall is generally higher. This is attributable to the fact that the warm rain-bearing "trade" winds are moisture laden when they come in contact with the island on the east. As they rise over the mountains, they cool and lose their moisture as rain. These winds blow down the western side of the island as cool drier winds.

As a result of topography and the relief rainfall phenomenon, the Grand Etang Road dissects six agro-climatic zones. Rainfall in these zones range from 1500 mm - 2000 mm per year in lowland areas up to a high of over 4000 mm per

year in the Grand Etang hills. Due to altitude the Grand Etang Forest is not affected by the shifting of the Inter-Tropical Convergence Zone (ITCZ) as much as the lower land areas. Consequently, there is no dry season and relief rainfall is experienced throughout the year.

(4) Flora and Fauna

The influence of altitude and temperature, humidity, rainfall and soils interacts to produce distinct ecotypes from River Road to Grand Etang, and from Grand Etang to Grenville. Ecotones can be found in Mt. Gay, Vendome, St. Margaret and Grand Bras, where ecotypes blend into each other. The influence of man cannot be ruled out since forest management practices and agriculture/cultivation have affected species type, dominance and diversity throughout the study zone.

In the lowland areas all of the primary vegetation have been removed due to years of cultivation and settlement. The resultant climax community is a deciduous seasonal forest. Representative plants include; tantacayo, silk cotton, mangoes, galba, coconut, wild tamarind, sand box, cutlet and cypre. Some food crops are also grown in backyard gardens.

Intensive farming of cash crops, bananas, cocoa, and nutmeg can be found along Grand Etang Road, between Mt. Gay and Vendome, and Grand Bras and St. Margaret. From Mt. Gay to Vendome, and Grand Bras to Balthazar, the climax community type is an evergreen and semi-evergreen forest. An extensive lower montane forest extends from Vendome to Lower Capitol. In the Grand Etang Reserve primary and secondary growth of hardwood trees, ferns, mosses, epiphytes, bromeliads along with an extensive list of small shrubs flourish, as part of a protected watershed and national park system. Plant species take advantage of high humidity and rainfall, and bio-diversity is relatively high. Line transects were conducted in the forest reserve and the Shannon Weaver diversity index (H) was found to be 2.63, and the maximum possible diversity 3.45. This means that the equitability index or evenness of distribution for the area is 76.33 percent.

The Grand Etang Forest Reserve provides a haven for a wide variety of birds, mammals, reptiles and insects, where they can nest and reproduce without interference from humans. Many of these animals however, migrate to the lowland to feet since most fruit bearing trees are found there. They are most vulnerable during their migration and are often caught and eaten by locals. From coast to coast (River Road to Grenville), extant animals which can be encountered include: monkeys, opossum, tatoo, ramier, herons, galldin, cattle

egret, hawks, lizards, frogs and toads, grasshoppers, crickets, several species of butterflies and flies, mullets and freshwater fishes, crabs and crayfish.

(5) Aquatic Ecology and Water Quality

The streams within the reserve, and all of the watersheds which the road dissects, are very important in maintaining the ecological balance within the ecotypes observed along the road. Many insects and all amphibians complete their life cycle in water. Tests were conducted on grab samples at the point where streams and roads intersect at bridges. Emphasis was placed at the bridges where reconstruction or rehabilitation work will be done.

The following physio-chemical water quality parameters were monitored; Dissolved Oxygen, pH, Temperature, Ammonia, Chloride, Hardness, Total Alkalinity, Orthophosphate, Free Dissolved Carbon Dioxide, and Nitrates. These parameters are important in determining the systems' ability to sustain the life-forms which live there. This baseline date will be useful in determining the impact of construction works on stream water quality. Mean results obtained at five sampling stations are summarized in Table 13.1.1.

High Oxygen and low nutrient concentrations are encouraging results which suggests that there were no major sources of pollution at the time of sampling. In-stream biological communities provide the best indicator of water quality since they are resident in the stream ecosystem. Their abundance and relative dominance/diversity allow deductions to be made on stream quality.

Table 13.1.1 Water Quality Parameters for Streams Intersecting Grand Etang Road

Parameter	St. John's River River Road	Beaulieu Bridge	Great River Birchgrove Brg.	Balthazar Brdg. Great River	St. Cyr Bridge Great River
Dissolved Oxygen	6.6	7.2	8.2	7.4	7.4
Temperature	26.5	23.0	24.5	24.0	24.5
pH	8.0	8.0	8.0	8.5	8.8
Orthophosphate	<0.2	nil	BDL	BDL	BDL
Nitrate	<0.2	BDL	BDL	BDL	BDL
Ammonia	BDL	BDL	BDL	BDL	BDL
Chloride	60.0	36.0	Nil	16.0	20.0
Hardness	132.0	116.0	62.0	96.0	88.0
Total Alkalinity	132.0	108.0	0.0	88.0	78.0
Carbon Dioxide	10.0	10.0	35.0	No free	No free

Qualitative observations were also conducted to further characterize the streams. These include odor, color, substrate type and tree canopy cover - they are presented in Table 13.1.2.

Table 13.1.2 Streams Habitat Features and Faunal Community

Parameter	St. John's River River Road	Beaulieu Bridge	Great River Birchgrove Brg.	Balthazar Brdg. Great River	St. Cyr Bridge Great River
Substrate type	Stones, gravel; riffle/pool habitat	Riffle/pool/riffle habitat; pebbles gravel and fine silt	Riffle; pebbles and small stones insterspersed with gravel	Riffle habitat; medium sized stones; fin to coarse gravel	Small stones, detritus, fine sand/silt
Tree Canopy % cover	Open upstream sample station; closed down-stream	Open: macro-phytes on periphery and "islands"	75% cover by hardwood trees; open areas dominated by macrophytes	Open upstream; 65% closed downstream of sample station	Open in channel; 65% on the periphery
Vegetation type	Sedge, silk cotton, galba, wild tamarind, tantacayo	Sedge, water grass	Sedge, bamboo	Sedge on "islands', bamboo dominant downstream	Sedge; bamboo; sand box; governor plum; hog plum
Odor	---	---	---	---	---
Color	Slightly cloudy	clear	clear		Clear
Water Depth	12 inches	6 to 12 inches	16 to 30 inches		12 – 24 inches
Faunal Community	gastropods, fish, water striders, ephemeropteran dragon fly larva	gastropods, crayfish, mayfly, larva, stone fly larva, chironomid larva	gastropods, mullet, crayfish, dragon fly larva, stone fly, dipteran larva	Trichopteran; ephemeropteran; stone fly, dragon fly larva	Ephemeropteran; dipteran larva, dragon fly larva; crayfish; mullet, stone fly larva, trichopteran (caddies fly)

* color of water in rivers change during periods of heavy rain as sediment transport increases

There are no substantive records of stream macro-invertebrates or other aquatic fauna in streams/rivers of Grenada. Grab samples were collected from the substrate where water samples were collected for physio-chemical analysis. For all streams sampled, organisms from orders which are usually found in unpolluted systems were dominant.

13.1.3 Morne Jaloux Road (R-2)

(1) Relief and Drainage/Climatology

The Morne Jaloux Road travels in a southerly direction from its junction with the Parade Road, and ends on "The Cliff". This road dissects a region of similar physio-geography to the Mt. Gay/Springs road and therefore has similar climatology. The major differences between the two roads is attributable to the fact that the Morne Jaloux Road sits on the Richmond Hill ridge at elevations between 400 – 600 feet above MSL. There are no rivers in that area, and surface flow is as a result of run-off during rain events.

(2) Geology and Soils / Flora and Fauna

There are no distinctive geological features along the road and one main soil type exists. It is a Woburn clay which has slopes greater than 30 degrees in some places, where it is slightly eroded with up to 50% of the top soil removed. No important habitat type exists for flora and fauna known to be endemic to Grenada, endangered or threatened. Environmental concerns due to the road rehabilitation project are therefore minimal, and can be managed during project implementation.

13.1.4 Mt. Gay/Springs Road (R-4)

(1) Relief and Drainage

This road segment begins in the valley of the St. John's River, at an elevation of 200 feet above MSL. It reaches its' highest point (approximately 500 – 600 feet MSL) at the round-about which links it to several other main roads serving the St. George's capital. From there it winds its way into the Richmond Hill valley and ends up at the Woodlands Sugar Factory, a low lying area with an elevation under 100 feet MSL. The Tempe River is the only one crossed by the road. Other forms of drainage are mainly storm water flows which are channeled into ditches along the road.

(2) Geology and Soils

There are no significant geologic features along the Mt. Gay – Springs Road. The entire valley floor which it traverses is made up of re-worked volcanic deposits. Soil type along the road is composed mainly of Hartman clay, which has a high water retention capacity. It is slightly eroded with almost 50% of the top soil removed. Ground water which is fed from the surrounding hills is exploited in the Woodlands valley.

(3) Climatology

The zone around the Study Road receives 1520 mm to 2030 mm of rainfall annually. The growing period is short and the dry season extends for three to four months. These features result in a deciduous seasonal forest. Annual temperatures are very warm, ranging from 25°C to 27.5°C.

(4) Flora and Fauna

There is no significant wildlife habitat in this region since over 70% of the natural vegetation has been removed for human settlement. Roughly 65% of the Woodlands valley is used to cultivate sugar cane, and the rest is covered by a dry shrub forest. A similar mix of native birds to that found along the east coast can be observed in this area. It is not unusual to encounter opossum in the wetter months when fruits are in abundance.

