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1.0 INTRODUCTION

Highway 2000 (H2K) is one of the Government of Jamaica's landmark Millennium Projects. It will link Kingston to Montego Bay, through the parishes of Kingston & St. Andrew, St. Catherine, Clarendon, Manchester, St. Elizabeth, Westmoreland and St. James. The Highway will also connect Bushy Park and Ocho Rios, traversing the parishes of St. Catherine and St. Ann. The total length of the highway is approximately 230 km, with an anticipated right-of-way of 100m.

Segment 1 of the Highway 2000 Project has been divided into two phases as follows:

- Phase 1A will include extensive work on the Portmore Causeway, as well as work from Kingston to Sandy Bay. This will include construction of four lanes from Kingston to Bushy Park (2x2) and doubling of the Old Harbour Bypass (by construction of a second 2 lane carriageway).
- Phase 1B will include construction of the highway from Sandy Bay to Williamsfield, incorporating the existing Melrose bypass, construction of the May Pen interchange, and a main toll plaza at Williamsfield.

A Strategic Environmental Assessment (SEA) requested by the National Development Bank of Jamaica Ltd., the executing agency for the project was conducted by Dessau-Soprin International Ltd., of Canada in association with local partners including Environmental Solutions Ltd. (Development Bank of Jamaica Ltd, 2000 a-e). The SEA recommended issues for detailed project-level Environmental Impact Assessment (EIA) which would be necessary to support the application for an environmental permit. Within the Kingston to Williamsfield corridor ten areas were recommended for EIA studies. These were Portmore, Portmore Causeway, Rio Cobre, Bushy Park, Freetown, Rio Minho, Milk River, Sandy Bay, Porus and Williamsfield. These areas were selected because of issues related to community, infrastructure, settlements, economic enterprise, relocation, loss of economic activity, proposed interchanges, water resources, hazard vulnerability, hydrology, coastal dynamics, air quality and noise.

On Tuesday, June 26, 2001, the Prime Minister of Jamaica announced that Bouygues Travaux SA of France was selected as the Preferred Bidder for Segment I of the Highway, which will run from Kingston to Williamsfield. Environmental Solutions Ltd. has been contracted by TransJamaican Highway Ltd. to conduct the EIA for the expansion of the Portmore Causeway, which will be executed as a component of Phase 1 of the project.

1.1 PURPOSE

This document presents the findings of the Environmental Impact Assessment of the proposed Portmore Causeway upgrading and bridge construction. The EIA was conducted in support of the environmental permit application submitted to the National Environment and Planning Agency and meets the Terms of Reference approved by that regulatory agency (See Section 1.2). The Portmore Causeway project (Figure 1.1) is a component of Phase 1A of the Highway 2000 project being developed by TransJamaican Highway Ltd. under contract with the Government of Jamaica.

Phase IA of the Highway 2000 Project includes Kingston to Sandy Bay and the Portmore Causeway and Dyke Road. Phase 1B will see the construction of the highway from Sandy Bay to Williamsfield in Manchester. Construction for the section from Kingston to Sandy Bay has already commenced and includes:

- Doubling of the Old Harbour Bypass by construction of the a second two lane carriageway, reconstruction of the northern ramps of the interchange and extension of the main toll plaza with maintenance centre, with the tolling operation of the Kingston to Sandy Bay section as an open system
- The tolling of the two lanes of the existing Old Harbour Bypass (km 21.0 to 33.7) and the implementation of a main toll plaza on the east of the eastern ramps
- Construction of a four lane highway (2x2) between Kingston and Bushy Park with interchanges at Mandela Highway (km 0.3), Portmore Access Road (km 1.2) and Spanish Town (km 7.4) and the implementation of a ramp toll plaza on the eastbound ramps of the Spanish Town interchange.

1.2 TERMS OF REFERENCE

Based on the NRCA's "Guidelines for Conducting EIA's" the Terms of Reference for conducting the EIA of the Portmore Causeway were prepared and submitted to NRCA/NEPA for review. This approval was granted in a letter dated October 17, 2002 (Appendix I) with some additions and emphasis, as detailed in the letter.

The final TOR's for conducting the EIA are as follows:

1. Introduction – Identification of the development project to be assessed and explanation of the executing arrangements for conducting the Environmental Impact Assessment.

2. Background Information – A brief description of the major components of the proposed project, the implementing agents, a brief history of the project and its current status, including information on the entire Highway 2000 Project, the establishment of the National Road Operating and Construction Company Ltd. (NROCC) and selection of Bouygues Travaux Publics as the Preferred Bidder.

3. Study Area – Specification of the boundaries of the study area for assessment including the Portmore Causeway entrance, the Hunt's Bay Bridge, the Dyke Road and the Toll Plaza, as well as adjacent or remote areas that should be considered with respect to the project.

4. Scope of Work – Standard environmental impact assessment techniques including site reconnaissance, literature review, desktop research, field work, data analysis and interviews with appropriate personnel, will be utilized in order to satisfy the Terms of Reference. Reference will also be made to the extensive studies already carried out for the Highway 2000 Project including the SEA, Illustrative Design and

Construction Solution, Drainage and Hydrology Report and other relevant studies The following tasks will be performed:

Task 1: Description of the Proposed Project. A full description will be given of the project and its existing setting, using maps as appropriate. This is to include general layout, size, location, and physical characteristics and include major activities required such as dredging and bridge demolition. The Client will be expected to provide an aerial survey photograph of the site, a topographical survey map of the site, engineering designs and relevant plans. Special attention will be paid to the following:

- Sourcing and transport of material to be used as fill
- Method for deployment of the fill material
- Method for construction of shoreline protection work associated with the fill
- Methods to be employed to control sedimentation from fill activities
- Bridge construction

Task 2: Description of the Existing Environment. Assemble, evaluate and present data on the relevant characteristics of the study area, including the following:

- Physical environment: geology, topography, soils, surface and coastal dynamics, siltation in Hunt's Bay, water quality, water currents, storm surge vulnerability
- Air quality: particulates (PM10, SOX and NOX) and noise assessment
- Natural drainage features: surface run-off and flood (risk) hydrology
- Biological environment: wetlands, marine fauna, fisheries
- Socio-cultural environment: land use, traffic patterns, proposed developments, public health issues, demography, solid waste management, sewage disposal
- Development plans for Kingston Harbour – Ports and Airport, especially Hunt's Bay reclamation.

Surveying and soil analysis will not be undertaken as part of this study as it is envisaged that such data will be available for consultation and use from other studies.

Task 3: Legislative and Regulatory Considerations. A description will be given of the pertinent regulations, standards and regulatory bodies governing environmental quality, health and safety, protection of endangered species, siting and land use control, sewage and solid waste disposal, development and construction.

Task 4: Determination of Potential Impacts of the Proposed Project. Impacts will be determined as significant positive or negative, direct or indirect, short-term or long-term, unavoidable or irreversible. Special emphasis will be placed on:

- Maintenance of Existing Bridge Span vs Increase in Bridge Span
- Relocation/Resettlement requirements
- Traffic Flow
- Interchange and Toll Plaza
- Public sentiment
- Sourcing, Transport and Deployment of Fill Material
- Shoreline Protection Works
- Vehicle Maintenance and Fuel Storage
- Noise and Air Quality
- Loss of Wetlands
- Water Quality
- Bridge Construction
- Demolition Works
- Waste Disposal (construction spoil, demolition waste and sewage)
- Hazards and Risks (flooding, storm surges, health and safety, accidents)

Preparation of a resettlement plan is not included in this scope of work.

Task 5: Mitigation and Management of Negative Impacts. Recommendations will be made for feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels. This will include recommendations related to widening the causeway on the Hunt's Bay side or the Kingston Harbour side; sourcing and transport of fill materials; and fill activities. Indicative costs of these mitigation measures will be provided. Alternatives to the project site will be investigated including the "no-action" alternative.

Task 6: Recommendations for the development of a Monitoring Plan. Recommendations will be made for the development of a Monitoring Plan to ensure implementation of the mitigation measures and long-term minimization of negative environmental impacts. Monitoring should begin at the start of the construction phase and continue throughout the operation phase.

Task 7: Assist in Inter-Agency Coordination and Public Participation. As, and if required by the NRCA/NEPA, ESL will assist in the public participation/review process through meetings with relevant governmental agencies, in obtaining the views of civil society and participation in a public hearing/consultation. ESL will represent TransJamaican Highway Ltd. before the NRCA/NEPA and any other government agencies, as required.

5. **Report** – the Environmental Impact Assessment report will be concise and limited to the significant environmental issues. The main text will focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any references used in interpreting those data. The report will be organized according to, but not necessarily be limited by, the outline below:

- Executive Summary
- Description of the Proposed Project
- Description of the Environment
- Policy, Legal and Administrative Framework
- Significant Environmental Impacts and Mitigation Measures
- Analysis of Alternatives
- Recommendations for Monitoring Plan
- List of References
- Photographs, Maps and Plans as appropriate
- Summary of Public Consultation Process

6. Approach – ESL is executing the EIA based on the Terms of Reference as approved by NEPA, and in accordance with instructions from the client, TransJamaican Highway Ltd.

1.3 APPROACH AND METHODOLOGY

1.3.1 STUDY TEAM

A multidisciplinary team was identified to conduct the study and comprised the following persons:

Mrs. Eleanor Jones, MSc – Environmental Management Specialist and Team Leader

Mrs. Jones has over twenty-five experience in the areas of environmental management systems, environmental risk assessment, disaster prevention planning, environmental and social impact assessments, watershed management and community consultations and participatory planning. Mrs. Jones lectured in the Department of Geography of the University of the West Indies for 13 years, and has been consulting for fifteen years as President of Caritech Associates Ltd. and Managing Director/Founding Partner of Environmental Solutions Ltd. Mrs. Jones has much experience in road development projects including work on the North Coast Highway, the Kingston Coast Road Upgrade, the Jamaica Bridges Development Program, and was extensively involved in the SEA for Highway 2000. Mrs. Jones will be responsible for overall management of the project including client liaison and consultations/dialogue with the NRCA/NEPA, as well as the social assessments, community consultations, hazard management, analysis of impacts and recommendation of mitigation measures.

Dr. Barry Wade, PhD – Coastal Zone Management Specialist

Dr. Wade is an environmental scientist with over thirty years experience in coastal zone management issues, teaching, research, consulting and management. Educated in Jamaica and the USA, he has held senior technical and management appointments in the environmental, energy and financial sectors. Currently he is Chairman and Consulting Principal of Environmental Solutions Ltd., Jamaica, and Chairman of Environmental Solutions (Belize) Ltd. Dr. Wade's specialist skills are in ecology, environmental impact assessment, coastal zone management, pollution control, institutional development and

total quality management. He has produced several major works including his landmark study on the pollution ecology of Kingston Harbour and has conducted more than fifty environmental impact assessments and audits in Jamaica, the Caribbean and Central America. Dr. Wade will be responsible for coastal zone management issues, identification of impacts and recommendation of mitigation measures.

Dr. Margaret Jones Williams, PhD – Ecologist and Deputy Tem Leader

Dr. Jones Williams is an Environmental Scientist with over thirteen years experience in terrestrial and marine ecology, coastal pollution studies, environmental impact assessments and natural resources inventory. Educated in Jamaica, Canada and the United Kingdom, she has worked at the Conservation Data Centre-Jamaica, a biodiversity unit, where she did extensive field work and mapping of Jamaica's endemic and endangered fauna as part of a Rapid Ecological Assessment of the island and to assist in the establishment of Jamaica's national parks. Dr. Jones Williams has been involved in several road development projects including the Kingston Coast Road Upgrade, the Jamaica Bridges Development Program and was extensively involved in the SEA for Highway 2000. Dr. Jones Williams will be responsible for the ecological assessments and identification of impacts and recommendation of mitigation measures.

Mrs. Sharonmae Shirley, BSc, MPhil – Environmental Chemist

Mrs. Shirley is an Environmental Chemist and has over five years experience in environmental chemistry, including water and solid waste studies, planning and execution of environmental monitoring programmes, occupational health and safety programmes and environmental audits. She has had years of practical experience in designing and implementing environmental monitoring programmes in Jamaica and Belize. Mrs. Shirley will be responsible for analysis of air quality and water quality, as well as preparation of the recommendations for the development of a monitoring plan.

Mr. Phil Donaldson, M.Sc. – Hydrogeologist

Mr. Donaldson brings to the project considerable expertise in water planning, systems analysis, water quality and water resources management and development. Mr. Donaldson's experience in integrated water and sanitation programmes spans strategic planning and implementation in Jamaica, Uganda and Nigeria for governments, communities and internationally funded programs. He has been a key resource in the development of the recent (2002) Environmental Plan for the Northeast coast of Jamaica and in the assessment of flood damage associated with the extreme event of May-June 2002. Additionally, at the Water Resources Authority, and National Water Commission in Jamaica, Mr. Donaldson has played a pivotal role in water demand and supply programmes and Water Resources Master Plans. Mr. Donaldson was responsible for analyses of flow regimes and the determination of potential impacts and mitigation measures related to the highway construction.

Technical assistance was provided where required.

1.3.2 DATA COLLECTION

Baseline data for the study area was collected using the following methods:

- Windshield Survey
- Site Reconnaissance
- Aerial Survey
- Analysis of Maps and Plans
- Literature Review
- Desk Top Research
- Public Consultations
- Field Studies
- Laboratory Analyses
- Charette Style Consultations

1.3.2.1 Physical Environment

Information was gathered on the existing physical environment, particularly as related to geology, topography, soils, hydrology and drainage, coastal dynamics, riverine water quality, air quality and noise.

1.3.2.2 Geology, Topography, Soils

A review was conducted of relevant literature on the geology, topography and soils within the Highway corridor. However, extensive soil data is not presented here as soil borings have been conducted for the project (JENTECH Consultants Ltd., 2000).

1.3.2.3 Hydrology and Drainage

A literature review was conducted to identify the elements of the hydrologic cycle that are likely to impact on the project and the possible impact that the project could have on the hydrologic regime. Maps, aerial photographs and plans were reviewed. Field assessments included a determination and verification of all the existing inflows into the Hunt's Bay, including both natural and man-made features, assessment of drainage issues, interviews with local community members, and round-table discussions with stakeholders.

1.3.2.4 Air Quality

Ambient air quality measurements are essential to provide a description of the existing conditions, to provide a baseline against which changes can be measured and to assist in the determination of potential impacts of the proposed road/bridge construction on air quality conditions. Ambient background measurements were done at four locations.

The air quality assessment involved the determination of ambient levels of respirable particulates, PM10(<10µm). Particulates were measured using Sensidyne (BDX 530)

personal vacuum pumps (suction 2-3 1/min), attached to pre-weighed millipore filters. The pumps were placed at the approximate respiratory height of pedestrians for a specified period of time, after which the filters were stabilised and weighed to determine a Time Weighted Average (TWA) value for the particulates.

1.3.2.5 Noise

Noise level readings, wind direction and any unusual local noise sources were recorded. Measurements were taken using Quest Electronics sound level meters, which conform to ANSI S1.4 - 1983, TYPE 2 and IEC 651 - 1979, TYPE 2 standards. The meter was calibrated before and after each set of readings.

1.3.2.6 Water Quality

The objective of the baseline water quality programme was to determine pre construction water quality conditions and the nature and extent of present impacts. The extent of surface water contamination in the project area was assessed based on available data, Kingston Harbour Baseline Study in Webber et al, 2003.

Four surface water stations were investigated, and are shown in Figure 1.2.

Station PC1 is situated in the Rio Cobre by the Caymanas crossing.

Station PC2 is situated approximately 5m from the mouth of the Rio Cobre.

Station PC3 is located in the Duhaney River just below the trainline, south of the Riverton City landfill area. There is no other significant input to the Duhaney River prior to its discharge into Hunt's Bay.

Station PC4 is located on the southern corner of Hunt's Bay. Station PC5 was sampled during the KHBS and is located in the center of the Bay.

Samples were collected over a one-day period. Grab samples were collected at the sampling sites at a depth of between 0.5 and 1m from the surface using a "weighted bottle" sampler. All samples collected were stored in pre-cleaned 2 l polyethylene and 250/500 ml glass bottles (transparent and opaque). Bacterial samples are collected at the water surface in sterilized 100 ml glass bottles.

Dissolved oxygen and conductivity measurements were taken *in situ* at all sampling stations. Measurements were taken at the water surface (0.1m) and just above the bottom at each site.

Laboratory Analyses were performed at the Environmental Solutions Laboratory Division using certified methodology from Standard Methods for Water and Wastewater Analyses (Eaton *et al*, 1995).

1.3.3 BIOLOGICAL ENVIRONMENT

The status of the flora and fauna of the study area were determined by a review of literature relevant to the area, and an assessment of both terrestrial and aquatic environments.

1.3.3.1 Flora

The vegetative communities were identified using the method of Grossman *et al* (1991) and classified into community types. Identification was carried out of dominant tree species, assessment of stage of growth (mature or sapling) and assessment of canopy cover.

1.3.3.2 Fauna

Information on fauna was gathered from existing literature on reported species as well as observations in the field.

1.3.3.3 SOCIO-CULTURAL ENVIRONMENT

The consultants utilized a combination of desk research, field investigations, census data, parish profiles, structured interviews, maps, reports and aerial photo assessments to generate the data required for description of the existing social environment and assessment of the potential impact of Highway 2000. Data was gathered on the following aspects of the social environment:

- Housing Settlements
- Zoning and Land Acquisition
- Land use and Municipal Status
- Traffic, Transportation and Access Roads

- Demographics
- Livelihoods
- Fisherfolk
- Community Facilities
- Solid Waste Management
- Proposed Developments
- Recreational Activities
- Archaeological and Cultural Heritage

2.0 PROJECT DESCRIPTION

2.1 Alignment

The Portmore Causeway crosses Hunt's Bay and links the parishes of Kingston and St. Catherine, in the region of Gordon Cay and Fort Augusta, respectively. Currently the Causeway supports two lanes of traffic only and in an effort to improve traffic flow, directional changes occur during the weekdays. The morning peak hour flow has been restricted to east-bound traffic traveling into the capital city, and the evening peak hour flow has been restricted to west-bound traffic traveling into the dormitory town of Portmore. Two-way traffic is permitted during the off-peak hours between 9:00 am and 5:00 pm.

The Causeway upgrading provides for a new 2 x 3-lane highway from Kingston to Portmore leading over a new Hunt's Bay Bridge. A main toll plaza, located to the west of the bridge will be constructed. The Toll Plaza will provide 21 lanes as well as an Operation and Maintenance Centre. In addition a 2-lane urban highway through Portmore along the existing Dyke Road, will be upgraded and remain untolled.

2.2 Phasing and Timetable

Initially (CA – Outline Design) the route was along the existing Portmore Causeway and the construction was divided in two phases. The first phase was to provide 4 lanes with addition of one lane in each direction, and a second deck at the new Hunt's Bay Bridge in a second phase. In the course of the further development of the project the following amendments were made:

a) the initial two construction phases have been incorporated into one phase as described above

b) as a consequence of the recent expansion plans for the Port of Kingston, which will involve construction of new container terminals on the northwestern side of the existing terminal at Hunt's Bay, the new causeway alignment will pass west of the new reclaimed port area, so as not to dissect port operations. The new causeway alignment will be situated on land that has been created in the Hunt's Bay by means of the land reclamation completed in 2002 by the Port Authority of Jamaica as part of the Port of Kingston expansion plans. The Highway will provide an access to the port zone as well as an access to the Marina.

Site installation works are expected to begin in January 2004, and commissioning of the road is expected in April 2006. This work is expected to be completed in 30 months and will cover 12 kilometres of roadway. The General layout of the Portmore Causeway alignment is given in Figure 2.1. An update of the Outline Design for the Portmore Causeway was prepared on March 17, 2003, and these drawings are attached as Figure 2.2 (#002 - #008). Detailed drawings of some sections are presented in Appendix III.

The Timetable for the Portmore Causeway construction is given as the Developer's Indicative Timetable and is shown in Table 2.1.

2.3 Construction Camp/Site Office

The construction camp for this segment of Highway 2000 will have facilities for site offices, workshop and storage yard, and other related facilities including fuel storage. Approximately 30,000 m^2 of land will be required and the site originally proposed was that area designated for the Jam World entertainment Centre. However, this location is in the flood-way of the Rio Cobre and may place the construction camp facilities at risk of flooding. This site is not currently used and is Crown Lands.

It is recommended that the construction camp site be located at the recently filled area at Fort Augusta. This site has been filled by Port Authority of Jamaica for future expansion of the Port of Kingston facilities.

2.4 Sourcing, Transport and Deployment of Fill Material

The Hill Run Quarry located in March Pen, Hellshire which now also supplies material for other segments of Highway 2000, will be a main supplier for the Portmore Causeway section. However additional material sources **may** be required. Only licensed suppliers will be utilized, and/or additional permits will be applied for, as required, prior to utilizing new sources.

Currently underway in the Hunt's Bay are maintenance dredging activities which have been approved by NEPA. Use of some of this material, is being considered through acquisition from the contractor on that project.

2.5 Shoreline Protection Works

The shoreline protection works will be as indicated in the Outline Design drawing reference # 009 (Figure 2.3), and will include rip-rap and armour stone. Discussions have been held with the Port Authority of Jamaica to determine the minimum clearance requirement of the bridge, to ensure that access for fishing and other vessels will be maintained during the construction and operation phases.

2.6 Demolition Works for Existing Bridge

After completion of the new bridge, the old bridge will be demolished. Detailed method and scheduling for demolition of the existing bridge has not yet been finalized. Blasting works will be minimized. The bridge spoil will be removed from the marine environment and disposed of at a designated disposal site, within the Riverton City Landfill. This has been approved in principle by the relevant authority, the National Solid Waste Management Authority, at a meeting held on Friday June 13, 2003 (Appendix II). Existing steel piles may be cut at the sea bed, due to difficulties with extraction.

2.7 Solid Waste Disposal (Construction Spoil and Demolition Waste)

All solid waste material will be deposited at the Riverton City landfill as approved by the National Solid Waste Management Authority, or recycled within the project works. Construction material without steel or other metal will be accepted by the Riverton City Landfill for use in the Landfill's operations.

2.8 Mangrove Removal and Coastal Filling

Areas of mangrove removal and coastal filling will be required and these are shown in the Outline Design (Figure 2.2). It is estimated that approximately 70,000 m^2 of mangrove will be removed.

3.0 PERMITTING

Under the Natural Resources Conservation Authority Act (1991), the Natural Resources Conservation Authority (NRCA now the National Environment and Planning Agency, NEPA) is authorized to issue, suspend and revoke permits and licences. The Permit and Licence System was established in 1997 to ensure compliance with Sections 9 & 12 of the NRCA Act, which gives the NRCA the right to issue permits for new developments and request EIA studies where necessary. Highway construction is listed in the prescribed categories of projects requiring a permit.

A Project Information Form (PIF) and a Permit Application (PA) was completed and submitted to NRCA/NEPA (December 2001) with the requisite application fee of J$ 1000. NRCA/NEPA has determined that an Environmental Impact Assessment is required for this project (Letter dated April 4, 2002). The Terms of Reference for conducting the EIA, including issues raised by NRCA/NEPA are presented in Section 1.2.

The Beach Control Authority (Licensing) Regulations (1956) stipulates that a license is required for the modification of any beach/coastline and sets out requirements for the posting of public notices. Dredging works are included under these regulations. An application for a license was also submitted to the NRCA/NEPA (February 2002) with the requisite application fee of J$ 1000.

The NRCA has been interacting with the Highway 2000 project since its inception. The NRCA through an Endorsement Statement (March 2000) conveyed its support for efforts

made to ensure that Highway 2000 satisfied all the requisite environmental standards. The NRCA received and reviewed the SEA and was invited to participate at various meetings and events. The NRCA indicated that it was prepared to work with the preferred bidder to facilitate the application and evaluation process so as to prevent inordinate delays in the permitting process.

This EIA Report forms a part of the application process before an Environmental Permit can be approved and issued.

4.0 NATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS – NATURAL ENVIRONMENT

4.1 Natural Resources Conservation Act (1991)

The Natural Resources Conservation Act was passed in the Jamaican Parliament in 1991 and provided the basis for the establishment of the Natural Resources Conservation Authority (NRCA) with primary responsibility for ensuring sustainable development in Jamaica through the protection and management of Jamaica's natural resources and control of pollution. Sections 9 and 10 of the NRCA Act stipulate that an Environmental Impact Assessment (EIA) is required for new projects and existing projects undergoing expansion.

4.2 Environmental Review and Permitting Process (1997)

The environmental Permit and License System (P&L), introduced in 1997, is a mechanism to ensure that all developments in Jamaica meet required standards in order to minimize negative environmental impacts. The P&L System is administered by NEPA, through the Applications Section (formerly the Permit and License Secretariat). Permits are required by persons undertaking new development which fall within a prescribed category. Under the NRCA Act of 1991, the NRCA is authorized to issue, suspend and

revoke permits and licences if facilities are not in compliance with the environmental standards and conditions of approval stipulated. An applicant for a Permit or License must complete an application form as well as a Project Information Form (PIF) for submission to the NRCA.

4.3 Wildlife Protection Act (1945)

The Wildlife Protection Act of 1945 prohibits removal, sale or possession of protected animals, use of dynamite, poisons or other noxious material to kill or injure fish, prohibits discharge of trade effluent or industrial waste into harbours, lagoons, estuaries and streams, and Authorizes the establishment of Game Sanctuaries and Reserves. Protected under the Wildlife Protection Act are six species of sea turtle, one land mammal, one butterfly, three reptiles and several species of birds including rare and endangered species and game birds.

4.4 The Endangered Species (Protection, Conservation and Regulation of Trade) Act (1999)

This Act deals with restriction on trade in endangered species, regulation of trade in species specified in the schedule, suspension and revocation of permits or certificates, offences and penalties, and enforcement. Many species of reptile, amphibian and birds that are endemic to Jamaica but not previously listed under national protective legislation, or under international legislation, are listed in the Appendices of this Act.

4.5 The Natural Resources (Prescribed Areas)(Prohibition of Categories of Enterprise, Construction and Development) Order (1996)

The island of Jamaica and the Territorial Sea of Jamaica has been declared as a Prescribed Area. No person can undertake any enterprise, construction or development of a prescribed description of category except under and in accordance with a permit. The

Natural Resources Conservation (Permits and Licenses) Regulations (1996) gives effect to the provisions of the Prescribed Areas Order.

4.6 Water Resources Act (1995)

The Water Resources Act of 1995 established the Water Resources Authority (WRA). This Authority is authorized to regulate, allocate, conserve and manage the water resources of the island. The Authority is also responsible for water quality control and is required under Section 4 of the Act to provide upon request to any department or agency of Government, technical assistance for any projects, programmes or activities relating to development, conservation and the use of water resources.

It is the responsibility of the WRA as outlined in Section 16 to prepare, for the approval of the Minister, a draft National Water Resources Master Plan for Jamaica. Areas to be covered in this Draft Master Plan of 1990 included objectives for the development, conservation and use of water resources in Jamaica with consideration being given to the protection and encouragement of economic activity, and the protection of the environment and the enhancement of environmental values.

Section 25 advises that the proposed user will still have to obtain planning permission, if this is a requirement, under the Town and Country Planning Act. In addition, Section 21 of the Act stipulates that if the water to be used will result in the discharge of effluents, an application for a license to discharge effluents will have to be made to the Natural Resources Conservation Authority or any other relevant body as indicated by the Minister.

With regard to underground water, Section 37 states that it is unlawful to allow this water to go to waste. However, if the underground water "interferes or threatens to interfere with the execution or operation of any underground works", it will not be unlawful to allow the water to go to waste in order to carry out the required works provided that there is no other reasonable method of disposing of the water. The Authority also has the power to determine the safe yield of aquifers. (Section 38).

activities may be granted if application is made to the Protected Area Manager.

4.7 Country Fires Act (1942)

Section 4 of the Country Fires Act of 1942 prohibits the setting of fire to trash without prior notice being given to the nearest police station and the occupiers of all adjoining lands. In addition, a space of at least fifteen feet in width must be cleared around all trash to be burnt and all inflammable material removed from the area. Section 6 of the Act empowers the Minister to prohibit, as may be necessary, the setting of fire to trash without a permit.

Offences against this Act include:

- Setting fire to trash between the hours of 6.00 p.m. and 6.00 a.m. (Section 5a);
- Leaving open-air fires unattended before they have been completely extinguished (Section 5b);
- Setting fires without a permit and contrary to the provisions outlined in Section 6 (Section 8);
- Negligent use or management of a fire which could result in damage to property (Section 13a);
- Smoking a pipe, cigar or cigarette on the grounds of a plantation which could result in damage to property (Section 13b).

4.8 Quarries Control Act (1983)

The Quarries Control Act of 1983 established the Quarries Advisory Committee, which advises the Minister on general policy relating to quarries as well as on applications for licenses. The Act provides for the establishment of quarry zones, and controls licensing and operations of all quarries. The Minister may on the recommendation of the Quarries Advisory Committee declare as a specified area any area, in which quarry zones are to be established and establish quarry zones within any such specified area.

Section 5 of the Act states that a licence is required for establishing or operating a quarry though this requirement may be waived by the Minister if the mineral to be extracted is less than 100 cubic metres. Application procedures are outlined in Section 8. The prescribed form is to be filed with the Minister along with the prescribed fee and relevant particulars. The applicant is also required to place a notice in a prominent place at the proposed site for a period of at least 21 days starting from the date on which it was filed.

4.9 The Pesticides (Amendment) Act (1996)

The Pesticides (Amendment) Act of 1996 amended sections of the principal act, which came into effect in 1975 and established the Pesticides Control Authority. This Act gives the Authority the responsibility of controlling the importation, manufacture, packaging, sale, use and disposal of pesticides. Section 11 states that the Authority is required to keep a register or record of all relevant information such as registered pesticides, restricted pesticides, pest control operators and persons licensed to import or manufacture pesticides. Under Section 16 of the Act, the Authority may also, with the approval of the Minister, make regulations which relate to areas such as:

- Aerial application of pesticides;
- Supervision required for the use of pesticides, the prescribed protective clothing to be worn and other precautionary measures;
- The permissible levels of pesticides to be used;
- The periods during which particular pesticides may or may not be used on certain agricultural crops;
- The disposal of pesticides and packages.

4.10 Air Quality Standards

The Federal Clean Air Acts which came into force in the United States in 1990 established air quality standards for six pollutants: ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), respirable particulate matter (PM10) and lead (Pb). An allowable level for each of these pollutants has been set by the United

States Environmental Protection Agency (US EPA) whose objective is to protect the public from exposure to dangerous levels. National standards, known as the National Ambient Air Quality Standards (NAAQS), were established and they were categorized into two groups. In one group, there are the primary standards, designed to protect human health and in the other, there are the secondary standards designed to protect the environment and limit property damage.

4.11 Noise Standards

To date, Jamaica has no National legislation for noise, but World Bank guidelines are often used for benchmarking purposes. The NRCA is currently preparing a draft document for national Noise Standards.

4.12 Water Quality NRCA Act (1990)

The NRCA has primary responsibility for control of pollution in Jamaica's environment, including pollution of water. National Standards exist for industrial and sewage discharge into rivers and streams. WHO Standards for drinking water are used and these are regulated by the National Water Commission. There are no national standards for ambient water quality of riverine systems.

4.13 The Beach Control Authority (Licensing) Regulations (1956)

The Beach Control Regulations require a permit for any works on the beach, coastline or foreshore. Application must be made to the Applications Secretariat at the National Environment and Planning Agency (NEPA). Requirements include a Notice of Application to be posted on the landward and seaward sides of the property and said Notice should be served on adjoining neighbours.

5.0 NATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS – HUMAN, CULTURAL AND SOCIAL ENVIRONMENT

5.1 Town and Country Planning Act (1958)

Section 5 of the Town and Country Planning Act authorizes the Town and Country Planning Authority to prepare, after consultation with any local authority, the provisional development orders required for any land in the urban or rural areas, so as to control the development of land in the prescribed area. In this manner, the Authority will be able to coordinate the development of roads and public services and conserve and develop the resources in the area.

Any person may, under Section 6 of the Act, object to any development order on the grounds that it is:

- impractical and unnecessary;
- against the interests of the economic welfare of the locality.

However, if the Minister is satisfied that the implementation of the provisional development order is likely to be in the public interest, he may, under Section 7 (2) of the Act, confirm it with or without modification by publishing a notice in the Gazette. Section 8 of the Act also gives the Minister the authority to amend a confirmed development order.

Section 10 of the Act states that a development order must include:

- clearly defined details of the area to be developed;
- regulations regarding the development of the land in the area specified;
- formal granting of permission for the development of land in the area.

If the provisions of section 9A of the Natural Resources Conservation Authority (NRCA) Act apply to the development, the application can only be approved by the Planning Authority after the NRCA has granted a permit for the development. (Section 11 (1A). The Authority may impose a "tree preservation order" under Section 25 of the Act if it

considers it important to make provision for the preservation of trees and woodlands in the area of the development. This order may:

- prohibit the cutting down, topping, lopping or willful destruction of trees;
- secure the replanting of any section of the woodland area in which trees were felled during the forestry operations permitted under the order.

The tree preservation order is not applicable to the cutting down of trees which were already dead, dying or had become dangerous and the order can take effect only after it has been confirmed by the Minister.

The Minister can, under Section 26 of the Act, make regulations to restrict and regulate the display of advertisements in any area to be developed if he considers this to be in the interest of public safety. Section 28 of the Act empowers the local authority to require the owner or occupier of land in the development area to take the steps necessary to ensure its proper maintenance.

5.2 Land Development and Utilization Act (1966)

Under Section 3 of the of the Land Development and Utilization Act (1966), the Land Development and Utilization Commission is authorized to designate as agricultural land, any land which because of its "situation, character and other relevant circumstances" should be brought into use for agriculture. However, this order is not applicable to land, which has been approved under the Town and Country Planning Act for development purposes other than that of agriculture. Among the duties of the Commission outlined in Section 14 of the Act is its responsibility to ensure that agricultural land is "as far as possible, properly developed and utilized".

5.3 The National Solid Waste Management Authority Act (2001)

The National Solid Waste Management Authority Act (2001) is "an act to provide for the regulation and management of solid waste; to establish a body to be called the National Solid Waste Management Authority and for matters connected therewith or incidental thereto". The Solid Waste Management Authority (SWMA) is to take all steps as necessary for the effective management of solid waste in Jamaica in order to safeguard public health, ensure that waste is collected, sorted, transported, recycled, reused or disposed of, in an environmentally sound manner and to promote safety standards in relation to such waste. The SWMA also has responsibility for the promotion of public awareness of the importance of efficient solid waste management, to advise the Minister on matters of general policy and to perform other functions pertaining to solid waste management.