(5) Aquatic Ecology and Water Quality

Surveys were conducted on the St. John's River at its intersection with the Tempe Bridge to assess the quality of the water and in-stream community. Although the sample record is too brief to give a true picture of the prevailing trend, one can conclude that at the time of sampling there were no sources of pollutants entering the stream. Physio-chemical parameters of Dissolved Oxygen, pH, Chloride, Hardness, and Dissolved Carbon Dioxide were monitored. Grab samples of the substrate were also collected to determine the biological index of the faunal community. As is the case for other streams sampled, species which are intolerant of heavy pollution, and are therefore found in "clean" systems were observed. Summaries are provided in Table 13.1.3.

Table 13.1.3 Water Quality of St. John's River

Parameter	St. John's River	Parameter	St. John's River
Dissolved Oxygen	6.6	Substrate type	Riffle habitat before bridge; gravel, pebbles
pH	8.0	Tree canopy % cover	85% covered
Carbon Dioxide	15.4	Vegetation type	Sedge, cypre, immortel, cedar, mango, galba
Chlorides	40.0	Water Depth	6 – 12 inches
Hardness	128.0	Color/Odor	clear/nil
Alkalinity	148.0	Faunal Community	Gastropods, crayfish, mullet, caddies fly

13.1.5 Eastern Main Road (R-5)

(1) Relief and Drainage

The Grenville/Sauteurs Road covers a distance of 16 km and connects to the town of Grenville in the South, to Sauteurs in the North. The segment selected for study passes through Dunfermeline, Pearls, Conference, Tivoli, Mt. Rose, Lower La Taste, Morne Fendue and La Fortune. In most cases the land is gently rolling and lies below an elevation of 400 feet MSL. From Grenville which lies below the 25 feet MSL contour line, the land gently rises to an elevation of 400 feet in Mt. Rose. There is a gentle decrease in elevation as one travels further North into Lower La Taste, and a gentle rise into Morne Fendue/Rose Hill area. The Study Road ends at an elevation of 200 feet above MSL, in the town of Sauteurs.

The road intersects seven watersheds, and their associated rivers which drain their valley slopes. The largest crossings are facilitated by bridges at Paradise, Dunfermline, Moya, Poyntzfield, and Morne Fendue. Generally, the area is well drained with flooding taking place only at the low lying bridge at Poyntzfield. Landslides are an uncommon feature along this road due to the gentle terrain. However, in areas of human disturbance where vegetative cover has been cleared for planting or construction, earth movement may occur.

(2) Geology and Soils

The underlying geologic structure along the entire road is characterized as re-worked volcanics. The associated soils show more variation with aggregational deposits in the river floodplains, and Belmont clay loam from Telescope to Lower La Taste. The Rose Hill area is made up of Perseverance clay soil which has a slope of 10 – 20 degrees and is slightly eroded. Soils in the La Fortune area consists mainly of Woburn clay loam which also has a slope of 10 – 20 degrees and is slightly eroded. The alluvial deposits in the valley floor are exploited for agricultural purposes.

(3) Climatology

Due to its location on the Northeastern border of the island, the road dissects an area that receives under 2500 mm of rainfall annually. This agro-climatic zone experiences very warm temperatures with average ranges of 25°C to 27.5°C in the growing period. The growing period is relatively short, under 200 days per year. Most of the Northeast trade winds which blow over that region

lose its moisture in the Mt. St. Catherine area. As a result the dry season is long, lasting for three to four months. The agro-climatic conditions which characterize this area supports a deciduous seasonal forest.

(4) Flora and Fauna

The deciduous woodlands which have developed as the climax community along the Grenville/Sauteurs Road is dominated by Cypre, Cutlet, White Cedar, Tantacayo, mangoes, galba, and varieties of fruit trees. Cultivated areas are dominated by sugar cane in the lowland, and nutmeg, cocoa, and bananas in higher elevations. Shrub areas are dominated by sage bushes.

Seed eating birds are the dominant fauna observed in the vicinity of the roadway. Species include ground doves, hawks, pek-a-o, mocking bird, red eye "grief", cici black birds, blue jacks, grass quits, and cobeau (local common names). The Grenadian fly-catcher was observed in the study zone. This bird is endangered, and a large percentage of its habitat in lowland areas are under threat due to expansion of human activity. Since road rehabilitation does not involve any tree removal, there should be no concern for disturbance of its habitat.

(5) Aquatic Ecology and Water Quality

Three bridges will be rehabilitated under the project. Therefore, surveys were conducted on the rivers which they intersect to determine potential impact on in-stream water quality and ecology. Grab samples were collected and analyzed to provide baseline information which will allow for the development of appropriate protection measures during bridge construction works.

Results obtained suggests that the streams have good water quality and support faunal communities typical of unpolluted aquatic systems. Water quality data, stream characteristics and faunal community are summarized in Tables 13.1.4 and 13.1.5 below.

Table 13.1.4 Water Parameters for Streams Intersecting Eastern Main Road

Parameter	Madey's Bridge	Poyntzfield Bridge Antoine River	Dunfermline Bridge
Dissolved Oxygen	6.6	6.6	7.6
Temperature	25.6	24.0	24.5
pH	8.5	8.5	8.0
Orthophosphate	<0.2	BDL	---
Nitrate	<0.2	BDL	---
Ammonia	BDL	BDL	---
Chloride	88.0	64.0	84.0
Hardness	168.0	116.0	140.0
Total Alkalinity	144.0	120.0	148.0
Carbon Dioxide	no free	no free	no free

* values in ppm or mg/l BDL = Below detectable limit (not zero)

Table 13.1.5 Stream Habit Features and Faunal Community

Parameter	Madey's Bridge	Poyntzfield Bridge	Dunfermline Bridge
Substrate type	Stones, gravel; riffle habitat	Riffle habitat detrius, fine sand/silt	Pool/riffle habitat, stony with gravel
Tree Canopy % Cover	Closed, >85%	Open up stream, closed down stream	Open upstream; 65% downstream
Vegetation type	Mango trees, galba cypre	Mango, bamboo, sedge, silk cotton	Bamboo, sedge, roseau
Odor	---	---	---
Color	Clear	Clear	Clear
Water Depth	12 – 26 inches	12 – 30 inches	20 – 36 inches
Faunal Community	Stone fly larva, mayfly larva, dipteran larva, crayfish, mullet	Gastropods, crayfish, mullet, stone flies	Gastropods, crayfish, ephemeropterans; trichopteran larva

13.1.6 Mitigating Measures on Natural Environmental Impact

As the proposed road improvement works may affect the natural environment along the Project Roads, necessary mitigating measures are proposed as stated in the following sections for each road.

(1) Grand Etang Road (R-1)

Location	Proposed Improvement Measures	Recommendations and Mitigatory Measures
River Road (left side, along river opposite residential area)	• Cut trees along St. John's River to facilitate construction of road protection embankment walls.	• Provide plant boxes as part of embankment wall to plant trees which can provide shade and add aesthetic value to roadway. • Plant young trees in area north of improvement site which has sparse vegetation.
Mt. Gay spots 2 and 3	• Build retaining walls H=5.0m • Cut vegetation to facilitate works.	• Maintain unpaved area between road and embankment wall. This will allow for re-growth of vegetated buffer.
Beaulieu Bridge	• Rehabilitation and restoration work.	• Restore substrate of channel to previous conditions.
Sung Corner – Vendome	• Cut corners and embankment to widen road. • Removal of tree cover to facilitate work.	• Clean up dust and debris, and wet road during dry periods. • Create traps and diversions to prevent runoff of sediments into drains and ditches.
Vendome Bridge	• Realign roadway and complete new bridge. • Surrounding vegetation will be cut to facilitate road realignment.	• Protect stream (feeds water facility at Annadale) from increased sediment loading by creating temporary dams and traps. • Restore stream after bridge construction.
Grand Etang Forest Reserve Sta. 6+550 – Sta. 6+800	• Widen corners in two locations (1m) to improve stopping site distance. 1. length = 80m 2. length = 45m	• Remove displaced soil should be removed as soon as possible, and stocked piled for restoration / re-vegetation.
Grand Etang Forest Reserve Sta. 6+880 – Sta. 6+920	• Convex slopes of bend in road will be cut 1m, length = 40m	• Provide rounded top slopes and berms with width of 1.5m. • Re-vegetate as soon as possible using same plant types as existing conditions.
Grand Etang Forest Reserve Sta. 7+000 – Sta. 7+300	• Widen road 1.0m at two sections 1. length = 30m 2. length = 50m	• Provide embankment walls using stones, bamboo and rip raps, which will hold loose material in place and allow re-vegetation to occur.
Grand Etang Forest Reserve Sta. 7+350 – Sta. 7+390; Sta. 7+510 – Sta. 7+540	• Widen convex slopes of bend in road 1m , over 1. length of 40m 2. length of 30m	• Provide rounded top slopes and berms with width of 1.5m. • Re-vegetate as soon as possible using same plant types as existing conditions.