5.4 Jamaica National Heritage Trust Act (1985)

The Jamaica National Heritage Trust Act of 1985 established the Jamaica National Heritage Trust (JNHT). The Trust's functions outlined in Section 4 include the following responsibilities:

- To promote the preservation of national monuments and anything designated as protected national heritage for the benefit of the Island;
- To carry out such development as it considers necessary for the preservation of any national monument or anything designated as protected national heritage;
- To record any precious objects or works of art to be preserved and to identify and record any species of botanical or animal life to be protected.

Section 17 further states that it is an offence for any individual to:

- willfully deface, damage or destroy any national monument or protected national heritage or to deface, damage, destroy, conceal or remove any mark affixed to a national monument or protected national heritage;
- alter any national monument or mark without the written permission of the Trust;

- remove or cause to be removed any national monument or protected national heritage to a place outside of Jamaica.

5.5 Land Acquisition Act (1947)

Section 3 of the Land Acquisition Act (1947) empowers any officer authorized by the Minister to enter and survey land in any locality that may be needed for any public purpose. This may also involve:

- Digging or boring into the sub-soil;
- Cutting down and clearing away any standing crop, fence, bush or woodland;
- Carrying out other acts necessary to ascertain that the land is suitable for the required purpose.

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The Minister is authorized under Section 5 of the Act to make a public declaration under his signature if land is required for a public purpose provided that the compensation to be awarded for the land is to be paid out of the:

- Consolidated Fund or loan funds of the Government;
- Funds of any Parish Council, the Kingston and St. Andrew Corporation or the National Water Commission.

Once the Commissioner enters into possession of any land under the provisions of this Act, the land is vested in the Commissioner of Lands and is held in trust for the Government of Jamaica in keeping with the details outlined in Section 16. The Commissioner shall provide the Registrar of Titles with a copy of every notice published as well as a plan of the land. The Commissioner will also make an application to the Registrar of Titles in order to bring the title of the land under the operation of the Registration of Titles Act.

5.6 Registration of Titles Act (1989)

The Registration of Titles Act of 1989 is the legal basis for land registration in Jamaica, which is carried out using a modified Torrens System (Centre for Property Studies, 1998). Under this system, land registration is not compulsory, although once a property is entered in the registry system the title is continued through any transfer of ownership.

5.7 Involuntary Resettlement Policy

Jamaica's experience in resettlement has come mainly as a result of urban renewal and bauxite mining but documentation of the process has been limited. Proposed policy guidelines for involuntary resettlement were outlined in a draft report McHardy (1997). The following measures were recommended as the principles and objectives of the policy:

- Avoid unnecessary displacement
- Give the population the option of selecting their choice among possible alternatives
- Prepare Rehabilitation Action Plans which will ensure that the project-affected people regain at least their "former standard of living and earning capacity after a reasonable transition period"
- All project-affected people should be entitled to benefit from the rehabilitation measures even if they are not holders of legal property titles
- Compensation money due to the persons being displaced should be paid well in advance of the date of their removal

Rehabilitation measures should include:

- Cost of moving to the new site
- Compensation for losses to be incurred
- Subsistence/maintenance allowance during the transition period
- Development programme to assist those resettled in regaining or improving on their previous living standards

- Considerations geared to minimize disruption during rehabilitation

5.8 Mining Act (1947)

It is the responsibility of the Commissioner of Mines to exercise general supervision over all prospecting and mining operations in the Island. Section 8 of the Act identifies lands excluded from prospecting or mining. These include:

- Land to be used for any public purpose (other than mining), for a burial ground or within 100 yards of such places;
- Any area located within any town or village;
- Land reserved for the purpose of a railway or situated within 100 yards of any railway (unless the railway is constructed by the mining lessee for use during operations);
- Any area which is the site or is within 100 yards of any building, works, reservoir or dam or occupied by the Government or a public authority;
- Any street road or highway or any land within 50 yards of the centre line of a street, road or highway other than one constructed on the mining lease by the mining lessee;
- Land within 100 yards of any building.
- Prospecting may proceed in these areas only with the consent of the Commissioner, or in the case of a building, the consent of its occupier.

According to Section 9 of the Act, the Minister may at any time declare an area closed to prospecting and mining. This excludes any lands to which a lessee has rights under a licence or mining lease.

5.9 Toll Roads Act (2002)

The Toll Roads Act was tabled in the House of Representatives in February 2002. The Act was passed into law by the end of the legislative year on March 31, 2002, but there will be some reprieve for motorists for at least two years. This is an Act to provide for the designation of specified roads as toll roads, the establishment of the Toll Authority,

the operation and maintenance of toll roads, the collection and retention of toll, and for other connected matters. (1) The Minister may, by order - (a) subject to subsection (2) designate any road as a toll road for purposes of this Act; and (b) authorize any person, in return for undertaking such obligations as may be specified in an agreement with respect to the design, construction, maintenance, operation, improvement or financing of a toll road, to enjoy the rights conferred in the order, including the right to levy, collect and retain toll in respect of the use of the toll road. (2) No road shall be designated as a toll road under subsection (1) (a) unless in the area in which the toll road is to be established there is an alternative route accessible to the public by ferry, vehicular or other traffic.

6.0 INTERNATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS

6.1 Cartagena Convention (Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region) (1983)

Adopted in March 1983 in Cartagena, Colombia, the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, also known as the Cartagena Convention, is the only legally binding environmental treaty for the Wider Caribbean. The Convention came into force in October 1996 as a legal instrument for the implementation of the Caribbean Action Plan and represents a commitment by the participating governments to protect, develop and manage their common waters individually and jointly.

Ratified by twenty countries, the Cartagena Convention is a framework agreement which sets out the political and legal foundations for actions to be developed. The operational Protocols, which direct these actions, are designed to address special issues and to initiate concrete actions. The Convention is currently supported by three Protocols. These are:

- *The Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region* (The Oil Spills Protocol), which was adopted and entered into force at the same time as the Cartagena Convention;

- *The Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region* (The SPAW Protocol), which was adopted in two stages, the text in January, 1990 and its Annexes in June, 1991. The Protocol entered into force in 2000;
- *The Protocol Concerning Pollution from Land-based Sources and Activities in the Wider Caribbean Region* (LBS Protocol), which was adopted in October, 1999.

6.2 Biodiversity Convention

The objectives of the Convention on Biological Diversity are "the conservation of biological diversity, sustainable use of its components and the fair equitable sharing of the benefits arising out of the utilization of genetic resources". This is the first global, comprehensive agreement which has as its focus all aspects of biological diversity: genetic resources, species and ecosystems. The Convention acknowledges that the "conservation of biological diversity is a common concern of humankind and an integral part of the development process". In order to achieve its goals, the signatories are required to:

- Develop plans for protecting habitat and species.
- Provide funds and technology to help developing countries provide protection.
- Ensure commercial access to biological resources for development.
- Share revenues fairly among source countries and developers.
- Establish safe regulations and liability for risks associated with biotechnology development.

Jamaica’s Green Paper Number 3/01, entitled Towards a National Strategy and Action Plan on Biological Diversity in Jamaica, speaks to Jamaica’s continuing commitment to its obligations as a signatory to the Convention.

7.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

7.1 PHYSICAL ENVIRONMENT

7.1.1 Topography

The existing causeway site lies at sea level on land which was reclaimed. Topography of the area on either end of the causeway is flat and the bridge is anchored at the intersection of Hunt's Bay and Kingston Harbour (Figure 7.1).

Kingston Harbour, located on the south coast of Jamaica extends 16.7 km in an east-west direction and 6.5 km in a north-south direction at its widest points. The Harbour covers an area of over 50 square kms and is divided into three main sections - the inner, middle and outer basins. The Harbour is bordered on the south by the Palisadoes spit and on the north by the Kingston Metropolitan Area (KMA). The Causeway is located on the north western portion of the Harbour and separates the Harbour from the shallow Hunt's Bay lagoon. The general area for the proposed expansion is fairly flat and the elevation is approximately 1.5 m above mean sea level. The land slopes gently towards the coast at Hunt's Bay.

7.1.2 Geology and Soils

Sand mining at the western end of the proposed alignment on the Dyke Road has occurred over the years. The soil at the site is relatively thin, less than 0.2 m. Typically it occurs as a dark-brown to black organic or peaty soil in some areas or silty clay in other areas.

There is no evidence of any major geological structures such as faults traversing the site, so no major displacement along a zone of weakness is anticipated, nor would there be complications of drainage along fault-directed courses.

7.1.3 Climate

The main regional scale weather features that affect the island are upper level pressure troughs (an elongated area of low atmospheric pressure at high altitude), tropical waves and incipient storms and cold fronts. Upper level troughs occur year round but are more frequent in the winter when there are more frequent temperate latitude low pressure systems and fronts. The summer troughs are fewer but can be more persistent. The troughs sometimes interact with the easterly waves (a wavelike disturbance in the tropical easterly winds that usually moves from east to west) and tropical storms to produce intense rainfall.

Tropical waves and incipient storms occur in the summer and move from east to west and are good rainfall producers. During winter months, cold fronts associated with low pressure systems that form over the south central United States can reach Jamaica although they are moderated by the still warm water in the Gulf of Mexico and the Caribbean. These fronts can be stationary and produce much rainfall over the northern areas of Jamaica.

Data from the meteorological station at Norman Manley International Airport (NMIA) was used to obtain relevant information for the site. This was possible since there are no intervening topographical features that would cause differences in meteorology between NMIA and the site.

The monthly mean values for selected parameters for NMIA from 1951 to 1980 are summarized in Table 6.1 and wind data for the period 1981 to 1990 are summarized in Table 7.2. Wind rose data is shown in Figure 7.2.

Table 7.1: Selected Monthly Mean and Annual Mean Meteorological Values (1951-1980) Norman Manley International Airport

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Mean
Maximum Temp. (°C)	29.8	29.6	29.8	30.3	30.8	31.2	31.7	31.9	31.7	31.3	31.1	30.5	30.8
Minimum Temp. (°C)	22.3	22.3	22.9	22.6	24.7	25.3	25.6	25.3	25.3	24.8	24.1	23.1	24.0
Rainfall (mm)	18	16	14	27	100	83	40	81	107	167	61	31	62.1
No. of raindays	4	4	3	5	5	6	4	6	8	10	6	4	5.4
Rel. Hum.-7am (%)	80	78	77	77	76	73	76	76	78	80	79	78	77.3
Rel. Hum.-1pm (%)	61	62	64	60	66	65	65	68	68	65	65	64	64.4
Sunshine (Hours)	8.3	8.6	8.5	8.7	8.2	7.7	8.2	8	7.2	7.4	7.8	7.8	8.0

Table 7.2: Wind Speed and Direction Data: Norman Manley Airport 1981 – 1990

Wind Speed	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**All DIR**	**All DIR**	**Avg speed**
Knots	020 - 030	040 - 050	060 – 070	080 – 100	110 - 120	130 - 140	150 - 160	170 - 190	200 - 210	220 - 230	240 - 250	260 - 280	290 - 300	310 - 320	330 - 340	350 - 010		%	kt
0																	12792	14.72	0
1 – 3	102	47	61	151	66	60	85	143	88	84	64	290	556	644	798	438	3677	4.23	2
4 – 6	373	194	346	796	431	371	545	1035	457	297	281	697	1435	2253	3486	2104	15101	17.37	5
7 – 10	536	311	857	2470	1434	1027	1093	1429	578	279	216	545	866	1801	3787	3020	20249	23.29	8.5
11 - 16	169	121	868	5520	3675	1714	751	257	87	59	31	79	96	255	809	930	15421	17.74	13.5
17 - 21	35	14	265	3734	3322	1475	327	45	10	4	2	6	8	53	108	97	9505	10.93	19
22 - 27	15	0	59	2786	3254	1509	238	12	3	1	1	3	5	54	51	70	8061	9.27	24.5
28 - 33	7	0	8	594	520	224	19	7	1	0	1	0	5	24	31	52	1493	1.72	30.5
34 - 40	0	0	0	7	8	10	3	3	0	0	1	0	1	15	0	13	61	0.07	37
41 - 47	0	0	1	1	0	1	4	0	0	0	0	0	0	0	0	0	7	0.01	44
48 - 55	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0.00	51.5
56 - 63	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	3	0.00	59.5
>63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0.00	63
Frequency by DIR	1237	687	2465	16059	12710	6391	3068	2932	1224	724	597	1620	2972	5099	9072	6724	86373	100.00	
Missing																		0.64	
Average Speed	18.54	19.09	18.29	14.80	13.67	14.32	17.74	19.46	19.16	18.11	18.03	16.99	16.59	17.54	18.54	18.89	13.94		

The maximum daily temperature ranges from 29.6 °C to 31.9 °C and the minimum temperature ranges from 22.3 °C to 25.6 °C with highest temperatures in July and August. The relatively narrow range in temperature reflects the moderating influence of the sea. Highest monthly average rainfall occurs between May and October and the annual mean rainfall is 62.1 mm. October has the highest average monthly rainfall (167 mm) and days with rain (10 days).

The 30- Year mean rainfall for the Riverton area, located just north of the Hunt's Bay, is 1108 mm and the monthly mean ranges from a low of 30 mm to a high of 263 mm. The annual 30 –Year mean Class A Pan evaporation for the Norman Manley International Airport, the nearest station with long-term evaporation data, is 2550 mm. The annual evaporation is higher than the annual rainfall. This implies there is a water deficit or extremely dry climatic condition at the site.

Government of Jamaica (2000e) detailed volumes of precipitation for different locations along the entire alignment for Highway 2000. For the Rio Cobre the following figures were given:

Watershed Area	554.0 (km^2)
1/10 yr	204 (24 hrs)(mm)
1/25 yr	264 (24 hrs)(mm)
1/50 yr	298 (24 hrs)(mm)
1/100 yr	338 (24 hrs)(mm)

The dominant winds over Jamaica are the northeast trade winds whose strength is governed by the strength and location of the Azores-Bermuda sub-tropic high pressure cell. During the summer months the high pressure cell is weaker and farther north (than in summer) and consequently the trade winds are broad, persistent and extend further south. In the winter months, the central pressure of the cell is higher and further south and the winter trade winds are weaker and have a more northerly component.

The wind data for the period 1981 to 1990 show that the most predominant wind directions (Table 7.2 and Figure 7.2) are from the east and east-south-easterly. These are the prevailing sea-breeze directions and reflect the effects of the mountains which lie along an east-west axis. The mountains deflect the dominant northeasterly trade winds and provide the easterly component to the winds. Sea breeze influences provide a southerly component. Winds from the north-northwest and north are the other dominant direction and reflect land breeze as well as influences of cold fronts and the northeast trades.

The mean wind speed over the period was 10.3 knots (19.1 km/h). Winds from the south had the highest wind speeds (19.5 knots (kt) followed by the south south-west. Winds from the ESE had the lowest average wind speeds. Calm winds were reported 14.7% of the time and wind speeds of 1 to 3 kt were reported 4.2% of the time.

7.1.4 Hydrology, Drainage and Coastal Dynamics

Several rivers and gullies discharge into Hunt's Bay. These include the major inflows of the Rio Cobre, Duhaney River (Fresh River) and the Sandy Gully, and relatively minor inflows from the Waterford Canal, the Jew Gully and at least 5 other minor gullies (Figure 7.1). A 50-yr flood event would be associated with a very slow moving tropical depression as might typically occur outside the hurricane season.

Table 7.3 Rivers and Gullies that Discharge into the Area

River or Gully	Catchment Area (Km^2)	Approx 50 yr return flood (Cumecs)
Rio Cobre	600	1800
Duhaney River	70	200
Sandy Gully	56	1400
Jew Gully	5	300
Waterford Canal	8	300
Other misc. gullies	Inc	200
TOTAL	739	4200

Source: Environmental Solutions Ltd., 2001

The two main contributors of flows to the Hunt's Bay are the Rio Cobre and the Sandy Gully, which together account for 72% of the total inflows. The Rio Cobre also brings in large volumes of debris and silt as evidenced by the visible plume after a heavy rainfall event (Plate 1).

Astronomical tide data for Kingston Harbour is given in Table 7.4.

Table 7.4: Astronomical tide data for Kingston Harbour

Tide	Level (m)
Highest tide	+ 0.46
Mean high Water	+ 0.14
Mean Sea Level	+ 0.0
Mean Low Water	- 0.11
Lowest Tide	- 0.43

Source: Environmental Solutions Ltd., 2001

The tidal movements are so small that wind effects are often as significant as the astronomical effects. Maximum water levels above mean sea level in Hunt's Bay and the maximum flow velocity through the existing Causeway Bridge are given in Tables 7.5 and 7.6, respectively.

Table 7.5: Maximum water levels above MSL in Hunt's Bay

Bridge bed profile	**Hydrograph A**			**Hydrograph B**			**Hydrograph C**		
	Reclamation Area (km2)								
	0	0.3	0.8	0	0.3	0.8	0	0.3	0.8
	Maximum water level above MSL (m)								
Existing	0.252			0.333	0.333	0.333	0.289	0.289	0.290
-2.5m	0.226	0.226	0.226	0.288	0.288	0.288	0.254	0.254	0.254
-5.0 m	0.214	0.214	0.215	0.269	0.269	0.269	0.239	0.239	0.239

Source: Environmental Solutions Ltd., 2001

Table 7.6 Maximum flow through Causeway Bridge (Environmental Solutions Ltd., 2001)

Bridge bed profile	**Hydrograph A**			**Hydrograph B**			**Hydrograph C**		
	Reclamation Area (km2)								
	0	0.3	0.8	0	0.3	0.8	0	0.3	0.8
	Maximum water level above MSL (m)								
Existing	1.91			2.46	2.46	2.46	2.18	2.18	2.18
-2.5m	1.41	1.41	1.41	1.81	1.81	1.81	1.61	1.61	1.61
-5.0 m	1.11	1.11	1.11	1.43	1.43	1.43	1.27	1.27	1.27

The average maximum velocities through the Causeway Bridge opening are very high, up to 2.4 m/sec.

7.1.5 Hazard Vulnerability

7.1.5.1 Seismicity Activity

Earthquake risk zoning for Jamaica determined over the period 1692 to the present time, shows that the Kingston area is susceptible to seismic activity (Figure 7.3). Data from the Earthquake Unit at the University of the West Indies indicate that for Modified Mercalli Intensities (MMI) the Kingston area has an average exposure rate of 7 occurrences per century. MMI is the threshold for damage to ordinary but well-built structures. Moderate and high intensities have been experienced already three times in this century as shown below:

1907 (MMI9) Cracking of ground and slumping along coastline, increased spring flow and new spring bursting out of limestone hills. Masonry building damaged or destroyed. Possible liquefaction (Tomblin and Robson, 1971).

1914 (MMI7) Brick walls cracked, much non-structural damage. Landslides occurred (Ibid).

1993 (MMI7) Much non-structural damage, some structural damage. Masonry walls cracked. Ground cracks and settlement near coastline, submarine telecommunication cable broken. (Wiggins-Grandison and Ahmad, 1996)

A more detailed map of the Kingston Metropolitan Area showing seismic hazard assessment is given Figure 7.4 (Ahmad, 2003). This map shows site-corrected earthquake ground motions that have a 10% chance of being exceeded in 50 years, and also shows site specific study areas where geotechnical investigations are necessary. These areas include Portmore, the area surrounding Hunt's Bay, the Kingston coastline and the Causeway. Geotechnical investigations have been undertaken as part of the engineering design and are available (JENTECH Consultants 2002).

7.1.5.2 Storm Surge

Typically the rainy season occurs between May and October with tropical storms and hurricanes occurring between June and November. Tidal fluctuations are minimal for the island (approximately 15 cm) but storm surges, as well as flooding and ponding, from high intensity rainfall events are characteristic of most of this low lying coastal area. Hurricane tracks across the island from 1880 to 1988 are shown in Figure 7.5).

A study was completed in the Preliminary Design Phase of Highway 2000 (Development Bank of Jamaica, 2000f) on the Portmore Causeway to determine the design water levels along the Causeway; to characterize the urban hydrology of the Portmore area in order to design stormwater flows; and to carry out an ecological assessment of the mangroves and benthic community in the project area. The study showed that the static water level rise due to extreme hurricane wind and wave conditions was greater than that due to extreme stormwater runoff conditions. Design water levels were given as follows:

Return Period (Yr)	Hurricane Wave – Static Water level components (m)	Stormwater Runoff – Static water level components (m)
25	1.55	0.645
50	1.74	0.845
100	1.98	1.195

The highest vulnerability for the Causeway will be when hurricanes approach the island from the south and south-east. Heavy rains, wind and storm surge will all contribute to the risk of flooding and scour.

Regarding urban hydrology, the Highway will cross two major stormwater drainage features – the UDC Town Centre Drain and the Waterford Canal (Development Bank of Jamaica, 2000f). This document revealed that inspection of engineering drawings and subsequent discussions showed that there were concerns about the hydraulic capacity of the UDC Town Centre Drain, specifically the inability of the drain to conduct the 1:5 Year Return Period design storm flows, without flooding of the adjacent road surface.

Potential issues and impacts were also identified and mitigation measures have been included in the Design Phase.

7.1.5.3 Ponding

Another potential hazard to the highway alignment is ponding. The project area is characterized by low lying topography and includes coastal mangrove lagoons such as at the Skeet Club at Chainage 193+800 to 194+100 (Plates 2 and 3).

7.1.6 Air Quality and Noise

Potential air quality impacts can arise because of fugitive dust and other pollutant emissions that result from site operations. The following sections reviews historical air quality data for Kingston and describes current conditions in Portmore.

7.1.6.1 Historical Air Quality Data

Ambient air quality monitoring data for the Kingston area are limited. Two studies that included measurement of PM at locations in Kingston and St Andrew are Davis *et al* (1997) and the Environmental Control Division (ECD, 1998). The measurements of PM10 and NOx are relevant to the project since these pollutants can be emitted from

windblown dust and traffic at the site and from motor vehicle exhaust; nitrogen oxides are emitted from vehicular traffic at the site.

In a study by the Environmental Control Division (1998) of the Ministry of Health, daily average PM10 concentrations were measured for between 2 and 16 days between April and August 1997, at 18 locations in the Kingston Metropolitan Area (KMA). Mean PM10 levels at the KMA stations ranged from 30 to 221 (g m^{-3} and maximum values ranged from 55 to 221 (g m^{-3}). The mean PM10 concentration at KMA stations was 70 (g m^{-3}). In the study by Davis et al (1997), TSP measurements were made at 23 stations throughout the island (~14 samples at each site) during the dry season over a two-year period. The mean TSP levels at the 6 stations in the KMA was 55 (g m^{-3}) and the values ranged up to 158 (g m^{-3}).

Ambient SO_2 measurements made during the ECD study ranged from 19 to 107 ug m^{-3}. Samples were collected in tedlar bags over a 16 h period and analysed using Drager tubes. The highest SO2 levels were found at Three Miles which is ~2.7 km ESE of the Riverton Landfill. Three Miles is 2.9 km NNW from the Petrojam refinery and 3.3 km NNW from the JPSCo Hunt's Bay facility which are the two largest sources of SO_2 in the vicinity.

7.1.6.2 Measurements made during the EIA (2002-2003)

As detailed under Section 1.3.2.1, air quality sampling was conducted in order to obtain current data for areas within the project site. Table 7.7 details current air quality measurements for the area.

Table7.7: Air Quality Data

LOCATION	PARTICULATE CONCENTRATION/$\mu g/m^3$	USEPA/NEPA $\mu g/m^3$
Portmore Square	145.4	150
4- Way intersection for Greater Portmore, Hellshire, & Spanish Town	140.0	
Dyke Road by Waterford	135.0	

Key: $\mu g/m^3$- milligrams per cubic meter air;

The air quality data show that ambient particulate (PM10) levels, for respirable particulates, are currently within the recommended guidelines. The existing levels are however very close to the recommended standard, and leaves very little margin for the accommodation of dust generated by construction works. Efforts should be made to ensure that particulate levels do not exceed the national guideline.

7.1.7 Noise

World Bank guidelines for road noise differ depending on where the road is sited and frequency of use. Busy roads or highways generally have noise limits typical of those for industrial zones; consequent to the fact that they carry both domestic and heavy- duty equipment.

The section of the Highway 2000 road corridor that traverses Three miles and Portmore will pass through a busy town center as well as suburban residential communities.

The results of the noise testing conducted in November 2002 are presented in Table 7.8 . Noise data was collected from five (5) sites.

Table 7.8: Noise Data

LOCATION	NOISE (db)	NIOSH Standard dB(A)	NRCA/World Bank Guidelines dB(A)
Newport West	65 - 89.3	85	70
Causeway	65 - 80.4		
Portmore Square	74.3		
4- Way intersection for Greater Portmore, Hellshire, and Spanish Town	67.1		
Dyke Road	56.4		

The baseline noise measurements indicate that some sections of the road corridor are noisy falling within the category of 'busy roads' as detailed in Figure 7.6. The noise levels measured in the residential areas fall within the category of 'quiet roads'.

7.1.8 Water Quality

The proposed highway is expected to impact both directly and indirectly on the Rio Cobre and Duhaney Rivers, Hunt's Bay and Kingston Harbour.

Hunt's Bay is a shallow basin of an area of 10.10 km^2 with depth ranges from 0.31 m - 4.57 m (Goodbody, 1970; Wade, 1976; Ranston, 1998 in Webber 2003). Hunt's Bay is subjected to considerable salinity fluctuations due to fresh water run off from the Rio-Cobre, Ferry and Duhaney rivers and from the Sandy Gully (Figure 7.1) and is connected to the Harbour by a 213.36 m (700 ft.) opening since the construction of the Causeway Bridge in 1969 (Webber 2003). The creation of the solid fill Causeway and the bridge resulted in a narrowing of the connection between the two water bodies (Hunt's Bay and

Kingston Harbour), which has significantly reduced the flow between them, resulting in deterioration of water quality.

Fresh water enters the Harbour at Hunt's Bay from two main rivers, the Rio-Cobre and the Duhaney rivers, and by a drainage scheme, the Sandy Gully as well as via several intermittent streams (Webber, 2003). The most important source of fresh water is the Rio-Cobre, which has a mean discharge of approximately 6.2 m^3 s^{-1} but during flash flood peak flow may rise to 283 m^3 s^{-1} (Government of Jamaica, 1968; Wade, 1976 in Webber 2003). The discharge rate of the Duhaney River is fairly uniform (2.83 m^3 s^{-1}) but less than half that of the Rio Cobre while Sandy Gully discharge over a one-year period was approximately 61,317 million litres or 1.9 m^3 s^{-1} (Government of Jamaica, 1968; Wade, 1976 in Webber 2003). When there is significant land runoff, water also enters the harbour along its northern shore via several gullies. The flow rate of these gullies on the north shore was 1.7 m^3 s^{-1} or 54,504 million litres per year (Webber, 2003).

Kingston Harbour currently receives industrial effluent from shore based industries, discharge from urban drainage channels, sewage effluent and terrestrial run-off from the riverine inputs. Webber *et al* (2003) clearly show that the concentration of pollutants in Hunt's Bay has increased considerably over the last twenty years. Further, Webber *et al* (2003) show that the eutrophication of Kingston Harbour can only be reversed by control of the domestic and industrial waste presently released into it. Even with such waste being diverted, the slow flushing time of the Harbour make that a difficult task (Webber *et al* 2003). It is important therefore that adverse impact(s) on these surface water systems be minimized to prevent further degradation of the water quality. The management/mitigation of the impacts associated with the road and bridge construction must therefore be considered a serious priority.

The stations sampled during this study and the station sampled in the Kingston Harbour baseline study by Webber *et al* are listed in Table 7.9. The current and historical water quality data generated are presented in Table 7.10. The data give an indication of the current water quality of the surface water systems under investigation.

Table 7.9: Surface Water Quality Stations sampled for Portmore Causeway EIA

STATION ID	LOCATION
PC1	Rio Cobre – Caymanas Bridge
PC2	Rio Cobre Mouth
PC3	Duhaney River at the railway line, south of Riverton City
PC4	Hunt's Bay – South

Table 7.10: Water Quality Data for Portmore Causeway EIA

PARAMETER	PC1	PC2	PC3	PC4	NEPA STANDARD
pH	7.4	7.0	7.2	8.1	7-8.4
DO (mg/L)	5.4	9.5	8.4	6.6	4.5-7.0
Conductivity (mS/cm) Salinity	0.52	6.8	11.7	 27.6	0.15 - 0.60 -
BOD (mg/L)	1.0	55	20	11	0.8 - 1.7
Nitrate (mg/L)	9.7	5.3	-	8.1	0.1 - 7.5
Phosphate (mg/L)	0.77	6.0	-	0.8	0.01 - 0.8
Total Coliform (MPN)	>2,400	>2,400	>2,400	460	<450
Faecal Coliform (MPN)	460	>2,400	>2,400	460	<450
TSS (mg/L)	5.0	18.1	8.0	19.8	-
Oil and Grease mg/l	-	13.0	-	1	<10

Key:
***** ***:*** Draft NEPA Ambient Water Quality Standard for Marine Water

- : Analysis was not done

The data generated for the surface water systems show considerable organic contamination and high bacterial loading.

Conductivity

Conductivity measurements ranged between 6.47 and 11.71 mS/cm at the sampling stations. The lowest conductivity measurement was recorded at RC1 in the mangroves. Conductivity measurements were highest in the six miles area at RC4 prior to the Duhaney entering Riverton City. This can be attributed to the effect of the nearby Cremo Milk Factory.

Dissolved Oxygen

Dissolved oxygen levels varied considerably at the water quality stations. Dissolved oxygen levels were supersaturated at Stations PC2 and PC3. High oxygen levels at these stations are most likely attributable to the algal blooms present at these sites at the time of measurement.

pH

The waters at all four stations sampled were neutral (at or just above 7 pH units), or slightly alkaline.

Biochemical Oxygen Demand (BOD_5)

BOD for surface waters in excess of 2.0 mg/l indicates elevated organic loading, which is a cause for concern. BOD levels were elevated at Stations PC2, PC3 and PC4 (no data is available for PC5) ranging between 11 and 55 mg/l, 10 – 50 times the national guideline. High BOD levels are a direct consequence of the high concentration of oxygen demanding species in the surface waters.

Total and Faecal Coliform Bacteria

Fecal Coliform is used as indicators of the possible presence of pathogenic organisms. The generally accepted limit for fecal coliform in surface waters is 200 MPN/100 ml. A guideline of 450 MPN/100 ml is used for one off samples. This limit has been exceeded at all stations, and significantly so at two stations, where levels were in excess of 2,400 MPN/100ml. Sewage effluent from several sewage treatment facilities, as well as raw sewage from residences without sanitary facilities is discharged into these surface water systems. It is well known that many of these treatment plants are not operating efficiently and are discharging untreated sewage effluent into the surface water systems. These activities are the probable cause of the high faecal coliforms present in the surface water systems.

Total Suspended Solids (TSS)

The Duhaney River and Rio Cobre River (particularly at its mouth) contained a large quantity of debris consisting of plastic bags, metal pieces, logs, etc. Total Suspended Solids loading at the water quality stations ranged between 5 and 20 mg/l. The water was murky and visibility was poor.

Oil and Grease

Oil and grease data are available for two sites, PC2 and PC4. Oil and grease levels at PC4 is low whereas the level at PC2 is elevated, higher than the industrial effluent standard of 10 mg/l.

7.2 BIOLOGICAL ENVIRONMENT

7.2.1 Flora

The terrestrial vegetation in the areas along the proposed alignment is dominated by modified vegetative communities particularly scrubland as defined by Grossman *et al*, (1991). This includes coastal vegetation (Plates 2 and 3) and terrestrial adjacent to the dyke road, and fringing areas of development (Plates 4 and 5).

7.2.2 Fauna

The area of the Portmore Causeway is bordered by Hunt's Bay to the north and Kingston Harbour to the south. Immediately east and west, are the Industrial Zone and residential areas of the Kingston Metropolitan Area and Portmore, respectively. Seabird species were observed and recorded, due to the proposed alignment, through wetland areas and across the Hunt's Bay.

A study by Douglas (2003) on the seabirds in Kingston Harbour and adjoining areas revealed nine species of true seabirds, in addition to other species such as ibises, rails, herons and egrets. True seabirds were described as those birds that spend relatively large portions of their time over the seawaters and which are only rarely (if ever) recorded on dry land outside of the breeding season. The nine species of seabirds and other birds observed by Douglas (2003), in the Kingston Harbour area are given in Table 7.11. Additional information on these species including scientific name, habitat, and range have been included based on Downer and Sutton (1990); Bull and Farrand Jr (1977); and Bond (1985), to provide complete ecological information for these species. Other species that have been observed in the area as part of this study have also been included.