Location	Proposed Improvement Measures	Recommendations and Mitigatory Measures
Grand Etang Forest Reserve Sta. 7+920 – Sta. 7+970	• Widen concave corner 1m, over a length of 50m	• Remove displaced soil as soon as possible, and stocked piles for restoration / re-vegetation. • Deflect storm water runoff from site.
Grand Etang Forest Reserve Sta. 8+605 – Sta. 10+390	• Widen road 1m to improve stopping site distance in 6 places: 1. length = 25m 2. length = 30m 3. length = 35m 4. length = 26m 5. length = 30m 6. length = 50m	• For concave slopes: Remove displaced soil as soon as possible, and stocked piled for restoration / re-vegetation. • Deflect storm water runoff from site. For convex slopes: Provide rounded top slopes and berms with width of 1.5m. • Re-vegetate as soon as possible using same plant types as existing conditions.
St. Margaret Sta. 10+625 – Sta. 11+145	Road works include: • Cutting of banks to straighten out bends and widen road. • Embankment walls	• Remove displaced soil as soon as possible, and stocked piled for restoration / re-vegetation. • Deflect storm water runoff from construction site to prevent sediment transport into tributary of Great River.
St. Margaret's to Birch Grove Sta. 11+480 – Sta. 12+600	• Several small corners in the road are proposed for widening, 1m, to improve stopping site distance. • Embankment walls will be built in a few places.	• Remove displaced soil as soon as possible, and stocked piled for restoration / re-vegetation. • Deflect storm water runoff from construction site to prevent sediment transport into tributary of Great River.
Birch Grove Bridge Great River flows underneath bridge	• Bridge will be rehabilitated to allow two lane traffic.	• Protect river from increased sediment loading by creating temporary dams and traps. • Restore aquatic habitat after bridge construction to allow recolonization of fauna.
Lower Capital to Balthazar Sta. 14+130 – Sta. 15+050; San Souci Estate and Grand Bras Sta. 18+490 – Sta. 18+520	• Widening of road around bends and construction of embankment walls.	• Remove displaced soil as soon as possible, and stocked piles for restoration / re-vegetation. • Provide water turnouts at 200 feet intervals to reduce volume of water discharged into streams.
Balthazar and St. Cyr Bridges - crossing with Great River	• Bridge will be constructed upstream and downstream, respectively, from the old one. Road will be realigned.	• Protect river from increased sediment loading by creating temporary dams and traps. • Restore aquatic habitat after bridge construction to allow recolonization of fauna. • Remove displaced soil from banks along road way as soon as possible, and stocked piled for restoration / re-vegetation.

(2) Morne Jaloux Road (R-2)

Location	Proposed Improvement Measures	Recommendations and Mitigatory Measures
Sta. 0+710 Sta. 1+150 Sta. 1+665 Sta. 2+340	• Create turnout to improve traffic flow along narrow road. 1. W=3.0m, L=20m 2. W=3.0m, L=20m 1. W=3.0m, L=10m 1. W=3.0m, L=30m	• Clear mature strands of vegetation to create turnouts. As much as possible the periphery of the turnouts should be re-vegetated. • Enhance vegetated zones in other locations along the study road mitigate for that which will be destroyed. • Remove displaced soil as soon as possible, and stocked piled for restoration / re-vegetation. • Create water turnouts at 200 feet intervals to reduce volume of water discharged into storm drains.
Sta. 3+400	• Road widening 0.9m, length = 740m	• The same recommendations and mitigatory measures above can be also applied at this road segment. • Sprinkle dust with water to reduce air borne particles and fouling of vegetation in residential and tourist area.

(3) Mt. Gay / Springs Road (R-4)

Location	Proposed Improvement Measures	Recommendations and Mitigatory Measures
Tempe Bridge	• Widen bridge (down-stream end) to allow two land traffic	• Protect river from increased sediment loading by creating temporary dams and traps. • Restore aquatic habitats after bridge construction to allow recolonization of fauna.
All Segments selected for road widening	• Road widening to improve traffic conditions and stopping site distance	• Remove displaced soil as soon as possible, and stocked piled for restoration / re-vegetation. • Deflect storm water runoff from construction site to prevent sediment transport into waterways.
Springs/ Woodlands Junction	• Intersection improvement – realignment of roadway	• Deflect storm water runoff from construction site to prevent sediment transport into waterways.

(4) Eastern Main Road (Grenville / Sauteurs) (R-5)

Location	Proposed Improvement Measures	Recommendations and Mitigatory Measures
Bridge at: 1. Dunfermline 2. Poyntzefield 3. Madey's	• Widen bridge (upstream) to allow 2 land traffic • Low-lying bridge will be lifted above flood0plain to prevent flooding • Bridge will be reconstructed downstream from existing structure	Same mitigatory measures apply for all bridge. • Protect river from increased sediment loading by creating temporary dams and traps. • Restore aquatic habitats after bridge construction to allow recolonization of fauna.

13.2 SOCIAL ENVIRONMENTAL IMPACT ASSESSMENT

13.2.1 Grand Etang Road (R-1)

(1) Historical Background

This road started from the town of St. George's, and made its way along the St. John's River. It started as a footpath, then a trace, and later a carriage-way. It was one of the main areas that benefited in 1879, which marks the beginning of road construction and bridge building in Grenada. In 1902, the iron bridge at La Force which crosses the Great River was constructed. Historical sites along the route include:

- Great house at Beaulieu
- Constantine Methodist Church
- Balthazar Estate
- Byelands Estate Ruins
- Mirabeau
- Road Sign at Balthazar
- San Souci Estate
- Bridge at Birch Grove

(2) Population and Community Structure

The major population centers are along the road and in the towns of St. George's and Grenville, where densities are the highest. Table 13.2.1.1 provides information on the population of villages found along the roadway (1991 Population Census). As in earlier sections of this report, women make up over fifty percent of the communities. The town of St. George's, has a population of 3909, and Grenville 1264 persons. The village with the highest population is Vendome, and St. Margaret has the lowest.

Data on the households along the way, represents that collected during field surveys. It shows that River Road has the largest population (based on households) which will be affected by the project. Women are the head of most households and children account for fifty percent of the population.

(3) Land use and Settlement Pattern

With the exception of the towns and the land along roads, lands within the study area are forested with natural vegetation and agricultural crops. In River Road and Grenville, settlement is in dense clusters, while along the road it is linear. The surrounding hinterland has few houses and most developments are only a few meters from the roadway.

(4) Manpower and Employment Opportunities

The area has a young and active workforce. Forty-four percent of the women are unemployed and over fifty percent are under the age of 36. There are several shops, schools and commercial establishments which can provide employment for women. Most of the employment opportunities however, are in the town, St. George's. Agriculture represents the largest employment sector for people along the Grand Etang Road from Vendome to Grand Bras.

(5) Housing and Community Infrastructure

Table 13.2.1 provides a listing of the number and sizes of houses found along the roadway, as well as shops and other community service centers. The majority of the houses are small, yet have the basic amenities of telephone, electricity and water. Squatting is found only in the River Road area. There are many small retail shops which provide self-employment for mainly women. Larger commercial establishments are found in St. George's.

(6) Natural Spots and Cultural Centers

Grand Etang National Park is the major tourist attraction along the Study Road. It receives over one thousand visitors a month in the peak tourist season. The facilities at Grand Etang were used in the past for weddings, festivals, and honeymoons. Today the park is still used by locals as a recreational center.

Annandale falls which is accessed via this road through Constantine at its' junction with New hampshire also attracts visitors. St. Margaret falls is frequented by both locals and eco-tourists. The condition of this road is therefore of socioeconomic importance to the locals, tourists and Grenada as a whole.

Table 13.2.1 Socioeconomic Conditions - Grand Etang Road

Feature	River Road	Mt. Gay	Beaulieu	Snug Corner	Constantine	Vendome	Grand Etang	St. Margaret	Spring Garden Estate	Birch Grove	Lower Capitol	Balthazar Estate	San Souci	Grand Bras	Grenville
Population	Town	284	682	228	180	589	Forest		361	414	314			421	end in
- male		136	334	131	98	289	reserve	1	188	209	163			236	town
- female		148	348	157	85	299		0	173	205	151			185	
Number of houses	291	123	155	54	27	142		5	87	98	121	9	38	110	53
- large	75	39	29	18	5	40		-	16	15	36			6	
- medium	115	48	74	28	10	52		2	30	37	37			3	
- small	101	36	52	12	12	50		3	41	48	48				
Commercial	38		110		10	5			6	21	22		4	110	12
- large	8		-	1	-	-			-	1	-				
- medium	19		7	3	5	2			1	10	6				
- small	19	2	4	2	5	3			5	10	18				
Churches	1			2	1	2				1				1	1
Schools	1			1	1	2				2				1	3
Health Center				1						1				1	
Post Office	1			1		1				1					
Community Center	1					1				1				1	
Police Station										1					
Agricultural lands			21			18			11	18	12		2	7	
- large			9		-	3			-	2	-				
- medium	1		4		2				5	7	4				
- small	2	8	8	13	4	15			6	9	8				
Historical/Cultural archaeological sites															
Nature Spots							Hiking trails								
Tourist Attractions							Lake, forest, national park								
Recreation Centers	1			1		1									
Industries/Manufacturing		3								2			1		

13.2.2 Morne Jaloux Road (R-2)

(1) Historical Background

The development of roadways or access routes in this area could be traced back to the latter part of the 17th century during the period of the French Occupation of the island. This area came to prominence during the period 1779 – 1791 when the French recaptured Grenada from the British and began building a series of forts, namely Matthew, Frederick, Lucas and Adolphus. Places like White Gun, a former security outpost, and buildings like the Kennedy Home were built during that period. Historic and important buildings in that area include:

- Forts Matthew, Frederick, Lucas and Adolphus, 1779 – 1791
- Former Kennedy Home building – 1782
- Morne Jaloux Windmill – 1700's
- Morne Jaloux Great House – 1700's
- Richmond Hill Tennis Court – 1900
- Prisons
- Home for the Aged

(2) Population and Community Structure

This community is similar in structure to those observed along other Study Roads. As expected, women make up over fifty percent of communities and 85% are the head of their household. This is a fairly mature community wherein most of the community is between the ages of 36 – 50. The three main communities of Richmond Hill, Morne Jaloux and The Cliff had the following population statistics during the 1991 Census:

VILLAGE	TOTAL	MEN	FEMALE
Richmond Hill	278	139	139
Morne Jaloux	755	37	279
The Cliff	15	9	6

(3) Land Use and Settlement Patterns

Due to topography (hilly terrain), there is not much emphasis placed on agriculture in this area. The road crosses the plateau of a ridge, and most of the surrounding lands descends into the Richmond Hill Valley. Linear settlements line the entire roadway from Richmond Hill to the Cliff.