Table 7.11 Bird Species reported from the Kingston Harbour area by Douglas (2003)(*) and observed in field surveys

Common Name	Scientific Name	Status	Range	Habitat
Laughing Gull *	*Larus Gull*	Common resident	Coasts of N. America, West Indies and northern S. America	Coasts and in harbours
Royal Tern*	*Sterna maxima*	Common resident	Throughout the West Indies, C and S. North America, coast of W. Africa	Along coasts
Sandwich Tern*	*Sterna sandvicensis*	Common winter visitor	N. C and northern S. America, British isles and Europe	Along coasts and coastal ponds
Least Tern*	*Sterna antillarum*	Common summer resident	Worldwide	Nesting on salt ponds and beaches
Brown Pelican*	*Pelicanus occidentalis*	Common resident	Subspecies *P.o. occidentalis* in the West Indies. Also coastal N., C. and S. America	In coastal waters, on reservoirs, fish farms and in marshy areas
Magnificent Frigate Bird*	*Fregata magnificens*	Common resident	Subspecies *F.m. magnificens* in the West Indies. Also tropical oceans around the Americas.	Often seen over fishing beaches
Ring-billed Gull*	*Larus delawarensis*	Common resident	Costs of N. America, West Indies and northern S. America	On coasts and in harbours
Herring Gull*	*Larus argentatus*	Vagrant or rare transient	Common in the N. Atlantic but rare in the West Indies	Harbours
Brown Booby*	*Sula leucogaster*	Locally common resident	Subspecies *S.l. leucogaster* in the West Indies. Also pantropical.	On cays or at sea, immatures on coastal beaches
White Ibis	*Eudocimus albus*	Uncommon resident	Greater Antilles, N. and S. America	In mangroves
Clapper Rail	*Rallus longirostris*	Uncommon resident	*Subspecies R.l. caribaeus* in the Greater Antilles and Virgin Islands. Also C. and S. America, Bahamas and WI islands.	In mangrove roots, marsh grasses and rushes
Great Blue Heron	*Ardea herodias*	Common winter	N. America, wintering in the WI	In wetlands

		visitor	and C. America south to northern S. America	
Little Blue Heron	*Egretta caerulea*	Common resident	Bahamas, WI and the Americas	In wetlands
Great Egret	*Casmerodius albus*	Common resident	Subspecies *C.a.egretta* in the Bahamas and Greater Antilles. Also worldwide	In wetlands
Cattle Egret	*Bubulcus ibis*	Very common resident	Worldwide	Pastures and open areas
Black-Crowned Night heron	*Nycticorax nycticorax*	Fairly common resident	Subspecies *N.n. hoactli* in the Antilles. Worldwide except Australia.	Beaches and in wetlands
Yellow-Crowned Night Heron	*Nycticorax violaceus*	Common resident	Subspecies *N.v. bancrofti* in the WI and C. America. Other races in C and S America.	Beaches and in wetlands

Douglas (2003) concludes that Kingston Harbour is an important area for a number of wintering seabirds, and the numbers of individuals vary dramatically throughout the year with the highest numbers recorded in winter for all species. The numbers of the Brown Pelican changed relatively little throughout the year, but Laughing Gulls and Terns were most abundant in the winter. Kingston Harbour is important as a feeding, nesting and roosting site for the Caribbean Brown Pelican – which is now listed as endangered (Douglas 2003).

Based on studies by Sutton and Hay (2003) twenty-three species of resident and migratory ducks have been recorded in Jamaica but little is known of their status or distribution. One species, the West Indian Whistling Duck *Dendrocygna arborea*, is internationally classified as vulnerable. Kingston Harbour and its environs are known habitats for several species of resident and migratory ducks.

The American Crocodile (*Crocodylus acutus*) is native to Jamaica and is protected under both national and international legislation. Known habitats include the southern drainages of the island, which include the Rio Cobre, as well as the mangrove habitats of the Kingston Harbour. The Waterford Canal, which will be crossed by the Highway also has crocodiles and they are usually sighted by residents in the early morning and afternoon hours.

7.2.3 Wetlands

Mangroves exist along sections of the proposed alignment as shown in Figure 2.1 and Plates 6, 7 and 8. The Skeet Club (Plates 2 and 3) located in the mangroves by Dawkins Pond provides a habitat for several species of waders and shore birds (See Table 7.11). Approximately 60% of the lands in the Skeet Club will be utilized for the highway alignment. The dominant species is the Black Mangrove (*Avicennia germinans*) with the aerial roots or pneumatophores visible, on both sides of the existing road.

7.2.4 Marine Environment

Hunt's Bay is a small bay connected to the north-west of the Kingston Harbour. The Bay receives inflows from three major sources the Rio Cobre, the Duhaney River and the Sandy Gully (Figure 7.1), as well as six minor gullies including the Jew Gully in the north eastern section. Inflows into Hunt's Bay (Section 7.1.2) carry sediment, solid waste, industrial effluent, sewage effluent and non-point source chemical pollutants.

Filling will be required in the wetlands between Dawkin's Pond and Hunt's Bay. The channel that existed between Hunt's Bay and Dawkins was closed following a Governmental decision in 1978. The construction of the proposed Highway will therefore not be responsible for the closure of this channel and filling in the area will not adversely affect any flow between the two water bodies, as flow is non-existent at this point. An aerial photograph of this area is given in Plate 9. Details related to this closure are given in Appendix IV.

7.3 SOCIAL ENVIRONMENT

Analysis of the social environment of the Portmore Causeway segment of Highway 2000 must take account of the characteristics of the project site as well as the service areas of the project, in that the causeway serves as the main access route between the business districts of the Kingston Metropolitan Area (KMA) and the residential and commercial areas southwest of the KMA. The Port of Kingston and its related operations, the Tinson Pen aerodrome, transportation hubs, commercial, retail and wholesale enterprises, industrial plants, boating, fishing, and residential settlements all form part of the social setting of the project.

7.3.1 Housing Settlements

Settlement within the project area is dominated by the Causeway fishing village, but the residential areas of Portmore, Greater Portmore, Hellshire, Braeton and Port Henderson, (Figure 7.7 and Plate 6) all with their respective housing subdivisions and support services, are significant to the project in that it is the growing population in these areas which has created the demand for an upgraded arterial link to the KMA.

The Hellshire Bay Development Co. was established under the aegis of the Urban Development Corporation (UDC) in 1969 with a mandate to develop a new town which would stimulate development in a westward direction from Kingston helping to absorb some of the growing population of the KMA which was due primarily to in-migration from rural areas and the adjacent parish of St Catherine. Tourism development was integral to the Hellshire Hills development, which was designed to include Hellshire Bay New Town, Manatee Bay Development and the Central Highlands New Town. It was projected that the Hellshire Development would accommodate up to 450,000 persons.

The Portmore Land Development Co. Ltd. was formed by private enterprise and had as its main objective development of housing on the plains of southern St Catherine. The flood vulnerability of the proposed development area was reduced by construction of an eleven-mile dyke which controlled the floodway of the lower Rio Cobre, and land within the Rio Cobre delta was reclaimed by dredging to elevate the area above inundation levels. A three-mile causeway was built to facilitate transport connection between the proposed development area and downtown Kingston, through Newport West - the general cargo wharf area of the Port of Kingston.

The first housing development – Independence City - consisting of 1,000 two and three-bedroom units was constructed in 1969. Edgewater (Plate 6), Bridgeport Phases 1, 2 and 3, Passage Fort and Waterford were constructed by 1976. Portsmouth and Southboro followed between 1978 and 1979, and in the 1980s Westchester, Cumberland, and

Westbay were completed. By mid 1990s additional developments occurred in Westbay and Cumberland and Bridgeview was constructed. These areas are collectively referred to as Old Portmore.

Greater Portmore led to a gigantic leap in settlement in that 16,000 units were constructed west of and adjacent to Old Portmore on approximately 1300 acres. Additional units are being constructed on an adjacent 93 acre tract. Yet another 2,000 unit development was executed as Braeton New Town on approximately 1400 acres south of Old Portmore.

"Portmore" is the collective name given to the entire area which has functioned as a dormitory settlement of the KMA on which it depends for employment, commercial and administrative functions (Figure 7.1).

7.3.2 Zoning and Land Acquisition

Zoning is not an issue as the proposed alignment will traverse an existing transportation corridor. However, there will be a minor variation to the existing roadway as the proposed alignment will travel along the Dyke Road, through the gates of the existing Jam World Entertainment Centre (Plate 10), and cross the Waterford Canal with a newly constructed bridge, before rejoining the existing alignment in the region of Dawkins Pond.

With respect to land acquisition, NROCC is the agency responsible for all issues related to land acquisition. The lands in this area are 100% public lands under the jurisdiction of the Commissioner of Lands. Negotiations for land acquisitions are now complete (Pers. Com., NROCC, March 2003).

7.3.3 Land Use and Municipal Status

7.3.3.1 The Road

The Causeway is a transportation corridor which includes a causeway bridge that traverses the Kingston Harbour in the vicinity of Hunt's Bay. The bridge separates the Causeway into Causeway north and Causeway south. On Causeway south there is a thriving fishing village regarded as an "informal settlement". The village has a combination of accommodation units, vending areas, gear sheds, and beaching facilities for boats.

7.3.3.2 The Port

Causeway north is dominated by the operations of the Port of Kingston. The Port of Kingston occupies Kingston Harbour and accommodates the major general cargo port and container terminal for Jamaica, and transshipment port for the subregion. All the services associated with port operations such as berthing, warehousing, cargo clearance and distribution, trucking, government agencies and others, are found in the area of Port Bustamante. In addition the eastern section of the Harbour accommodates berthing operations for oil tankers, wheat, cement, and gypsum.

The Port is a major economic unit and plays a substantial role in the island's economy, as Jamaica is perfectly placed as a transshipment port. Shipping is reported to occupy the largest percentage of the Kingston Harbour coast (20%) while the contribution of shipping to the national economy (of activities in the Kingston Harbour area) is given as 45% (Bacon *et al*, 1988). Port expansion has been on-going and has included widening of the ships channel, facilitated by cutting of a coral cay, as well as land reclamation works for berthing facilities and container transshipment. Reclamation works have

changed the shoreline in the north east of Hunt's Bay which has influenced the alignment of the proposed Highway 2000 Causeway Upgrading (Plate 11), as the Highway cannot bisect the Port Authority's property and operations, and must be aligned along the perimeter of the newly reclaimed area.

A small marina sits adjacent to the port operations in the southeastern corner of the Causeway on approximately 1 acre of landfill. Boat cleaning and other maintenance services are offered from the marina, and a dredging operation is based there.

On Marcus Garvey Drive, the Free Zone with several manufacturing/service uses is a major use. There is also an abandoned zinc factory.

Within Kingston Harbour are several fishing beaches as discussed in Sections 7.3.6 and 7.3.7.

The Causeway is linked to Kingston via Marcus Garvey Drive and Hagley Park Road, and at the three mile interchange Spanish Town road joins the intersection (Figure 7.1). A significant use on Marcus Garvey Drive just north of the Causeway intersection is the Tinson Pen aerodrome, and flight safety envelopes have been considered in the design and siting of the alignment, and particularly the interchange.

7.3.3.3 Portmore

Portmore received Municipal status by legislation in 2002 and the new "city" includes the area extending southwest- northeast from the coast around through the Hellshire Hills toward the intersection with Nelson Mandela Highway in the north (Figure 7.7). As of June 2003, the municipality is governed by a Municipal Council, led by a Mayor, which has the power to regulate and manage solid waste, and in particular garbage collection and street sweeping (subject to the National Solid Waste Management Act of 2000); street lighting; the Local Planning Authority; beautification; disaster management; and municipal amenities and facilities. The power to regulate the Local Building Authority is shared with the St. Catherine Parish Council. The Portmore municipality lies within the

parish of St Catherine and therefore falls within the jurisdiction of the St. Catherine Parish Council, as outlined by law.

Land use in the Portmore municipality is primarily residential with commercial support services (Plates 12 and 13). There are still large tracts of agricultural land much of which is under utilized or abandoned. The road network was designed to support the residential subdivisions in that there are main arteries with internal networks.

The Augusta Drive area accommodates both residential and commercial uses, and the southern side along Port Henderson Beach is an active recreational area.

Drainage canals are integral to the landscape and these are interconnected to lead stormwater from the interior to the coastal wetlands and shoreline.

7.3.3.4 Surrounding Land Use/Commercial Environs

The existing Causeway alignment intersects Marcus Garvey Drive, which runs east to west from downtown Kingston, to the three mile intersection where it joins Spanish Town and Hagley Park Roads. An industry lined thoroughfare linking downtown Kingston with major areas of the Kingston Metropolitan Area, Marcus Garvey Drive is a high density traffic corridor for entering and leaving the city, particularly during the early morning and late afternoon peak periods.

Jamaica's Oil refinery, Petrojam, is located along Marcus Garvey Drive and three petroleum based industries are located within relatively short distances of the refinery. Hunt's Bay Power Station operated by The Jamaica Public Service Co. Ltd, which is based on oil fired generators; the Esso Standard Oil SA Ltd. corporate office and storage facility; and the plant and loading facilities of The Petroleum Company of Jamaica (PETCOM) which is one of the local petroleum marketing companies. These petroleum-based companies collectively comprise Jamaica's largest infrastructure of petroleum storage capacity and collectively employ at these locations several hundred persons.

The three mile intersection is an important transportation node linking the Marcus Garvey/Port area with Spanish Town Road leading into Mandela Highway and ultimately Spanish Town.

Spanish Town Road is heavily commercialized with retail and wholesale establishments, traditional industrial plants, some low-income residential areas, transport establishments and the major landfill for the KMA, St. Catherine and Clarendon.

Hagley Park Road leading into Half-Way Tree is also heavily commercialized with mixed use including old residential, light industrial, commercial, institutional, public offices and recreational activities.

7.3.4 Traffic, Transportation and Access Roads

Based on studies by NROCC (NROCC, Pers. Com) an average of 37,000 vehicles use the Portmore Causeway each day for travel to and from the downtown Kingston area, and other parts of the KMA. Travel is mainly for work, commercial undertakings and personal reasons. The high demand and resulting traffic congestion over the years has resulted in a restriction in directional flow. Traffic flows one-way, easterly into the city of Kingston in the morning peak hours (6:00 – 9:00 am), and one-way westerly into Portmore in the afternoon peak hours (4:00 – 7:00 pm).

The high demand for traffic access stimulated the demand for upgrading which is the subject of this EIA.

Livelihood opportunities are growing within the wider Portmore area, but the jobs are essentially in the KMA. The Portmore area is also connected via Dawkins Drive to the Mandela Highway from which junction, traffic flows primarily east into Kingston. (Figure 7.7). During the upgrading of access roads as well as construction of the new bridge, this main transportation artery must remain accessible.

7.3.5 Demographics

A study by the Social Development Commission (SDC) in 2002 revealed a total of 103 shacks (or camps as called by the fisherfolk) on the seaward side of the Causeway bridge and 34 shacks on the northern side. Approximately 1300 fisherfolk currently utilize the areas (Social Development Comission, 2002) although the SDC has listed 160 fisherfolk with ID's and 95 residents (in 17 families) living at the Causeway Fishing Beach.

Table 7.12 details the number of fisherfolk, vendors and families.

Table 7.12 Fisherfolk, Vendors and Families at the Causeway Fishing Beach

Type of Resident	Number
Fisherfolk and Vendors	95
Number of Families	17
Total Vendors (non-residents)	46
Total Fisherfolk (non-residents)	53

(Source: Social Development Commission, 2000)

Daily population peaks would be achieved by influx of workers to the Port and Freezone areas on the eastern end of the Causeway.

Approximately 250,000 persons reside in the Portmore community, where there are about 62,000 housing units. This figure reflects the population explosion that has occurred since 1970 when the population was about 2,200. This increase has resulted from the planned residential development which accompanied the policy of Portmore's establishment as a growth center, and the increasing demand for housing in the KMA and Spanish Town areas.

The school age population (5-19) is approximately 25% of the total, and the working age group (20-59) amounts to around 56%. The 0-4 and >60 age cohorts complete the remaining 19% (extrapolated from Census 2001). Demand for transportation and services is therefore high, given the structure of the population.

7.3.6 Livelihoods

Livelihoods in the project area include the Causeway itself, the Portmore municipality, the Port of Kingston and environs, the Kingston Harbour/Hunt's Bay area, and the KMA.

7.3.6.1 Fishing

The Portmore Causeway was completed in the late 1960's, and at that time a number of Kingston Harbour fisherfolk who had been operating from beaches along the northern rim of Hunt's Bay, moved southward to find themselves more convenient bases inside Hunt's Bay along the shoreline of the causeway embankment. The move was inspired in the first instance by a sense of isolation created by the Causeway, and later (1979/80) additional fisherfolk moved to escape from political violence in western Kingston (Social Development Commission, 2000). By the end of the 1970s the practice of landing the catch inside Hunt's Bay along the causeway embankment, just south of the new bridge, had become firmly entrenched, and fisherfolk began to attract much patronage selling directly from their boats, to passing commuters between Kingston and the rapidly expanding Portmore.

Over the past two decades fish vending along the causeway has increased, to the extent that at times, especially on weekends, a section of the main road near the bridge has become a drive-through fish market with patrons coming from both the Kingston and Portmore side. Over the years, this continually worsening situation has attracted considerable adverse public comment, but despite several announcements regarding the need to address the critical environmental issues that have been generated (public health, sanitation, traffic hazards, visual aesthetics), the colony of fishers and vendors has continued to flourish. The quarter mile stretch of the Causeway on the Portmore side of the bridge, is lined on both shoulders with clusters of unsightly shacks which serve as shops and dwelling units for both fishers and vendors.

Recent data provided by the Fisheries Division (Environmental Solutions Ltd, 2002) indicates that the Causeway/Hunt's Bay location has some 734 registered fishermen. Fishing is undertaken in Hunt's Bay, Kingston Harbour, on the Pedro Banks, St. Thomas

and as far west as St. Elizabeth. In 1996 the population of boats berthed on the Causeway was a modest 25 to 40 although an additional small number were kept at Dawkins Pond nearby. The Fisheries Division (Environmental Solutions Ltd., 2002) reports approximately 103 boats on the Causeway beach, but a recent report (Environmental Solutions Ltd., 2002) has reported some 146 boats counted in 2002, with 126 of these berthed on the inside of Hunt's Bay.

The Kingston Harbour based fishing fleet comprises both larger long distance boats and smaller canoes. The fishing beaches licensed by the Fisheries Division in the Kingston Harbour include Port Royal, Hunt's Bay, Port Henderson, Passage Fort, Greenwich Beach, Gypsum Wharf , Harbour Head, and Rockfort. The Causeway is recognized as a beach which has been traditionally used by fisherfolk.

7.3.6.2 Portmore Residents

The Portmore population is largely a commuter population engaged in employment mainly in Kingston and Spanish Town. Kingston and Spanish Town are two large urban centers with the mix of occupations associated with urban areas. The KMA is the economic and cultural hub of the island. Spanish Town as the capital of the parish of St. Catherine has, in addition to municipal functions, retail, wholesale, industrial, commercial and service activities. The town is densely populated and is characterized by traffic congestion.

Spanish Town is described as part of the "Historic Triangle" of the Kingston Metropolitan Region, which includes Kingston and Port Royal, all with significant heritage assets that form a significant part of the tourism product.

The new Portmore municipality includes agricultural land, but most activity is "urban centred". The principal occupations include the many retail and commercial services attendant on growing communities.

7.3.7 Relocation Requirements

Fisherfolk are currently illegally occupying Government-owned lands within the proposed right-of-way along the Causeway (See sections 7.3.4 and 7.3.6). NROCC, as the Grantor, is responsible for land acquisition, and for the provision of a corridor free of encumbrances to the Developer for construction of the highway, and the operation of a limited access Toll Road.

The details of the issues relevant to relocation have been outlined to NEPA in a letter from NROCC dated January 22, 2003 (Appendix V). There are three aspects related to the relocation of fisherfolk along the Portmore Causeway. These are:

1) Landing Beach
2) Residence
3) Vending

Landing Beach

Currently the fisherfolk land their catch on the Portmore Causeway. A proposal has been made to the Ministry of Agriculture for the provision of an alternative beach area where the fisherfolk can land their catch. An area has been suggested by the Ministry of Agriculture on the south west portion of Hunt's Bay. This land is public land. The Ministry of Agriculture would have to be responsible for all the aspects related to the establishment of a new fishing beach. Another proposal under consideration is a shift of the alignment between chainage 191+600 km to 192+200 km. This would then result in the fisherfolk on the south side of the Causeway remaining there, and those on the north side being relocated to the other side, within the fishing village. All proposals are still under consideration.

Residence

Fisherfolk currently residing on the Portmore Causeway, if relocated completely, would possibly be provided with the opportunity to purchase land at Portmore Villas, north of Waterford and adjacent to the Dyke Road (in the area commonly referred to as Lesser Portmore). Portmore Villas is already zoned as a residential area. NROCC will need to determine how many persons would qualify to purchase land in this area. If the alignment is shifted so that only the northern based fisherfolk are dislocated, the relocation of the entire village, and residential options, would not need to be implemented. All proposal are still under consideration.

Vending

Currently the fisherfolk also sell their catch from the Portmore Causeway. NROCC has had discussions with the Portmore Foundation, which is a Non-Governmental Organization that has identified the need for a public market facility in the area. The Foundation has prepared a Business Plan for 2002-2006 which addresses the need for a market in the area with a wet area for handling fish and meat. 2.89 acres of land has already been leased for a twenty-five (25) year period, from the Urban Development Corporation (UDC), in the Portmore Town Centre. A plan of the proposed market is given in Appendix VI.

It is intended that NROCC will contribute to establishment of the wet area of the market so as to accommodate fish vendors being relocated from the Causeway.

A few Fisherfolk are also situated at the mouth of the Waterford Canal, with residences and boats landed. These Fisherfolk will also have to be relocated to facilitate the Highway alignment.

7.3.8 Community Facilities

The Highway 2000 Portmore Causeway upgrading project will terminate on the Portmore side in the vicinity of the City Centre where a major shopping mall (Plate 12), and other retail and service activities are located. The City Center is also a transportation node. Portmore Community College and Heart/NTA facilities are located in the general area. Schools, churches and community centers are well represented in the Portmore municipality.

7.3.9 Solid Waste Management

Plastics, paper/cardboard, glass, and metal containers dominate the waste stream in the project area. Waste comes from informal communities in the area, and along the fringing mangroves waste is lodged, having been washed up from Hunt's Bay. The waste is washed into the bay primarily by Sandy and Jew Gullies, and other drains emptying into the area. (Figure 7.1)

The area in the vicinity of Jew Gully in the northeastern section of Hunts Bay is virtually stagnant and is shallow from the deposition of soft sediments and large quantities of submerged waste – tyres, old vehicles, tree branches etc. The area is aesthetically unpleasant and malodorous.

Solid waste generated as a result of the construction activities will be disposed of at the Riverton City Landfill. This will include the existing causeway bridge after it is demolished. Discussions were held with officers of the National Solid Waste Management Authority (NSWMA) on Friday June 13th, in order to discuss issues related to the capacity of the Riverton City Landfill to accommodate the construction waste (Appendix II). The NSWMA has indicated that the Riverton City Landfill can accommodate the bridge structure and other construction waste, as there are 45 hectares of land now available (NSWMA, Pers. Com). Construction rubble without steel and other metals, will actually be welcomed by the NSWMA, and accepted free of tipping

fees, and used in the operations at the Landfill (NSWMA, Pers. Com.). Metal and other construction rubble would be accepted with requisite charges.

7.3.10 Recreation

There are no recreational areas in the immediate vicinity of the project but the Causeway provides the main transportation link between residents of the KMA and the Hellshire Beach and Port Henderson areas. The Port Henderson area accommodates clubs and restaurants, while Hellshire and Fort Clarence provide bathing beach facilities. The JamWorld Entertainment Centre on Dyke Road has not been in use for many years.

7.3.11 Archaeological and Cultural Heritage

Two listed sites under the Jamaica National Heritage Trust Act are located in the project area. The Site of Passage Fort (Puerto de Caguaya), site of the first port in the Kingston Harbour, is a listed site and is located just south-south-west of the mouth of the Waterford Canal (Figure 7.5). The Highway alignment will cross the Site of Passage Fort. It appears that there are no visible structures located at this site, and the JNHT has been asked to provide information on this site (Appendix VII). Fort Augusta (Figure 7.5) is also a listed site under the Jamaica National Heritage Trust Act. The Fort is currently used as a Women's Prison. Highway 2000 will not impact Fort Augusta.

Port Henderson, a former fortification also during the British period of history, is located in the project area. Port Royal, Spanish Town and Kingston together form the Historic Triangle in Jamaica.

8.0 CONSIDERATION OF ALTERNATIVES

8.1 ALIGNMENT

Other options for the alignment for the Portmore Causeway section of Highway 2000 have been considered.

1. The plans for the expansion of the Port of Kingston operations required an increase in land space for the Kingston Container Terminal. This has been achieved by reclaiming a section of Hunt's Bay on the western side of the originally proposed alignment of the Portmore Causeway and in the north eastern part of Hunt's Bay (Plate 11). The alignment as originally designed would have resulted in the container terminal's operation being divided by the highway's six-lane dual-carriageway. The Port Authority land reclamation is now complete in the north eastern part of Hunt's Bay.

Given the completion of the PAJ's reclamation programme the Highway alignment was reconsidered, at the request of the Port Authority of Jamaica, to run along the western perimeter of the Port Authority's reclaimed area. Suitable access to the Port Authority's facilities has been discussed, between NROCC and the Port Authority.

2. The Jamaica Institute of Engineers (JIE) (Farquarhson Institute of Public Affairs, 2001) in their viewpoint on Highway 2000 raised some specific issue with regard to alignment of the Portmore Causeway section. The JIE proposed an interchange at Six Miles, to pick up traffic from Kingston, rather than further west on the Mandela Highway at Caymanas in the vicinity of the Rio Cobre Bridge. From Six Miles the JIE proposal is for the alignment to run west-south-westerly connecting at the Greater Portmore Intersection (Figure 8.1).

From the JIE's point of view, this would be more feasible in routing traffic from Kingston onto the Highway. The JIE sees the inclusion of the Portmore Causeway in the Highway 2000 Project as a means of ensuring toll revenue from the citizens of Portmore. Revenue is a critical component of the cost-benefit for the Highway 2000 Project, and the JIE feels that the interests of the citizens of Portmore have been betrayed. The JIE realises the need for upgrading of the existing Causeway bridge, but feels that this upgrade should be undertaken separately by the Government of Jamaica, and should not be included in the Highway 2000 toll project.

The decision of the alignment of the Toll Road must take into account social, financial and other aspects. The interests of the citizens of Portmore has not been compromised as there will remain a non-tolled route as dictated under the Toll Roads Act of 2002.

The alignment as proposed by the JIE is along the northern boundary of the Riverton City dump, which would limit any proposed expansion of the landfill in this direction.

3. No alternatives to the alignment along Dyke Road, Dawkins Drive, nor along the existing Causeway Bridge have been proposed by any other entity.

8.2 BRIDGE DESIGN

8.2.1 Bridge Span and Design

The existing bridge approach is just above sea-level (Plate 14) and the bridge has a clearance of 8.75 m. This has resulted in a very distinct hump on the bridge (Plate 15), which reduces long range visibility and has been the cause of many traffic accidents. The design of the proposed new Causeway Bridge is given in Figure 8.2. The design includes raising the bridge approaches some 5m, while maintaining the same clearance. This will result in 'flattening' the bridge and reducing the existing 'hump'. The vertical alignment of the bridge will be designed in accordance with the design speed of the Highway.

The bridge span has been an issue of considerable debate over the years since its construction. The creation of the solid fill Causeway and the bridge resulted in a narrowing of the connection between the two water bodies (Hunt's Bay and Kingston Harbour), which has significantly reduced the flow between them, resulting in continued deterioration of water quality and ecological conditions in the Bay. This has also resulted in a 'jet-stream' effect of material passing from Hunt's Bay into the Harbour.

In a letter to the Environmental Solutions Ltd. regarding consultations on the bridge span, Mr. Cowell Lyn, a Coastal Engineer and Project co-ordinator for the Kingston Harbour Rehabilitation Project (administered by the National Environment and Planning Agency and funded by the Inter-American Development Bank) stated although it might be possible to increase the span of the bridge, he did not think *"that such concessions would be likely to restore, to any worthwhile extent, the original productive functions of the Bay" (Appendix IX).* Of greater importance is the cross-sectional area under the bridge so that the *"channel could be either wide and shallow or narrow and deep – so long as it would let out the design flood flow without scouring the footings of the bridge piers"*.

The design of the proposed new Causeway Bridge does not impact on the width and depth of the existing channel. In fact the new bridge is marginally wider than the existing bridge, and has one less pier than the existing, which represents one less obstructive unit to the flow.

It should be noted that the main issues related to the continued deterioration of Hunt's Bay are based on continued polluted inflows, which must be stemmed if any improvement in the condition of the Bay is to be achieved.

In addition to the physical and ecological considerations regarding the span of the bridge, it should also be noted that the cost of increasing the span of the bridge, from the existing 700 ft span to 1,200 ft. would cost approximately US$10 million (BYTPJ, Pers. Com.). The arrangements under the Highway 2000 project are based on a fixed-price contract

and this additional cost could not be borne by the Developer or the Contractor, but would have to be borne by an entity outside the highway 2000 Project.

8.2.2 Bridge Location

The Jamaica Institute of Engineers had also recommended that the new bridge be sited further west, which would allow more land to the east for continued expansion of the Port Authority's facilities. This would then place the bridge more in line with the flow from the Rio Cobre and the Sandy Gully, which would naturally improving the flushing potential of Hunt's Bay (Appendix X).

8.3 CONSTRUCTION CAMP

The Construction Camp Site currently in operation for other segments of Highway 2000 is located at Bodles in St. Catherine. However, this site cannot be used for the Portmore Causeway section as it would result in high costs for transportation of material.

Option 1:

An option for the Construction Camp Site was the PAJ's newly reclaimed area at Newport West in the north eastern section of Hunt's Bay. This site was not considered feasible as it is at the eastern-most extremity of the alignment and would involve high transportation costs to the western end of the alignment in the Christian Pen area (Figure 2.1). However, this site is still proposed to be used for possible stockpile of dredge material to be utilised in the Highway construction.

Option 2:

A second option for the Construction Camp Site is the Jam World site located between the Dyke Road and the Rio Cobre. This site is centrally located with regard to the Highway alignment, and has adequate space. The Commissioner of Lands has approved the use of this area for the Highway 2000 Construction Camp (Appendix X). However, this location is in the floodway of the canalised Rio Cobre, near the river mouth, and is prone to flooding. **This is the preferred option of the Contractor**. However, the

Contractor has indicated their intent to raise the base of structures approximately 1m above the existing level and the construct a small dyke.

Option 3:

A third option, that was considered is the newly reclaimed Port Authority land at Fort Augusta (Figure 7.8). The Port Authority has begun filling in the area between the existing road and the Fort Augusta Road, which will be included in the Port of Kingston expansion facilities. This area is centrally located with respect to the alignment, is undergoing a period of consolidation, and it is proposed that some of this land be utilised by the Highway for the construction of the 21-lane toll plaza**.**

8.4 SOURCING OF MATERIALS

Earth materials for the Highway construction currently underway (Old Harbour Bypass Dualization and Kingston to Bushy Park) are obtained from the Hill Run Quarry in St. Catherine (Plate 16). Bouygues Travaux Publics Jamaican Branch will continue to utilise the Hill Run Quarry for construction of the Portmore Causeway segment, but additional material sources may also be required. Several options have been explored for additional earth materials.

Option 1:

Dredging of sea sand from an area south of the Palisadoes Spit was considered. Discussions were held with NEPA to determine the feasibility of this option and permitting requirements. However, the costs for dredging in the deep sea and transportation to shore, proved prohibitive, and this option is no longer under consideration.

Option 2:

Obtaining dredge spoil from the Port Authority's dredging operations, which has been disposed of just outside the Harbour mouth. This option was also discussed with NEPA but administrative arrangements for the transfer of material are as yet unclear.

Option 3:

Dredging at the mouth of the Rio Cobre. Discussions were held with NEPA, ESL and Bouygues Travaux Publics Jamaican Branch, the contractors for Highway 2000, on Thursday July 3, 2003, to discuss the feasibility of this option, and permitting requirements. However, NEPA advised that a licence had already been issued to WIHCON Infrastructure Ltd. to carry out maintenance dredging in this area, in association with the National Works Agency, and it would not be practical or feasible to issue another licence to dredge in the same area.

Option 4:

Obtaining dredge spoil from the approved maintenance dredging project for Hunt's Bay. This work is being undertaken by the National Works Agency with WIHCON Infrastructure Ltd. as the contractors, and will involve the removal of 2,000,000 cubic metres of material. This dredging began in July 2003, under a license from NEPA, to dredge the portion of the floor of the sea at Hunt's Bay, at the mouths of the Sandy Gully, the Duhaney River and the Rio Cobre. Dredging works are expected to end in March 2004.

The contractor for Highway 2000 (Bouygues Travaux Publics) has had discussions with NEPA and WIHCON to determine the protocol for utilising some of this material. This option appears to be the most feasible, and NEPA has agreed in principle to the use of this dredge spoil for the Highway construction, at a meeting held on Thursday July 3, 2003 (NEPA, BYTPJ, TJH, ESL). Discussions have been held between Bouygues Travaux Publics and WIHCON to determine the protocol for acquisition of the dredge material. **However, NEPA has stated that the main constraint to this option is the**

amendment of the license for the current dredging operations to reflect the change in the disposal site.

8.5 No Action Alternative

The 'No Action Alternative' describes the situation and impacts that would occur if the project was not implemented. If the project, as proposed is not implemented, the existing bridge would continue to be used, exacerbating the issues related to traffic congestion and to the demise in the structural integrity of the bridge.

Traffic Congestion

One of the main concerns for the Portmore Causeway is the continued increase in traffic as a result of the growing population in the Portmore municipality. Traffic congestion induces motor vehicle idling which in turn wastes petrol and increases vehicular emissions. The risk of accidents is increased and productivity reduced. A one way system was therefore implemented on the bridge for the morning and afternoon peak hours. This system has been beneficial but cannot be seen as a long-term solution, as two-way movement should be restored. Two-way movement can only be restored if a new bridge is constructed offering more lanes than currently exists.

Structural Integrity of the Bridge

The existing Causeway Bridge is now over thirty years old and was not designed to carry the current load from the increased number of vehicles on the road, and the slow passage of the vehicles during peak hours. Many parties have expressed concerns over the structural integrity of the bridge and recommendations have been made for a new bridge to be constructed before any serious damage occurs, risking passenger safety.

Alternatively, if the project is not implemented, the existing bridge would eventually have to be closed to the motoring public if it is deemed unsafe.

9.0 DETERMINATION OF POTENTIAL IMPACTS

This section identifies the potential impacts and suggested mitigation measures as related to the Portmore Causeway segment of Highway 2000. Findings of the assessment are presented according to site preparation, construction and operation phases. The impacts have been determined as significant positive or negative, direct or indirect, long term or short term. The Impact Matrix presented in Table 9.1 identifies the inter-relationships between the project activities and the physical, biological and social environmental factors.

As indicated in the Terms of Reference the impact analysis has placed special emphasis on the following:

- The Alignment
- Hydrology and Drainage
- Coastal dynamics
- Bridge Construction
- Bridge Span
- Bridge Demolition
- Traffic Flow
- Location of Interchanges and Toll Plazas
- Relocation of Fisherfolk
- Sourcing, Transport and Deployment of fill Material
- Shoreline Protection Works
- Noise and Air Quality
- Loss of Wetlands
- Water Quality
- Location of Construction Camp

Table 9.1 Impact Matrix

Table 9.1 Impact matrix page 2

Potential impacts of the entire Highway 2000 Project, and recommended mitigation measures, were determined in the Strategic Environmental Assessment and are presented in Appendix VIII for reference. Some of these recommendations are generic to all sections.