(4) Housing and Community Infrastructure

There are 207 houses along the Morne Jaloux Road. Thirty six are large, 115 medium and 56 small. House size is an indication of a middle to high income neighbourhood. Three churches, two schools and five retail shops are located along the roadway. The nation's television station (GBC-TV) is also located en-route. The area is largely residential, and most persons travel outside of the community to work.

13.2.3 Mt. Gay/Springs Road (R-4)

(1) Historical Background

There is little documentation on the history of road development in that area. However, it has featured throughout the history of Grenada and is an important artery linking parts of St. George's. Historical sites along this route include:

- Soap Factory
- Mt. Helicon
- Botanical Gardens (oldest in Windward Islands)
- Sugar Factory

(2) Population and Community Structure

Most of the persons living within this area are believed to have migrated from other parts of the island and set up residence there. Therefore there are not strong links as those observed in other communities. Population distribution among villages are as follows:

VILLAGE	TOTAL	MEN	FEMALE
Tempe	776	373	403
Marrast Hill	14	6	8
Paddock	216	107	109
Springs	772	366	406
Woodlands	446	201	245

(3) Land Use and Settlement Patterns

Over 75% of the available land is settled by a mix of commercial and residential households. The largest farm area can be found in Woodlands, where sugar cane is cultivated. A few strands of natural vegetation can be found in isolated patches. Land value in this area is high compared to the rural communities. In

St. George's there are a few concentric settlement patterns, however settlement along the roadway is linear with dense clusters.

(4) Housing and Community Infrastructure

The following is a listing of households found along the roadway:

- Houses 319
- Schools 7
- Retail Shops 16
- Churches 4
- Cinemas 1
- Industries 5
- Garages 5

There are also several small commercial establishments that contain offices of professionals such as doctors. Government ministries are located on Lowther's Lane and in the Botanical Gardens.

13.2.4 Eastern Main Road (R-5)

(1) Historical Background

In 1891, three bridges were completed and the carriage road from Sauteurs to Grenville was completed. The Iron Bridge in Dunfermline, which is targeted for rehabilitation was built in 1879. There are many historical sites along this route which include:

- Paradise Sugar Factory, Water wheel, rounded pillar aqueduct - 1700
- Fort at Telescope 1796
- Windmill at Conference 1770
- Windmill at Mt. Rose 1800
- Great House at Mt. Rose 1700's
- Amerindian Site at Pearls BC
- Old Airport at Pearls 1942
- Dunfermline Rum Factory 1797
- Cottage -- Dunfermline Great House
- R.C. Church at Tivoli
- River Antoine Sugar Factory 1700's
- Hermitage Slave Pen
- Mt. Rich Amerindian Remains
- Boulogne Estate
- Morne Fendue Plantation House 1800's
- Tivoli Sugar Factory Ruins

(2) Population and Community Structure

St. Andrew's being the largest parish of Grenada, contains a significant percentage of the population. Table 13.2.2 provides a summary of the socio-economic conditions existing along the roadway. As evidenced elsewhere, over half the population are women. The population is fairly young and mostly women are under the age of 36.

(3) Land Use and Settlement Patterns

Most households are situated along the road, in a linear settlement pattern. There are no vegetated buffers along the highway, nor are there any zoning laws. Agricultural and residential plots co-exist, and in many cases, houses are built on lands which contain a backyard garden or small farm. Sugar is grown extensively in the River Antoine area, banana in the Poyntzfield area, and the other vegetated areas are mainly mixed crops. There are a few plots of natural vegetation, the most extensive being in the Levera National Park which is accessed via the Study Road.

(4) Manpower and Employment Opportunities

A significantly large percent of women (46%) in this area are self-employed. Most men are employed in the agricultural, furniture making and construction industries. The sugar factories and rum distillery also have many jobs, however, they are seasonal. The Seamoon Industrial Park which is accessed via this road provides employment opportunities, as well as the towns of Grenville and Sauteurs. Due to the size of the population in communities, there is a high rate of unemployment, especially among women (72%).

(5) Housing and Community Infrastructure

Although most houses are small, there is a large number of houses in the study area. Many of them are vacant, since their owners live in the USA or England. During the survey it was observed that there are several new residences being constructed. Data collated in Table 13.2.2 shows that there are few community centers which provide recreational and social services.

(6) Natural Spots and Cultural Centers

The Sulphur Springs at Chambord, Levera National Park and Lake Antoine are major tourist attractions. Festivals and parties are held at the Levera National

Table 13.2.2 Eastern Main Road Existing Socioeconomic Conditions

Feature	Telescope	Paradise	Dunfermline	Pearls	Moya	Upper Pearls	Conference	Tivoli	Poyntzfield Estate	Mt. Rose	LaTaste	Plains Estate	Rose Hill	Morne Fendue	Madey's - Sauteur
Population	952	1180	643	644	103	82	624	937							
- male	466	591	317	306	47	50	316	466							
- female	486	589	326	338	56	32	308	471							
Number of houses	57	18	42	96	29	37	62	120	86	46	114	38	65	29	49
- large	31	4	9	32	9	4	1	3	9	10	8	20			
- medium	17	7	20	35	9	1	-	1	28	5	45	3			
- small	9	7	13	29	110	32	61	116	49	31	59	15			
Commercial	20	5	6	12	5	4	4	14	8	4	8	3	6	6	110
- large	6	-	1	1	1				3	-					
- medium	7	-	3	1	2				2	-					
- small	8	5	2	10	2				3	4					
Churches	2	1	3	1	2	2		2		1	1		1		110
Schools		1		1				1		1	2		1		2
Health Center								1			1				1
Post Office			1	1				1	1				1		1
Community Center			1	1				1							
Police Station															1
Agricultural lands	7	7	6	14	7	4	9	6	1			16	30	25	
- large	2	3	1	3	2	1	1								
- medium	2	1	2	2	2	-	-								
- small	3	3	3	9	3	3	8								
Historical/Cultural archaeological sites				1											
Nature Spots															
Tourist Attractions				1											
Recreation Centers				1			1	3	1			3			2
Industries/Manufacturing															

Park, which is heavily frequented by locals. There is scant information on the use of these systems. The available record states that Levera National Park received 2814 visitors in 1994, 3636 in 1995, 4300 in 1996 and 4174 visitors in 1997.

13.2.5 Mitigating Measures on Social Environmental Impact

Social Impacts which will result from road improvement and rehabilitation work are expected to be short lived. All impacts can be managed during the construction and operation phases of the project. Residential communities and school zones require the most attention to ensure that impacts are minimal and reduced wherever possible. It will become necessary to relocate a few households, and compensate land owners for crops which will be cut or land acquired during road works. The net benefit of the project as contemplated will be positive. These benefits can be enhance by managing negative impacts during project implementation.

(1) Resettlement

The only negative social impact is the relocation of affected houses due to the widening works of some sections of Grand Etang Road. The affected houses are seven houses in total with areas and population as presented in Table 13.2.3.

Table 13.2.3 Resettlement Plan

Items	Grand Etang Road					Total
	STA 3+185(L)	STA 3+800(R)	STA 4+450(R)	STA 12+900(L) STA 12+975(L)	STA 3+185(L)	
Affected Houses	1	2	1	2	1	7
Affected Population	5	5	0	0	5	15
Land Area	200	2 x 400	200	400 + 200	600	2,400
Building (m2)	100	2 x 200	100	300	200	1,100
Others (m2)	0	0	0	0	0	0
House Classification	One storied	2 x two storied	One storied	Police Station	RC two storied	
		Wooden house	Shed	Woodworking Plant	House	
Mitigation Measures	Provide the land and utilities to affected families					

(2) Delays

Road work will reduce the rate of traffic flow, and some road segments may actually be impassable. Road signs, press releases and bulletins on local radio stations will keep travellers and motorists informed and allow them to plan their travel properly. A Public relations programme is necessary to keep all

concerned informed and aware of potential delays. Advise can be provided on the use of detours, estimated delay time and locations where delays should be expected.

(3) Air Pollution

The general trend observed in Grenada is that there are no existing air quality problems on the Island. Any dust and air borne particles fall-out in rain-wash, and are usually deposited over the sea. In the morning the air is rarefied after night deposition and consequently there are no build up of air pollutants. Local changes which may occur during the project will be short lived. Dust particles can be managed by sprinkling with water, especially in residential areas, during the dry season.

(4) Noise and Vibration

There will be unavoidable noise from equipment such as bulldozers, power shovels, dump trucks, compressors etc. Consideration must therefore be given for minimizing and attenuating excessive noise from construction equipment. At present there are no local environmental standards for noise above background levels generated by construction and like activities. Allowable daytime noise level for activities within the distance of 100m from schools, hospitals, etc., should not exceed 75 db(A).

Throughout the construction phase of the project noise levels should be monitored, and necessary preventive measures such as sound-proof fences may be erected during the operation of heavy equipment. For attenuation of vibration, similar considerations should be given. Other measures include selection of appropriate equipment, avoiding holiday and night work, especially in protected wildlife habitat and residential communities. Dump trucks and heavy equipment must be operated at reasonably low speeds, especially near schools and residential communities, and the Grand Etang National Park. This will prevent unnecessary vibration along the Study Roads.

(5) Deforestation and Reduced Aesthetics

Whenever vegetation will be cleared, a stringent re-vegetation programme should follow. This will allow for the maintenance of aesthetic values presently provided by trees. Hardwood trees of commercial value should be utilized appropriately. Mitigation banking should be employed by enhancing areas along the study road to compensate for that which will be disturbed. Young trees must be replanted elsewhere (nearby) so that similar ecosystem parameters can be established. In the Grand Etang Area, in particular, tree seedlings can be saved for replanting.