9.1 ALIGNMENT

The alignment for Highway 2000 was determined using several criteria and utilising the least constraining methodology. Optimisation of the alignment was carried out through the consideration of alternatives during the Functional Planning stage (Government of Jamaica, 2000 – Volume III). The selected alignment is the optimal alignment given the physical constraints. Potential impacts and proposed mitigation measures are described in Table 9.2.

Table 9.2: Alignment - Potential Impacts and Mitigation Measures		
	Potential Impacts	***Mitigation Measures***
• **Over gullies**	The Highway crosses the Waterford Canal at 194+500.	Drainage structures have been designed to ensure continuous flow thus preventing ponding and flooding. A 100-year return period has been used for major structures and the overall drainage system has been designed to accommodate flash floods and catastrophic events which characterize the area.
• **Through existing vegetative stands**	Vegetative stands are all modified vegetation including scrubland and wasteland. There are no stands of primary vegetation along the current alignment.	Landscaping should include trees and shrubs as appropriate in order to maintain airshed purification functions.
• **Through mangroves**	The alignment will go through mangroves along the south-western corner of Hunt's Bay and Dawkins Pond.	Discussions should be held with NEPA to determine the feasibility of the establishment of Wetlands Mitigation Banking in Jamaica, or for the identification of a suitable site or existing mangrove replanting project, into which Highway 2000 can contribute to the re-establishment of mangroves to replace acreage removed.

• **Land Acquisition**	Land acquisition for the required acreage is the responsibility of the National Roads Operating and Constructing Company (NROCC).	The land required for the Portmore Causeway alignment is 100% Crown Lands. All negotiations between NROCC and the Commissioner of Lands are complete (NROCC, 2003).
• **Existing local roads and access**	Points have been identified where the Highway will cross or intersect with existing local roads.	Access will be provided at the following points: ❖ Portmore Road to access the Mandela Highway Interchange ❖ Dawkins Drive Interchange to facilitate access to Portmore ❖ Fort Augusta Interchange ❖ Newport West Industrial Area ❖ Marcus Garvey Interchange
• **Archaeological and cultural resources**	Two sites in close proximity to the Highway alignment are listed by the JNHT as heritage sites. These are the Site of Passage Fort (Puerto de Caguaya) just south-south west of the Waterford Canal and Fort Augusta, which extends into Kingston Harbour. Fort Augusta is not expected to be	1. The Jamaica National Heritage Trust (JNHT) has already been contacted and made aware of the highway alignment. 2. The JNHT has been requested to provide any additional information that they see pertinent to these sites.

	impacted by the Highway construction.	3. The JNHT should be allowed to conduct a Watching Brief during the site preparation and construction phases, and to perform Rescue Archaeology as appropriate.
• **Coastal Filling**	Coastal filling will be required to facilitate the Highway alignment. Filling will be required in the north east section of Hunt's Bay in the vicinity of several gullies that drain Cockburn Gardens, Marcus Garvey Drive and Spanish Town Road. This area is prone to flooding (Figure 7.1) Filling activities can result in increased turbidity in the coastal zone which can result in settling of earth materials on the benthic environment. Additionally, one area is adjacent to the recently filled Port Authority of Jamaica area, which has resulted in an alteration of the originally proposed alignment. The PAJ reclamation will result in the Highway alignment extending farther west into Hunt's Bay than previously expected.	1. An application has already been submitted to NEPA for a Beach Licence for foreshore modification to conduct the filling as required. 2. Signs must be posted facing landward and seaward indicating that an application to conduct foreshore modification works has been submitted to NEPA. 3. Construction methods will consider and minimize additional silt loading in the coastal waters. 4. The Highway 2000 project must ensure that the highway construction does not restrict flow from existing drainage channels, particularly in the north east section of Hunt's Bay.

		5. Inter-agency dialogue must be initiated in order to resolve the issues related to potential flooding in the north east section of Hunts Bay.
Around the Port Authority of Jamaica's reclaimed land	In the east of Hunt's Bay the Port Authority of Jamaica has completed land fill in order to expand their terminal operations. This expansion was approved after planning for Highway 2000 was started. The Developer now has to adjust the alignment in this area as the Highway cannot bisect the Port Authority's operations. The fill was completed on top of existing peaty substrate, which has the potential to slump as it is not designed to have a high bearing capacity. This has been experienced along the eastern section of the existing causeway and has required continued maintenance (Cowell Lyn, Pers. Com.)	The fill area in the eastern corner of Hunt's Bay should be removed, leveled to grade and re-filled using proper engineering techniques suitable withstanding the load carried by a 4-lane Highway, and for the peaty substrate. This would include layering of geotextiles to ensure maximum bearing capacity. This would be an initial cost, but long term costs in continued maintenance of the Highway, resulting from slumping of the road, could be higher.
Crossing the Railway Line	The alignment crosses the railway in the vicinity of Chainage 197+000 on the Dyke Road (Plate 16). Recommendations for the entire Highway 2000 project, made in the Strategic Environmental Assessment (Development Bank of Jamaica, 2000 a-d) included the maintenance of the railway right-of-	The railway line must not be sterilized at this point and the level crossing should remain.

	way, at all crossings, so as to avoid sterilization of the railway.	
Marcus Garvey Drive Interchange	The interchange proposed at the intersection of Highway 2000 with Marcus Garvey Drive is a cause for serious consideration due to the proximity of the flight paths and the critical envelope of the Tinson Pen Aerodrome. Also under consideration is an at-grade intersection which will maintain the design speed of the highway. Additional engineering solutions are also being considered.	The Tinson Pen flight paths and critical envelope have been assessed by the engineering design team and the interchange has been designed to take account of the flight path requirements and not to form an obstruction. In response to queries from NEPA regarding this interchange a letter was prepared by TransJamaican Highway on May 14, 2003 with the following clarification: "*In order not to form an obstacle to aircraft operations and eventual aerodrome extension, a grade separated interchange has been designed, with an overpass and loop located approximately 600m in the west of the actual intersection. The parts of the future road which are located within the 15% envelope needed for plane arrivals and departures are not more elevated than the existing road – this means in the average less than 0.60 m above ground level. The new road forms by no means an obstacle to aircraft operations".* This engineering solution is shown in Figure 9. 1.

9.2 Site Preparation Construction and Operation Phases

Table 9.3: Natural Environment – Potential Impacts and Mitigation Measures

Environmental Aspect	Potential Impacts	Mitigation Measures
Hydrology and Drainage	Impacts on hydrology and drainage are both direct and indirect. They relate to all phases of the development and to high volume events (major drainage) as well as to drainage requirements for run-off from more frequent events (minor drainage). The Causeway spans the outlet of Hunt's Bay which receives storm run-off from several major and minor drainage channels as described in Section 7.1.4 and these systems require careful engineering to avoid blockage of flow. The natural drainage is north to south and the highway alignment varies from east-west and north-south. Inadequately designed hydraulic structures could result in a negative impact to the highway,	1. Surface drainage design considers both the major and minor systems. The major system is the route followed when the minor system is exceeded. 2. The engineering design has used the 100-yr. event as design criterion for major drainage, including bridge openings, to accommodate flash floods and catastrophic events, which typify the area. 3. Storm water runoff (more frequent events) will be handled by curbs, channels, catch basin inlets, storm sewer\s, minor swales and roadside ditches. These have been designed to prevent ponding and flooding of the highway and adjacent properties. 4. Maintenance dredging at the mouth of the Rio Cobre and The Sandy Gully would assist in the free flow of water from Hunt's Bay into the Harbour and reduce build up of

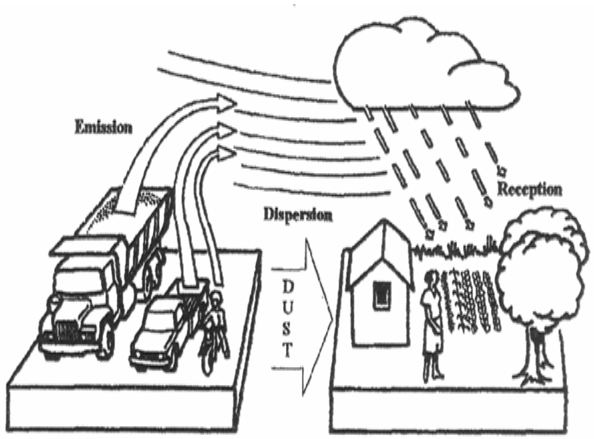
	existing infrastructure and properties adjacent to the highway. Direct impacts involve : ➢ Storm channel outlets into Hunt's Bay ➢ Ponding ➢ Siltation ➢ Pollution ➢ Water Supply Indirect impacts involve: ➢ Pollution ***Site Preparation and Construction Impact*** A major consideration is the flow from Hunt's Bay into Kingston Harbour. Construction of the Causeway Bridge over thirty years ago resulted in restricted flow from the Bay into the Harbour, causing semi-stagnation of the Hunt's Bay, a decline in shrimp and fin fisheries and increased	sediments. The guiding principles for the design of the highway in relation to drainage are: ➢ All bridges and culverts over 5.0 m in total opening width are designed to pass the 100 year storm with a minimum freeboard of 1.0 m between lowest point on bridge and high water level. ➢ Culverts under 5.0 m opening width are designed to pass 25-yr storm with minimum 600 mm freeboard between the edge of the road and high water level during 100-yr storm event. ➢ Scour protection will be provided where necessary. ➢ Highway profiles must be consistent with major drainage to enable free flow. The gullies that currently run under the road must be maintained, and design must ensure that there is no blockage of the existing channels. In the north-eastern section of Hunt's Bay where land filling is required, gullies will have to be extended to ensure that

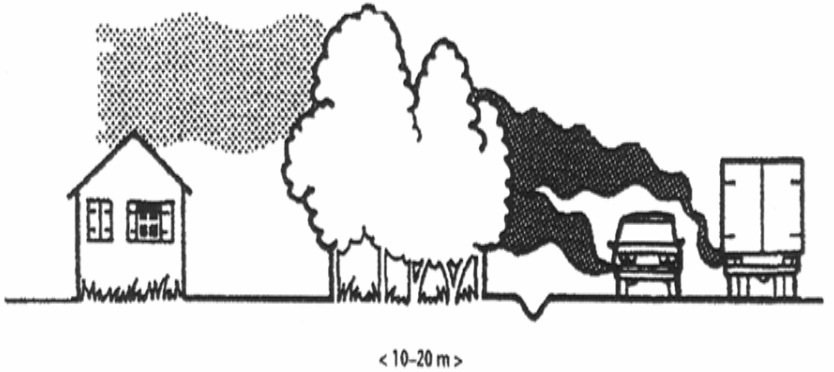
	sedimentation. Hunt's Bay prior to the Causeway played a significant role in the flushing of Kingston Harbour. The proposed alignment runs parallel to the Rio Cobre River along the Dyke Road and crosses the Waterford Canal. Widening the Dyke Road and the existing Causeway will remove some vegetative cover and the paved surfaces will result in the reduction of percolation of water through the soil at the level that currently obtains. The low-lying topography is also currently susceptible to ponding.	their channels remain open. The two gullies to be crossed (UDC Town Drain and the Waterford Canal) are accommodated in the engineering design. If these principles are adhered to, the potential for flooding, as a consequence of the highway construction, should be negligible. ***Operation Phase*** During the operation phase the mitigation measures incorporated in the engineering design should prevent problems of ponding on the Highway. Scheduled inspections and maintenance of drainage channels is critical.

Hazard Vulnerability	Impacts during site preparation or construction relate to the effect of flood events and stormwater run-off on the project as well as the effect of activities on the ability of Hunt's Bay and the Harbour to accommodate storm surges and seismic events. Flooding is a major natural hazard to be encountered by construction of the highway, and the major impact is derived from the effect of extreme runoff on the site and the low-lying nature of the topography. The area adjacent to the Skeet Club by Dawkins Drive is also prone to flooding. With respect to man-made/technological hazards, accidents can occur as a result of construction activities directly on-site and as a result of activities off-site, such as transportation of equipment and materials. Storm surge is also a risk as the alignment crosses the Kingston Harbour. Health and safety aspects must be considered	1. Design of bridges, culverts and drainage channels have taken account of the 100-year event and the channels are therefore expected to handle the flood flows. 2. The area adjacent to the Skeet Club which is prone to flooding and other areas that will require fill, will be elevated to approximately 1m in order to minimise the flood hazard. 3. Shoreline protection has been engineered to include rip-rap. 4. Site preparation and construction schedules should take account of the traditional rainy season between May and October, and of the hurricane season from June to November, during which tropical systems sometimes cause flood rains. Extraordinary tropical systems have also caused problems of supersaturated soils, so that schedules should factor this eventuality. 5. A safety management plan including traffic handling and equipment management procedures should be developed as part of the construction scheduling.

	related to workers during the Construction Phase and the motoring public during the Operation Phase. ***Operation Phase*** During the operation phase the mitigation measures incorporated in the engineering design should prevent problems associated with hazards. Safety is a major consideration and it is strongly recommended that a targeted driver education campaign be mounted to ensure acceptable driving practices, and to meet the requirements of the toll road. The existing bridge has a distinct hump which limits visibility and has been the cause of many accidents. Mitigation of this has been included in the engineering design. The design of the new bridge will be similar to the existing bridge with the	6. A Public Education Programme specifically on highway use should be developed for the general public. 7. The integrity of the dyke is of critical importance. Vegetation stabilizes the banks and serves to prevent undermining of the integrity of the dyke from erosion. 8. Sedimentation of the Waterford Canal must be avoided by using silt screens during the construction phase. 9. Garbage along the route should be removed and properly disposed of to prevent wash down into the canals.

	exception that the approaches will be raised by 5 m. This will result in a significant levelling of the bridge to eliminate the existing hump and the associated hazards. This is also essential in order to maintain the design speed of the Highway at 90 km/h. The clearance under the bridge will not be negatively affected.	
Air Quality	***Site Preparation and Construction Phase*** Analysis of road construction activities indicates that the movement of trucks and heavy-duty equipment to and from the project area will be responsible for the greatest amount of dust emissions. Construction activities will also result in the removal of vegetation that will expose and loosen soil which can become airborne with medium to strong winds. This would add fugitive dust to the area, which is already dust prone because of previous	1. Watering of un-vegetated areas and stripped road surfaces along which construction vehicles and trucks travel will control dust emissions by up to 70%. A full-time watering truck should be maintained on site for watering road surfaces as needed to minimize fugitive dust emissions. Over-saturated conditions, which would cause outgoing trucks to track mud onto public streets, should be avoided. Watering would not be necessary on days when rainfall exceeds 2.5 mm (0.01 inch).

	land clearance. The transport of aggregate for road and drainage culvert construction will also contribute to the fugitive dust levels. Construction vehicles will emit air contaminants such as nitrogen and sulphur oxides as well as particulates.  **Figure 9.2: Illustration of Dispersion of Dust Emissions**	2. Stock piling of earth materials for construction should be carried out within temporarily constructed enclosures to limit fugitive dust. Vehicles transporting earth materials should be covered en route. Mixing equipment should be sealed properly and vibrating equipment should be equipped with dust removing devices. Stockpiles of fines should be covered on windy days. 3. A monitoring program for dust is recommended to assess the effectiveness of control measures in meeting ambient air quality standards. 4. Provide dust masks to operators in order to protect them from dust impacts. 5. Take account of prevailing wind direction and plant tall leafy and dense vegetation between roads and human settlements to filter pollutants. Vegetation should also be planted on the Dyke Road to prevent erosion.

	Operation Phase The main air impacts during the operational phase will be an increase in the concentration of vehicular emissions as a consequence of the expected increased vehicular throughput. There are currently no vehicular emissions standards for Jamaica. However, improved traffic movement is expected to reduce idling time and therefore the level of carbon monoxide (CO) emissions.	 **Figure 9.3: Illustration of the Effect of Vegetative Barriers on Vehicle Emissions**

Noise	*Site Preparation and Construction Phase* The noise level is expected to increase during site preparation and construction with the use of heavy machinery and earth moving equipment. Existing noise levels are significant along the stretch of road between Marcus Garvey Drive and the Causeway Bridge as a result of the port operations. ***Operation Phase*** The toll plaza which will have 21 booths is expected to generate high levels of noise.	***Site Preparation and Construction Phase*** 1. Although not expected to create a significant negative impact, noise impacting on the public from construction activities can be minimized by limiting noisy construction activities to the hours between 7 am and 6 pm, where construction is in close proximity to residential areas. Service construction machinery and vehicles at regular intervals in order to keep noise to a minimum. ***Operation Phase*** 2. The use of vegetative barriers, defined as a series of narrow and dense trees and shrubs planted near the roadside can significantly reduce roadside noise. Vegetative barriers have been shown to reduce noise by 1-3 dB. 3. The toll plaza will be sited near to Fort Augusta which is not near a residential communities and adjacent to the proposed Port Authority expansion site.