(6) Waste Management

All construction debris, liquid and solid waste, should be prevented from entering waterways. Dams and detours used to control sediment transport can provide some additional benefits of trapping waste or spills and retarding their downstream migration. Whenever large amounts of oil is used for the operation and maintenance of vehicles, standard safety procedure and equipment should be on site to manage any accidents. Solid wastes should not be buried at anywhere along the study roads. All waste must be properly packaged for safe disposal at the landfill sites.

(7) Construction Site Management

Any temporary work sites must be established in areas that are not socially sensitive. These include residential and school zones. After the completion of works the contractor must dismantle and remove such sites, and return the area to previous conditions. Warehouses, storage yards, construction and civil engineering equipment, and concrete batch plants, must be relocated. The contractor must have adequate plans for the abandonment of temporary roads and bridges upon completion of works. All detours, signs, residual materials, dirt, and debris which may affect subsequent reclamation works must be removed. Accidental spills of oil, solvents and hydraulic fluids must be soaked up with sand, rags or oil absorbent materials (if available). Solvents should not be mixed with oil since this will prevent proper disposal and potential for recycling.

(8) Restoration Plans After Cessation of Project

For all study roads, consideration must be given to the following, after cessation of road rehabilitation and improvement works:

1) Cleaning of the site: all the construction sites shall be cleaned and restored to a satisfactory condition, upon completion of the project. No waste materials shall be left at the sites

2) Restoration of storing places: all materials left unused at stockyards such as aggregates, concrete blocks, piles etc, must be completely removed from the yards. The yards should be cleaned and restored to their original conditions.

3) Reforestation of work site temporarily denuded or excavated: any site denuded or excavated for the construction works or stockyards, must be re-vegetated. Suitable trees and other types of vegetative cover can be replanted. If the top soil was stockpiled it can be replaced and allow a similar community to that existing before to repopulate the area.

4) Restoration of temporary bridge and access roads: all temporary bridge structures including abutments must be removed. Cut soil should be back filled to the original conditions, and gravel and asphalt used for temporary roads completely removed.

5) Restoration of diverted streams: any streams diverted for construction purposes shall be restored hydraulically and physically to the original conditions.

6) Restoration of water supply, storm water drains and sanitary systems must be completed, and original or planned ground leveled as required.

Considerations must also be given for the environmental integrity of sites where gravel, sand and other aggregates will be mined for use in road construction work.

13.3 WOMEN IN DEVELOPMENT

(1) Status of Women in the Project Areas

Population data from the 1991 census consistently shows that women make up at least fifty percent of villages in the study area. The survey conducted among the women folk further reveals that over 65% of the women are head of their household. Unemployment rates were very high, reaching critical levels of over 60% in some of the areas sampled. Most women had a primary, and even secondary education, and felt that there was still the need for further training. In many cases, the women were of the view that their community had no job opportunities and saw road development not only as an opportunity for short-term employment, but more so to allow movement out of the community.

The Study identifies that although women make up over fifty percent of the labor force, they have more difficulty in finding jobs than men. This trend has serious implications for the socioeconomic status of women in the study areas, and in Grenada as a whole.

In this study areas, bus was the most common mode of transportation, since most women did not drive, nor owned a vehicle. Thirty percent were interested in work in the construction industry as clerical workers, six as skilled laborers, and thirty-nine were not interested at all.

(2) Expects of Women toward Road Improvement

There is a strong expects from women for more safe road conditions including bus stops, speed limits, road signs and traffic policemen. Most fear that better roads would conversely mean faster travel speeds and greater incidences of accidents. Feedback from communities within the study areas are summarized as follow.

Expectations of Women

- Better Road Surface
- Bus Stop
- Wider Road
- Speed Bump
- Side Walk
- Road/traffic Signs
- Lighting

Benefits to Women

- Access to services
- Access to jobs
- Temporary Jobs

Fears of Women

- Dust
- Noise
- Delay of construction

(3) Strategy for WID

To develop a strategy for women participation in the road improvement project, a series of discussions and consultations were held with a group of women. Women representing a cross-section of organizations and institutions working with socioeconomic development issues which affect women, were brought together to share their views on the matter.

There was agreement among participants that there was a need for education of women and personal development training. Representative from the Grenada National Women's Organization (GNOW) adopted the motion for advocacy programmes to encourage women to enter non-traditional careers. Understanding the wage benefits to the gained from employment in this sector, should propel women to pursue opportunities in that employment market.

Discussants were of the view that there is the need to formulate policies for the protection of women's rights in that industry as it relates to health and safety, sexual harassment, pregnancy, and sexual discrimination. Regulations should also stipulate that a certain percentage of women are employed by construction companies, especially for government funded projects. The consultative process created an awareness of the need to focus women's attention to the construction industry. It is hoped that those trained through on-the-job opportunities in this and other road projects can find long-term employment in this sector, and may even form women construction companies.

From discussions held, some of the issue which confront women and thus act a barriers to their involvement in the development process were brought to the fore. They include:

- low self-esteem
- lack of skills training
- low self-discipline (affects their ability to stick with a programme)
- inadequate opportunities for growth
- insufficient jobs
- gender bias
- cultural norms
- unequal distribution of economic resources

Cognizant with the situation of women mentioned above and discussions with the Department of Women's Affairs, it is proposed that the appropriate strategy should have three distinct phases. Phase I will involve activities before the implementation of a project, Phase II addresses the implementation stage, and Phase III is to stimulate post project activities.

Phase I – Before the Project

Activities during this phase should focus on awareness building, policy formulation, strengthening on-going programmes, and training. Women are excellent resources for collected data, conduction of studies and surveys during the preparation for a project (feasibility studies etc). In conducting this Study, seven unemployed women were used to collected data and conduct field surveys. They all had a least a secondary education, and technical skills such as computing.

Since this is a relative new approach to increases women's role in their socioeconomic development, advocacy work through existing programmes and channels of communication should be encouraged. Policies for the protection of

women should be developed and promulgated with the involvement of personnel from the following groups:

- The construction industry
- Development of Women's Affairs
- Ministry of Communications and Works
- Ministry of Education and Labor
- Non-governmental Organizations
- Skills Training Institutions
- Workers Unions

Phase II – During the Project

Projects can provide direct and indirect jobs for women. They include jobs from the project itself, and others which it can initiate or enhance. For instance, women living within the project execution area can provide hot-meals, and refreshment service. Existing projects within an area can receive exposure, new clients and as a result increased income generation. A listing of job opportunities available for women should be publicized.

Where practical, on the job training opportunities for women should be initiated. This will give hands on experience and hopefully stimulate women to continue working in the construction industry. Employment of women within the project areas will also ensure that there are direct socioeconomic benefits for them. Their involvement can also provide quiet education, and break down cultural barriers for both men and women.

Phase III – After the Project

The participatory approach in development ensures sustainability of efforts, long after the stimulus and actual project has been removed. Long-term benefits would include not only, safer roads, decreased travelling time and reduced expenditure for vehicle maintenance, but also a new world of employment opportunities. Continuous training programmers and advocacy, and policy review will be necessary to ensure that the process of involvement continues. An even greater ideal which can be stimulated by the involvement of women in the road construction project is the formation of a female (*owned, managed, and staffed*) road construction crew/company.

PART V

PROJECT IMPLEMENTATION

CHAPTER 14

MAINTENANCE AND MANAGEMENT PLAN

CHAPTER 14

MAINTENANCE AND MANAGEMENT PLAN

14.1 MAINTENANCE AND A MANAGEMENT STRATEGY

Maintenance is defined as the process of preserving and restoring existing road infrastructure facilities in good operating conditions, prolong their useful life, and hence avoid premature and costly rehabilitation or reconstruction.

Through the review on the current maintenance system in the country, the following strategies are recommended not only for the maintenance of the Study Roads, but other roads under the Ministry of Works, Communications and Public Utilities.

(1) Maintenance Planning and Programming

The main objectives of maintenance and programming are the allocation of appropriate funds required for each road segment based on the actual condition, including the following works.

1) Inventory and Database

The road conditions shall be monitored and inspected in the routine and periodic levels, and data obtained through activities shall be well arranged in database. The routine inspection shall be conducted every month and the inspection report shall be submitted. The database shall include the road class, length, construction year, maintenance history, among others.

2) Budget Allocation

Important is the allocation of appropriate fund based on the actual road conditions which will be identified through the inventory works. The road maintenance budget is preferred to be appropriated in the following three (3) categories.

- Administration
- Equipment and Spare Parts
- Maintenance Works
  - Routine Maintenance

- Periodic Maintenance
- Engineering/Calamity

(2) Contract System

The current maintenance practice is in general carried by the following two (2) systems. Since maintenance work by contract has advantages (e.g. practical use of professional skillfulness) and disadvantages (e.g. relatively high cost for small works), the Government is suggested to study and adopt the most practical and efficient system.

1) Maintenance Work by Administration (MWA)

The Government is responsible for road maintenance and carries out the maintenance work. The MOW is mandated for the work in Grenada.

2) Maintenance Work by Contract (MWC)

Professional contractors are hired through competitive bidding and carry the maintenance work by contract. The maintenance works under contract are usually only for emergency/calamity works, but can include the routine and periodic maintenance works.

(3) Organization and Management

The organization for road maintenance is preferred to consist of the following two (2) units: head office and field operation office. The head office is responsible for planning, budgeting, preparation of work program, maintenance of equipment, stock of material, and technical guidance to field operation office. While, the field operation office is responsible for monitoring, inspection and actual maintenance works. With the limited manpower resource in Grenada, a similar organization is recommended to be established.

Head Office:

- Administration
- Accounting
- Overall Planning
- Central Laboratory, Control of equipment, spare parts, material.
- Technical Division & Technical assistance and guidance to field
- Division offices.

Field Operation Office:

- Administration
- Accounting
- Inspection and Monitoring
- Maintenance Work Crews / Teams
- Equipment Maintenance Teams

(4) Equipment and Spare Parts

The maintenance equipment is recommended to be purchased through the Project as discussed in Chapter 14.3.

A central laboratory shall maintain those equipment in operational condition with enough spare parts. In general, most units of road maintenance equipment stay longer at repair shops, thus, maintenance activities are often impaired, and aggravated due to insufficiency of equipment maintenance fund.

(5) Maintenance Technique

The most vital factors in maintenance system are a proper timing in release of maintenance fund, securing of maintenance equipment and materials, and skillful maintenance crews with advance maintenance technique.

Without these, the efficient road maintenance can not be expected not only for simple works to restore the existing road condition, but for the complex engineering works to prolong the useful life of roads

An emphasize is given on development of maintenance technique, involving the following items.

- Preparation of Maintenance Manual

  A maintenance manual applicable in the country should be prepared during the detailed engineering of the Project. The advanced technology for road design, construction and maintenance shall be studied and established in the manual.

- On-Job Training for Construction and Maintenance Works

  Some engineers of the Government are recommended to participate in

actual construction of the Project, so that they can develop the construction technique, which is also useful for road maintenance after the completion of the Project.

- On-Job Training for Operation and Repair of Equipment

  Suppliers of equipment through international competitive bidding shall be requested to submit the comprehensive operation and maintenance manual of equipment to be supplied, and to demonstrate and transfer the technique to engineers of Grenada.

14.2 MAINTENANCE ORGANIZATION AND SYSTEM

The main maintenance problems raised by officials of division offices can be stated as:

- Insufficient maintenance fund
- Delays in release of fund
- Poor equipment condition, frequent breakdown of equipment, delay in repair of equipment and insufficient number of operational equipment

Mandated to undertake the necessary and required services for the maintenance of roads and bridges are the Maintenance Division in close coordination with the offices concerned. Maintenance of roads and bridges is under the responsibility of MOW through its concerned officers as follows:

Overall Planning and Technical Assistance/Guidance to Offices

- Chief Technical Officer Office

Implementing Arm of Road/Bridge Maintenance

- Eastern Division Office
- Western Division Office

Functions and organization of each office are presented in chapter 2. The following discussions aim to strengthen the existing process and to provide an efficient system for maintaining the Project Roads in a good condition.

14.2.1 Present Maintenance Management System

(1) Data Collection

1) Patrolling System

The number of patrol staff and cars are insufficient for daily and regular maintenance, and thus can not grasp and inspect road damage promptly.

2) Real-time Data Collection System

Real-time data collection facilities are required for effective grasping of the meteorological conditions rapidly and anticipating the occurrence of road damage. Such facilities are necessary for a future management and operations system.

(2) Data Processing

1) Internal Communication

Information on road damage should be reported promptly from a division office to the head office in a serious damage. Thus, the head office can grasp the situation quickly, and indicate the appropriate maintenance measures.

2) Guidelines for Maintenance

There is no standard or guidelines for counter-measures for routine maintenance work or road serious damage. Therefore, it is necessary to prepare guidelines promptly.

(3) Presentation of Information

Traffic signs and other efficient information measures such as road information boards are required to inform road users of road and traffic conditions.

(4) Road Maintenance Budget

The biggest issue concerning road damage repairs is budgetary restraints. The yearly budget for maintenance is decreasing year by year, as shown in Table 2.3.3, and most of the budget is for simple maintenance work such as re-paving some spots, not for any serious repair work.

In summary, the main comments on the present maintenance system are as follows:

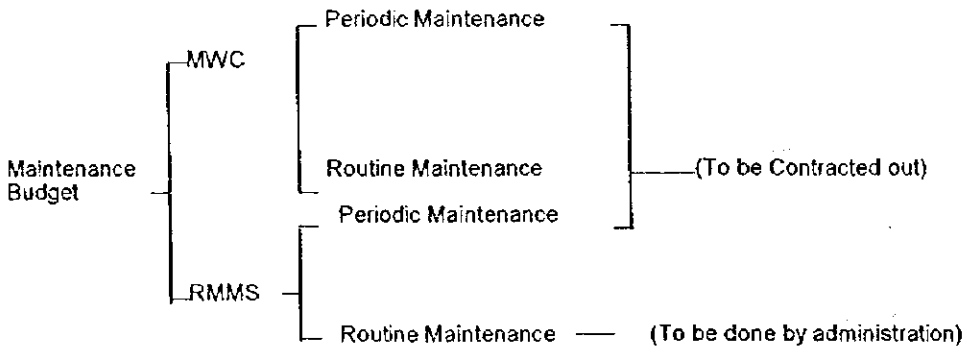
- As pointed out by Division, the Government should make continuous effort to increase maintenance budget.
- Release of maintenance budget should be made at a proper timing.
- With the introduction of MBC system, MOW will have less manpower and equipment. Proper system should be established to cope up with natural calamities and other emergency cases.
- Most units of MOW-owned maintenance equipment are reported to be antiquated and not functioning. Equipment conditions should be re-assessed and proper measures should be taken including the establishment of a training center for people involved in the maintenance work.

14.2.2 Maintenance Planning and Programming

Maintenance planning and programming is carried out within the following framework:

- Maintenance budget allocation for routine maintenance and periodic maintenance.
- Maintenance budget allocation for Maintenance under Road Maintenance Management System the (RMMS) and Maintenance Work by Contract (MWC).

Budget allocation is specified as follows:



Based on feature inventory data, the annual maintenance work program and performance budget (AMWP/PB) is prepared for the road sections under RMMS and the annual work program (AWP) is prepared for the road sections under MWC.

14.2.3 Maintenance Procedure

(1) Maintenance Work by Administration (MWA) under RMMS

The maintenance by administration follows the concept of RMMS. Under this

system, routine maintenance is undertaken by maintenance crews of division office, while periodic maintenance is contracted out to private contractors.

Maintenance activities are determined through inspection conducted by division office or regional personnel, and complaints by the public. The Division Engineer is responsible for conducting routine inspections of all the roads in the area at least once in 15 days. Semi-monthly schedule is prepared for each area by the Division Engineers and approved during a scheduled meeting conducted by the Division Maintenance Engineer.

(2) Maintenance Work under MWC

Under MWC, all routine and periodic maintenance activities selected for MWC sections are contracted out through competitive bidding at the division office.

Maintenance works are scheduled on a tri-monthly basis. The tri-monthly work schedule states the activities, the corresponding quantities, the location and the deadline for the activities to be undertaken.

Daily records are taken by the foreman or Engineer at division office level to record all activities on site and measurements of all completed works. Each week, the accomplishment and the corresponding quantities are summarized and agreed upon between contractors and division office. Every month, the accomplishment is summarized in the Monthly Summary Sheet. The summary sheet is used by the contractor to substantiate his request for payment and also used for contract monitoring in the division levels.

14.3 MAINTENANCE EQUIPMENT

Majority of units of the road maintenance equipment assigned to division office are antiquated or more than 10 years old as can be shown in Chapter 2. As shown in Table 2.3.4, out of 52 units, 36 units (or 69%) are non-operational. Accordingly, most of the units of road maintenance has to stay long periods at repair shops and maintenance activities are often impaired. Insufficiency of maintenance equipment fund is further aggravating equipment conditions.

In order to allow the MOW to carry out its role in the road maintenance task, proper and new equipment are required. Based on the maintenance needs of the road network, Table 14.3.1 gives the proposed required equipment which can be used in both construction and maintenance activities. It is necessary that these equipment which will procured by the MOW, to be lent out to project contractors for construction. Then, they will be used for road maintenance after construction by the maintenance crews of MOW.

Table 14.3.1 Proposed Construction and Maintenance Equipment

Equipment Name	Type / Capacity	Number of Equipment			Cost of Equipment (M EC)	
		West	East	Total	Unit Cost	Total Cost
(1) Construction Equipment						
1) Earth Work / Base Course						
Vibratory Roller	10ton to 13ton			1	0.415	0.415
Vibratory Plate Compactor	3.5ps to 5.0ps	2	2	4	0.007	0.028
Motor Grader	100ps to 120ps	1	1	2	0.349	0.698
Tired Roller	10ton to 15ton			1	0.237	0.237
Back Hoe	0.4m3	1	1	2	0.446	0.892
Water Truck	8.0m3	1	1	2	0.217	0.434
Dump Truck	7.0m3	3	3	6	0.266	1.596
Bulldozer	142ps to 160ps	1	1	2	0.527	1.054
Crawler Drill	130ps to 170ps			1	0.142	0.142
Wheel Loader	1.3m3	1	1	2	0.257	0.514
2) Pavement Work(AC Pave.)						
Bitumen Distributor	2,000l to 3,000l			1	0.179	0.179
Paver	2.4m to 4.5m			1	0.552	0.552
Tired Roller	10ton to 15ton			1	0.237	0.237
Steel Roller	8ton to 12ton			1	0.250	0.250
Vibratory Roller	5ton to 8ton			1	0.288	0.288
Vibratory Roller	3ton to 4ton	2	2	4	0.159	0.636
Concrete Cutter	20ps	2	2	4	0.031	0.124
3) Bridge Work						
Truck Crane	15ton to 20ton			2	0.611	1.222
Concrete Pump	20cm/hr			1	0.283	0.283
4) Others						
Generator	65ps to 80ps	2	2	4	0.084	0.336
Air Compressor	30ps to 50ps	1	1	2	0.053	0.106
Concrete Vibrator	300w	2	2	4	0.001	0.004
(2) Maintenance Equipment						0.000
Road Marking	80to120kg. 15cm			1	0.022	0.022
Vibratory Tampa	40kg	2	2	4	0.005	0.020
Bitumen Sprayer	400l	2	2	4	0.033	0.132
Back Hoe w/Loader	0.09m3	2	2	4	0.167	0.668
Small Dump Truck	5ton	3	3	6	0.110	0.660
Breaker(for Mini Backhoe)		1	1	2	0.077	0.154
(3) Transport Equipment						
Pick-up Truck	Single Cab	4	3	6	0.066	0.396
Pick-up Truck	Double Cab	4	3	6	0.085	0.510
Truck w/ Crane	5ton Crane	1	1	2	0.384	0.768
(4) Workshop Equipment						0.000
Workshop Equipment & Tools		1	1	2		0.000
(5) Road and Bridge Inspection						
Nondestructive Testing				1	0.180	0.180
Roughness Meter				1	0.008	0.008
Distmat		1	1	2	0.003	0.006
Thedolite		1	1	2	0.002	0.004
AC Core Cutter	w/ engine	1	1	2	0.005	0.010
		42	40	94		13.765

Note: 1 US$ = 2.67 EC$ =120.0, 1EC$ = 44.94
Unit Cost = [(JP Price x 1.2) / 120 + (L x W x H) x 200 US$] x 2.67
Unit Cost is including spear parts.

14.4 RECOMMENDATIONS ON FUTURE MAINTENANCE

Upon completion of the rehabilitation/reconstruction works of the Study Roads, its conditions will be very much improved and maintenance burden of the Study Roads will be greatly lessened. However, maintenance activities can not be eliminated. Future maintenance of the Study Roads should be pursued focusing on the following:

- Road conditions of the sections where no rehabilitation works are implemented under this project will be continuously aggravated. Maintenance efforts should be focused on these sections.
- Ten bridges were classified as bridges only for maintenance and required repair and maintenance works are proposed in this Report. Division office should prepare a maintenance work schedule for these bridges and undertake required repair/maintenance.
- Inspection of completed road sections/bridges should be strengthened to identify early stage of distresses and /or damages, thereby preventive measures can be implemented at a proper timing.
- For flood sections and mountainous sections, concrete side ditches and cross drainage are proposed to be constructed. These drainage facilities must be always cleaned in order for them to function properly. Otherwise, prevention of floods or premature pavement deterioration will not be realized.
- For several bridges, dredging of river bed is included in the Project. It should be understood that dredging is the continuous efforts to be done by division office even after the completion of the project.

CHAPTER 15

PROJECT IMPLEMENTATION

CHAPTER 15

PROJECT IMPLEMENTATION

15.1 IMPLEMENTATION STRATEGY

In implementing the Road Rehabilitation and Improvement Project in Grenada, the strategies presented in the following sections are recommended.

15.1.1 Project Management

A special project management office is recommended to be established to facilitate smooth implementation of the Project and to ensure satisfactory quality and high performance of works, covering the following aspects of the project implementation:

- Project Administration
- Project Accounting (especially to cope with the requirement of the international lending agency)
- Project Tendering (for selection of consultants and contractors)
- Engineering Coordination
- Construction Coordination

15.1.2 Community Participation System

Greater involvement of the people affected by the Project is recommended to be promoted not only in the project assessment but also in service delivery including the following levels of Project implementation. Particularly, women's participation in the Project implementation shall be encouraged to the maximum possible extent.

- Environmental Impact Assessment
- Right of Way Acquisition
- Preparation/Implementation of Resettlement Action Plan
- Construction
- Maintenance

15.1.3 Detailed Engineering and Construction Supervision

Detailed engineering, tendering and construction supervision for the Project shall

be undertaken by professional consultants who shall be selected in accordance with the rules and regulations of the international lending agency.

The primary scope of works of the consultants shall include the following:

- Preparation of engineering plans, quantities, cost estimates, and specifications for international competitive bidding (ICB) by contractors.
- Preparation of tender documents including pre-qualification forms, bidding forms and contract forms.
- Construction supervision for scheduling control of the contractors, including certification of invoices.

15.1.4 Construction Stage

Construction of the Project shall be executed by professional contractors who shall be selected through international competitive bidding (ICB) in accordance with the rules and regulation of the international lending agency.

The following two (2) packages of international competitive bidding (ICB) are recommended with the reasons mentioned below:

Package 1 – Equipment

Some construction equipment which will be used for construction of the project and also usable for maintenance after construction, shall be procured by the Government of Grenada through ICB, and lent to the contractor for construction of the Project. Then, after the completion of the Project, as these equipment are the property of the Government of Grenada, they can be used for the road maintenance of the country's roads.

Package 2 – Construction

The contractor is responsible for the construction of the project using equipment procured and supplied through package 1, including but not limited to the following:

- Procurement of construction equipment other than those supplied through Package 1.
- Procurement of all construction materials
- Procurement of labour required for construction

15.1.5 Road Maintenance

The road maintenance system shall be established taking advantage of the construction of the Project, involving the following:

- Road Maintenance Organization
- Maintenance Equipment
- Preparation of Road Maintenance Manual
- Training of Road Maintenance Crew
- Monitoring System

15.2 IMPLEMENTATION AGENCY AND ORGANIZATION

The Ministry of Works, Communication and Public Utilities (MOW) is responsible for all the activities related to the major road network in the country. As the project is to improve the four (4) selected roads, the MOW and its organizations and agencies are in charge of implementing all activities of the project. The engineer projects section is assigned by the MOW to supervise and manage the activities of this project.

Under the MOW, there is Engineer Projects Office (EPO) which is established for the planning and technical management of the projects financed by international financing institutions and /or bilateral assistance. At present there are one EPO active for the road and bridge construction management activities, which are Caribbean Development Bank (CBD) Project, Kuwait Fund Project and Republic of China (ROC)Project.

In addition to the major road network, the MOW is responsible also for the public building and telecommunication as shown in the organization chart presented in Figure 15.2.1. Six departments are in charge of the activities of ministry which incorporates also planning and road engineering.

The organization chart of Engineer Projects Office (EPO) presented in Figure 15.2.2. Several international projects are assigned to the EPO included Western Main Road project, Eastern Main Road Project, CDB Project and ROC Project.

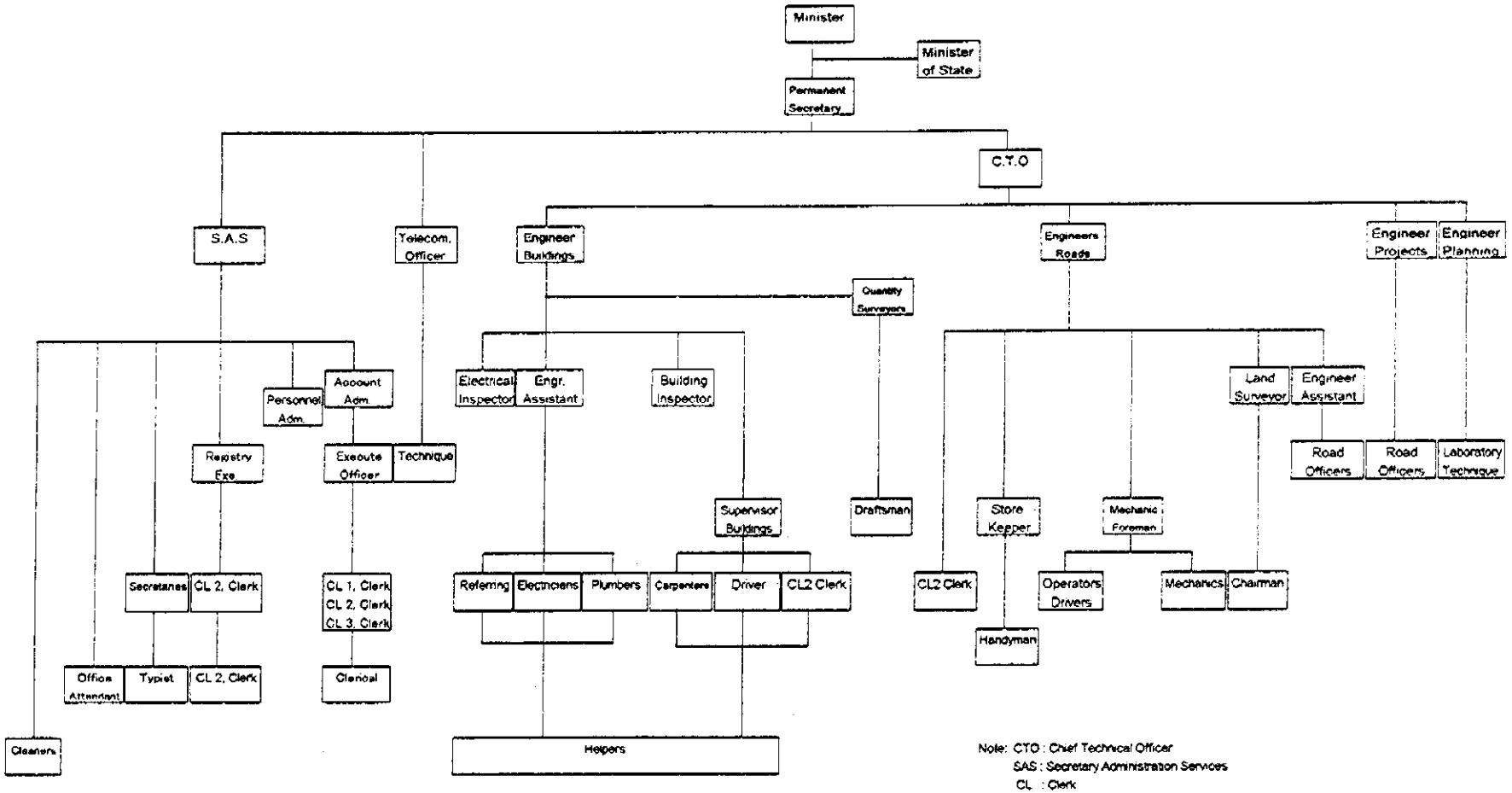


Figure 15.2.1 Organization of Implementation Agency

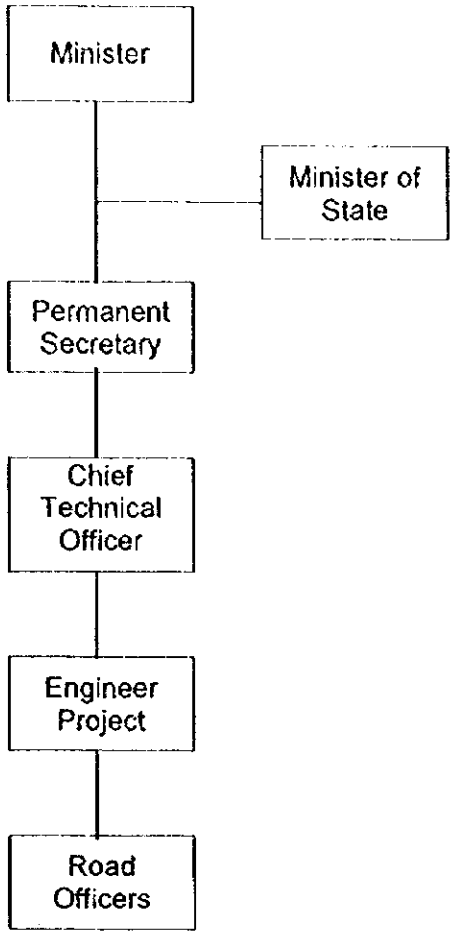


Figure 15.2.2 Organization Chart of Engineer Projects Office

15.3 IMPLEMENTATION SCHEDULE

Required procedures after the completion of this Study are listed and scheduled in the overall implementation schedule of the project shown in Table 15.3.1. Work on the clearance of the EIA will the start immediately in order to be materialized before the fund arrangement. To meet the target schedule of a 4-year framework, procedures for the selection of consultant will be as scheduled to complete the detailed engineering stage by the end of first year and to complete the construction activities by mid of the forth year.

The annual investment for construction cost is shown in Table 15.3.2.

Table 15.3.1 Overall Implementation Schedule

Item \ Year		1st Year				2nd Year				3rd Year				4th Year				Remarks
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Clearance EIA																		
Selection of Consultant																		
Detailed Engineering																		
R.O.W Acquisition																		
Procurement of equipment																		
Selection of Contractor																		
Construction Supervision																		
Construction	R-1 Grand Etang																	
	R-2 Morne Jaloux																	
	R-3 St. David's																	
	R-4Mt.Gay Springs																	
	R-5 Eastern Main																	

Table 15.3.2 Annual Investment for Construction Cost

(M ECS)

Road No.	Road Name	Road Length (km)	No. of Bridge	Construction Cost (MECS)	2nd Year				3rd Year				4th Year			
					1	2	3	4	1	2	3	4	1	2	3	4
R – 1	Grand Etang Road	21.7	5	27.11			2.71			15.72				8.68		
R – 2	Morne Jaloux Road	4.1	0	1.95			1.66		0.29							
R – 3	St. David's Perdmontemps	0.0	1	0.60								0.22	0.38			
R – 4	Mt. Gay to Springs Road	6.0	1	4.36			1.13			3.23						
R – 5	Eastern Main Road	16.5	3	9.72			-			5.05				4.67		
Total Annual Investment		48.3	10	43.74	5.50				24.51				13.73			

15.4 FUND REQUIREMENT

The total investment required to implement the project is divided into local and foreign potions. Chapter 11 presents the estimated cost for all the components in total. Based on the schedule of each activity, the cost was estimated for each year of the project implementation period. Table 15.4.1 gives a summary for the annual investment and total investment required during the total period of the project.

The total investment required to implement the project is divided into the following items for both local and foreign currency as shown in Table 15.4.2.

(1) Local Currency

- R.O.W Acquisition
- Engineering Cost (Professional B - local Junior Engineer, CAD Operator)
- Administration Cost

(2) Foreign Currency

- Resettlement Cost
- Engineering Cost (Professional A – Senior engineer, Survey Expense, etc,)
- Construction Cost

Table 15.4.1 Annual Investment (MEC$)

Item	1st Year	2nd Year	3rd Year	4th Year	Total
Construction Cost	0	5.50	24.51	13.73	43.74
Engineering Cost	2.62	0.33	1.47	0.82	5.24
R.O.W Acquisition	1.10	0.73	0	0	1.83
Resettlement Cost	1.07	0.72	0	0	1.79
Total	4.79	7.28	25.98	14.55	52.60

Note : Engineering Cost = Construction Cost x 12% + Equipment Cost x 3%

Table 15.4.2 Summary of Project Cost (MEC$)

Item	Foreign Currency	Local Currency	Total
Construction Cost	34.89	8.75	43.74
Engineering Cost	4.19	1.05	5.24
R.O.W Acquisition	0	1.83	1.83
Resettlement Cost	1.43	0.36	1.79
Sub Total	40.61	11.99	52.60
Administration Cost	1.75	0.44	2.19
Physical Contingency	3.92	0.98	4.90
Sub Total	5.67	1.42	7.09
Grand Total	46.28	13.41	59.69

Note: Administration cost : 5% of Construction Cost
Physical Contingency : 10% of Construction Cost and Engineering Cost

CHAPTER 16

OVERALL EVALUATION AND RECOMMENDATIONS

CHAPTER 16

OVERALL EVALUATION AND RECOMMENDATIONS

16.1 OVERALL EVALUATION

(1) Need of Project Implementation

The four (4) Study Roads play the most important role in the transportation system of the country. Three (3) of the Study Roads (R-5, R-1 & R-4) formulate the Trans-Grenada Highway, connecting the four (4) regions, namely North, East, West and South. The forth Study Road (R-2) is a tourist-oriented Sky-Line diversion road where urban traffic is congested in the center of the country's capital city, St. George's.

The Study Roads, however, suffer from various problems such as progressive deterioration of pavement, winding alignment with narrow road width, dilapidated bridges with structural deficiencies, inadequate drainage systems and sharp slopes, resulting in poor riding quality, reduced traffic safety and increased transportation costs.

It is therefore urgent that the project be implemented to provide a safe and reliable means of transport to the road users, thereby stimulate the positive activation of peoples' activities, and contribute to the socioeconomic development of the country.

(2) Viability of Project Implementation.

The viability of implementing the Project was evaluated from the various view points of engineering, economic, financial, environmental and implementation aspects as presented in the following sections:

1) Engineering Aspect

a) The Project is technically feasible with the normal construction methods to international standards, with special attention to the following:

- Modern technology for design and construction of asphalt concrete pavement and overlays.

- Determination of bridge length in view of river morphology and hydrology.
- Provision of appropriate traffic safety facilities.
- Application of mitigation measures for adverse environmental impacts.

b) Major construction equipment and materials will be imported for construction. The Government shall procure some equipment which will be lent out to project contractors for construction, and then be used for road maintenance after construction by the maintenance crews of the Government.

c) The following bridges are excluded from the Project because of the acceptable stability of the existing structures and expected high cost of improvement. But periodic monitoring of the structural condition of the bridges shall be carried out.

- Grand Etang Road
  - Mt. Gay Bridge
- Eastern Main Road
  - Paradise Bridge
  - Tivoli Bridge
  - Morne Fendue Bridge
  - La Fortune Bridge

2) Economic Aspect

a) The Project is economically feasible with a 25.25 % Economic Internal Rate of Return (EIRR), a Benefit-Cost Ratio (B/C) of 2.28 and a Net Present Value (NPV) of approximately MEC$ 70.652.

b) The Project is evaluated to play the most important and vital role – as "Trans-Grenada Highway" – in the country, along which the traffic demand is expected to be about 6,200 veh./day in the year 2005.

3) Financial Aspect

a) The Project can be implemented within a reasonable budgetary framework in accordance with the proposed implementation schedule.

4) Environmental Aspect

a) The Project is acceptable in terms of the natural and socio-economic environmental view point.

b) Foreseeable adverse environmental impacts may involve the relocation of a few inhabitants, traffic interference during construction and generation of construction waste, all of which will be easily resolved or mitigated with proper countermeasures.

5) Implementation Aspect

a) The Government of Grenada has highly emphasized that the Project should be implemented at the earliest feasible time in view of technical, economic and other aspects with the target completion year of 2001.

b) The 4 years implementation framework of the Project is employed with an estimated amount of MEC$ 52.6 as the total project cost and MEC$ 26.0 as the average annual construction cost.

6) Social and Development Aspect

a) The Project is highly appreciated in providing a reliable means of transportation for local communities and regional development.

b) The Project will contribute to an increase in socioeconomic activities, promotion of tourism industry, and thus the national development of the country as a whole.

16.2 RECOMMENDATIONS

(1) Early Implementation

To meet the national targets, it is recommended to implement the Project at the earliest possible time as justified.

(2) Mitigation Measures of Environmental Impact

Due consideration should be given to mitigate adverse environmental impacts. The main adverse impact is the relocation of inhabitants, for which a resettlement action plan shall be executed by the Government with involvement of the local community, and in particular women.

(3) Establishment of a Highway Functional Classification

The highways in the country are recommended to be classified in accordance with their role and functionality, based on the adopted international standards for road improvement. Additionally, proper activities in road maintenance shall be pursued.

(4) Development of Road Maintenance Technology

The advanced technology of road maintenance shall be, through the Project implementation, developed in order to protect the huge investment for completed infrastructure facilities from their fast deterioration, and to prolong their useful life.

(5) Coordination with Related Projects

The Water Supply Project, which is planned and committed by the MOW with a budget of about MEC$ 1.23, requires the installation of a water piping system under the Study Roads. In this regard, it is recommended to establish a coordinated implementation program so that construction activities for the two projects can be optimized.

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