Surface Water Quality	***Construction Phase*** The water quality data obtained from the present survey indicate trends, which are of concern. In general high organic loading and fecal coliform levels occur in most of the surface waters. The data show that the surface water bodies in the project area are being impacted from commercial and residential activities (untreated sewage effluent, deposition of human waste, commercial effluent, contaminated storm water runoff). The major water quality impacts likely due to the proposed road/bridge construction work are listed below: • Increased suspended solid loading (sediments and garbage) to the surface waters (from earth moving activities and terrestrial run-off) • Increased bacterial levels due to	***Construction Phase*** 1. Measures to control or limit sedimentation of streams and gullies during the construction phase will include storage of earth materials within containment berms 2. The deployment of silt screens as required at gullies and streams during the construction of bridges and culverts. 3. The deployment of sediment traps during filling in the coastal environment. 4. The engineering design has incorporated measures for slope stabilization and reinforcement at the approach to bridges. This serves to prevent slope failure, which not only undermines the bridge approach but also results in the wash down of soil into streams and gullies. 5. The proper removal and disposal of construction spoil, so as not to block drains and gullies. 6. Take all necessary measures to prevent refuse (solid

	indiscriminate disposal of human waste (particularly construction camp activities). • Oil and grease from heavy equipment and trucks. ***Operation Phase*** Of the likely impacts, the most important relate to contaminated storm drainage.	waste) and wastewater produced in construction camps from entering into drains and water bodies. 7. Provision of portable chemical toilets at work sites, with appropriate sanitary arrangements for disposal of the contents.

Vegetation	***Site Preparation and Construction Phase*** The vegetation identified along the Causeway alignment comprises, secondary scrubland, overgrown pasture, and thorny scrubland dominated by *Acacia sp*. No significant rare, threatened, endangered or endemic species are expected to occur in these areas. These areas provide green space, which assists in the purification of the air shed by removal of carbon dioxide and release of oxygen. Additionally, the areas provide host plants for species of insects, reptiles, amphibians, butterflies and birds. Site preparation and construction activities will remove several acres of these vegetative stands removing the airshed purification function and some habitat. Removal of the vegetation, at areas along the Dyke Road, will also expose top-soil which can be washed into streams and gullies during rainfall events.	1. Vegetation will have to be cleared to provide land for the proposed road works. Clearing of the vegetative stands should be carried out on a phased basis to reduce the amount of exposed top soil that can be washed down in rainfall events. 2. To continue to provide airshed functions of purification it is recommended that verges be replanted with trees and shrubs where appropriate. 3. Additionally, tree planting should be carried out to form shelter belts, windbreaks, noise buffers, slope stabilization bands, erosion control and for aesthetic appeal. 4. Selection of plants for landscaping should consider the following: habitat suitability, trees of national interest, flowering trees and shrubs. 5. Replanting of mangroves should be done in consultation with NEPA.

	Stands of mangrove (5.5 ha) will have to be cleared. This will remove habitat for waterfowl as well as removal of airshed purification functions.	***Operation Phase*** 6. Vegetation planted for landscaping buffers and for aesthetic appeal should be maintained, and a maintenance programme should be established and implemented.

Fauna	***Site Preparation and Construction*** Birds located in the modified vegetative communities and the mangrove stands will relocate when their habitat is removed. Species along the proposed alignment such as reptiles are also highly mobile and should also relocate to adjacent similar habitats. Insects, snails and other groups with low mobility may suffer from loss of specimens, as a result of heavy machinery and the use of earth moving equipment. ***Operation Phase*** ***Impact*** Once the highway is completed there is always the risk of increased access to rural areas resulting in poaching of wildlife	1. Landscaping and vegetation buffers, as well as mangrove replanting, will result in the replacement of some habitat for selected species. 2. Birds will relocate to adjacent suitable habitats. 3. It is not expected that poachers will be a threat, as targeted species such as Jamaica's endemic parrots do not occur in this area. 4. Encroachment by squatters could result in degradation of areas. As a Toll Road, the highway will be limited access and will be enclosed by fencing thereby reducing the possibility of encroachment from the road way. 5. Plant and animal communities immediately outside the project corridor should not be at risk.
Marine Ecology	***Site Preparation and Construction Phase*** The marine environment can be affected by increased levels of sedimentation and siltation through clearing of vegetation and exposure of	1. During site preparation and construction earth materials stock piled should be contained by a berm to prevent this material being carried to the coastal waters in terrestrial runoff during rainfall events.

	top soil, terrestrial wash down of stock piled earth materials and release of fines during construction and the filling of coastal areas. Additionally, construction of revetments and sea walls will permanently alter the coastline, changing wave dynamics and resulting in loss of benthos and associated marine flora and fauna, in these three areas. However, the revetments themselves may create a new habitat resulting in the establishment of other species.	2. Additionally, during land reclamation and construction of the revetments, appropriate measures should be taken to reduce suspended solids loading. This could include the use of silt screens and sediment traps. 3. Oil and grease which may be generated from construction equipment should not be allowed to run into the sea and should be properly stored and disposed of, off site, to prevent washdown in terrestrial run-off during rainfall events. 4. Construction camp and work areas should be adequately equipped with portable chemical toilets to prevent the discharge of raw sewage into the marine environment. 5. During the operation phase treatment of landscaped medians and verges should be carried out with organic fertilizers and pesticides to reduce terrestrial run-off

		of toxic chemicals.
Landfilling	Impacts on the marine environment are possible from activities related to land filling. These include: ➢ increased turbidity as a result of sedimentation from filling exercises ➢ coastal erosion resulting from inadequate shoreline protection	1. Construction methods will consider and minimize additional silt loading in the coastal waters. 2. Shoreline protection works have been engineered to mitigate shoreline erosion. Engineering design includes rip-rap along the entire length of the alignment where it runs along the coastline, on both the northern and southern sides of the road. These designs are detailed in Figure 2.4.
Mangroves	***Site Preparation and Construction Phase*** Loss of stands of mangroves. Loss of mangroves will result in the removal of nesting and roosting habitat for birds, alteration of the ecology of the area and removal of shoreline protection.	***Site Preparation and Construction Phase*** In trying to find innovative solutions to problems associated with standard on-site mitigation compensation, wetland mitigation banking became an important component of the United States' Clinton Administration's Wetland Plan, introduced in August 1993 (Lynn, 2003). The US Federal Administration supports mitigation banking and is currently developing inter-agency guidance for the establishment and use of mitigation banks. Approximately 100 mitigation banks are in operation or are

		proposed for construction in 34 states across the USA, including the first private entrepreneurial banks. A Wetlands Mitigation Bank is a wetland area that has been restored, created or (in exceptional circumstances) preserved, and is then set aside to compensate for future conversions of wetlands for development activities. A wetland bank may be created when a government agency, a corporation, or a non-profit organization undertakes such activities under a formal agreement with a regulatory agency. The value of a bank is determined by quantifying the wetland values restored or created in terms of "credits". Landowners needing to "mitigate" or compensate for authorized impacts to wetlands associated with development activities may have the option of purchasing credits from an approved mitigation bank rather than restoring or creating wetlands on or near the development site. Mitigation banking has the potential to play a significant role in wetlands conservation and watershed management, by reducing uncertainty and delays in project

		planning and project implementation, thereby improving the chances for successful mitigation efforts. It is recommended that discussions be held with NEPA, the regulatory agency, regarding the establishment of a wetlands mitigation bank in Jamaica. This would require the evaluation of potential sites, the determination of the most suitable site and the expertise to seed and manage the area, as determined by NEPA. The establishment of a wetlands mitigation bank would not only serve the purpose of re-establishing mangroves removed as a result of the Highway 2000 project, but also have the long-term impact of providing an ecological viable area to facilitate future proposed developments in implementing the mitigation measure of mangrove replacement, as required. Replanting mangroves through a wetland mitigation bank will provide nesting and roosting habitat for birds, provide vegetation for airshed purification and provide coastal protection for that area.

	Operation Phase Removal of mangroves will remove coastal protection and expose the Highway to daily tidal activity and storm surge, possibly resulting in shoreline erosion and undermining the integrity of the road.	***Operation Phase*** Shoreline protection works have been engineered to mitigate shoreline erosion. Engineering design includes rip-rap along the entire length of the alignment where it runs along the coastline, on both the northern and southern sides of the road. These designs are detailed in Figure 2.4.
Dredging	***Site Preparation and Construction Phase*** Dredging can result in the following negative impacts: ➢ loss of benthos ➢ modification of current and wave patterns ➢ increase in turbidity through suspended solids loading ➢ dispersion of contaminated sediments ➢ degradation of pelagic habitats ➢ damage to fishing gear, ➢ increased ambient noise levels reduction of visual aesthetics ➢ obstruction of shipping traffic	The following mitigation measures should minimise the negative impacts: 1. Apply careful control of dredge cutter head and restrict digging to specified boundaries 2. Apply control of ladder swing speed and cutter head rotation speed to minimise sediment dispersion 3. Do no overfill hopper which can result in spillage 4. Deploy silt screens down-current of dredge activity 5. Advise local communities and port interests of times of dredging activity

Disposal of Dredge Spoil	➢ Identification and approval of suitable disposal site ➢ Leakage of sediments during transport to disposal site ➢ Increased turbidity over inshore habitats ➢ Sedimentation of benthic habitat in disposal area ➢ Smothering of any benthic biota	1. Permitting requirements must be met through NEPA for any dredge activity and use of site for disposal 2. Monitoring is required for vessel logs and records for each disposal trip

Table 9.4: Social Environment – Potential Impacts and Mitigation Measures

Environmental Aspect	Potential Impacts	Mitigation Measures
Land-use and Zoning	***Site Preparation and Construction Phases*** Relocation of the Causeway fishing village will be the major land use impact in that the toll road will be privately owned and access will be limited to toll users.	***Site Preparation and Construction Phases*** The following alternatives have been suggested for relocation of fisherfolk on the Causeway (Section 10.2.2.9), in order to minimize potential negative impacts: 1. Relocation of fisherfolk from the southern side of the Causeway to the northern side, with a shift in the alignment, thereby allowing the fishing community to remain in the same area. 2. Relocation of the landing beach, to a nearby site, in collaboration with the fisheries Division of the Ministry of Agriculture. 3. Relocation of residential areas, to an area in

		Lesser Portmore, in collaboration with the National Housing Trust. 4. Contribution to the establishment of the Portmore Market, through the provision of a wet area, to facilitate fish vending.
	Operation Phase During the operation phase the Highway is not expected to have any additional significant negative impacts on aspects of land use and zoning. The impacts identified in the construction phase will obtain for the operation of the highway.	
Traffic, Transportation and Access Roads	***Site Preparation and Construction Phase*** Site preparation and construction activities will impinge on traffic flow in the areas where the Highway connects or crosses existing roads. This will include the Marcus Garvey Intersection, access to Port Authority of Jamaica, access to Tinson Pen	***Site Preparation and Construction Phase*** 1. Scheduling of construction work should seek to minimise disruption to traffic flow and allow for the movement of material and heavy equipment.

	Aerodrome, Dyke Road and access to Portmore. However, through-way will have to be maintained and obstruction to traffic minimised. Where interior roads will be truncated, the alternate routes should be clearly communicated. The proximity of the Tinson Pen Aerodrome to the Marcus Garvey Intersection, is a major concern for potential negative impacts on flight operations. Access to the operations of the Port Authority of Jamaica may be impacted by the Highway alignment and construction. Residents of Portmore desirous of using the Toll Road, as well as other commuters using the Portmore Causeway Bridge will see increased transportation costs, through the payment of the toll.	2. Arrangements for parking and storage of material should be made as far off-site as is feasible for efficient operations. 3. Discussions should be held early with relevant stakeholders to determine their needs and requirements and to advise them of the construction schedule. 4. Public notices by the print and electronic media should also be posted in order to make the general public aware of the construction schedule and to provide construction updates. 5. Properly trained flag persons and road side signs should also alleviate discomfort to commuters. 6. Mitigation measures for the Marcus Garvey Intersection will be incorporated in the design phase. Engineering solutions are under consideration to ensure that the Tinson Pen flight paths remain free on encumbrances in the specified envelope.

		7. The Port Authority of Jamaica has requested that the alignment of the Highway be adjusted to allow for the Port's expansion. This has been agreed by NROCC and will be facilitated at a cost to the Port Authority. 8. In addition to the Toll Road, there will remain an un-tolled option for cpmmuters, as specified under the Toll Roads Act (2001). This will be the Mandela Highway.
	Site Preparation and Construction Phase The siting of the construction camp may have potential negative impacts related to traffic, transportation and access.	***Site Preparation and Construction Phase*** 1. Several site options were considered and the site at Jam World appears to be the most feasible option 2. Proper signage and flag persons will be required to provide traffic management into and out of the camp site. 3. Public notification of the camp site location will be required . 4. Schedule of movement of heavy vehicles

		should be prepared.
	Operation Phase The operational phase of the upgraded artery will involve a toll for users. Imposition of a toll will be a relatively new concept for Jamaicans, and residents have been accustomed to using the Causeway and bridge free of cost.	1. The first segment of Highway 2000 to be open and tolled – the Old Harbour Bypass – will already have been in operation for a few years prior to the completion and tolling of the Portmore Causeway. 2. The Old Harbour Bypass began operating as a toll road in August 2003. Notwithstanding this fact, mitigation of negative impacts in this regard, will require considerable dialogue and education will need to be implemented with all stakeholders to minimise objections to the new tariff for this alignment. 3. A major mitigation measure will also be provided in an alternative untolled route to Portmore from downtown Kingston being maintained via Marcus Garvey Drive, Three Miles, Six Miles, Mandela Highway and the Greater Portmore Intersection.
Business Enterprises	***Site Preparation and Construction Phase***	***Site Preparation and Construction Phase***

	Some businesses have the potential to be affected by the Highway construction. These include: 1. Tinson Pen Aerodrome 2. Port Authority Newport West Industrial Area 3. Portmore Shopping Centre	1. Discussions have been held during the design phase with various Government agencies and businesses that are likely to be impacted by the Highway construction. Stakeholder meetings have been facilitated by NROCC and have included the Portmore Citizens' Association, Portmore Foundation Ltd., Civil Aviation Authority, Airports Authority of Jamaica, Port Authority of Jamaica, Jamaica Railway Corporation and the Urban Development Corporation 2. All parties have been made aware of the proposed highway alignment and have been involved in the process of optimizing the Portmore Causeway alignment.
	Operation Phase Impacts during the operation phase will include	***Operation Phase*** 1. Vegetation buffers and physical barriers should

	increased levels of traffic noise and atmospheric pollutants.	be constructed as appropriate in the vicinity of business enterprises to reduce the levels of noise and noxious fumes that may affect management and staff.
Employment	*Site Preparation and Construction Phase* Employment opportunities will be created during the site preparation and construction phases. This will mostly be unskilled labour for the duration of the construction activities. Additionally, economic opportunities will involve the sourcing of construction material and linkages created with local and regional suppliers and industries.	***Site Preparation and Construction Phase*** 1. Casual labour will find employment and this is expected to be a positive impact for surrounding communities. 2. Workers should be briefed on traffic management, solid and liquid waste disposal, dust management, parking, idling of equipment and oil spill control. 3. The "politicization" of employment opportunities often poses some challenge to contractors, and the need for security and relevant dialogue have to be factored into construction planning.

Solid Waste Management	***Site Preparation and Construction Phase*** Solid waste generated from the site preparation and construction activities will include construction debris, vegetation, solid waste from beaches, the demolished bridge and solid waste generated from the construction camp.	***Site Preparation and Construction Phase*** 1. Construction sites generate considerable waste and provision must be made for suitable separation and storage of waste in designated and labelled areas on the site and site camp. 2. Collection of waste by certified contractors and disposal at the Riverton City Landfill as recommended and approved by the National Solid Waste Management Authority. 3. Any hazardous waste should be separated and stored in areas clearly designated and labeled, for future entombing and disposal as directed by the National Solid Waste Management Authority. 4. Worker training should include instructions on how to dispose of food and drink containers emphasizing the need to

		protect the Harbour and the gateway to Kingston. 5. Construction camps and work areas along the proposed alignment must be adequately equipped with portable chemical toilets. 6. Portable chemical toilets must be provided, maintained and removed by a certified contractor.
Proposed Developments	There are proposed developments that may have an impact on the Highway. The main development is the expansion of the Port Authority of Jamaica's facilities to include dredge and fill in the east of Hunt's Bay. This development has had three major negative impacts: 1. The Highway alignment had to be altered to accommodate this fill area and is now proposed for the outer boundary of this fill area. This has	1. Highway 2000 has been n discussion with the PAJ regarding access to PAJ's Fort Augusta site. 2. Dredge material for the Soapberry Lands should be supplied after the requirements of Highway 2000 are met. 3. Inter-agency dialogue is required concerning the future of Hunt's Bay and the various proposed developments 4. Construction work in the area of the PAJ's filled

	resulted in altering the engineering design to re-route the alignment, accommodate the fill area and provide the PAJ with access to their new site. 2. The fill area is currently undergoing a period of consolidation. This will have to be completed before the bearing capacity and integrity can be determined as suitable to accommodate the Highway.	area will have to take into consideration the newly filled substrate and ensure that settlement is fully completed.
	Proposed development projects likely to be impacted by the Highway are: 1. Port Authority of Jamaica's container terminal expansion at Fort Augusta. The PAJ has been given permission to fill the area between Fort Augusta and the existing causeway to facilitate expansion of	

	terminal facilities. 2. Kingston and St. Andrew Water and Sanitation Project. This project proposes the construction of sewage treatment ponds on the Soapberry lands north of Hunt's Bay and the eventual disposal of treated effluent into the Bay. Dredge material from the current Hunt's Bay maintenance dredging (Section 8.4) was proposed for the Soapberry Lands to facilitate construction of sewage treatment facilities. Issues related to the Hunt's Bay's function as a siltation basin for Kingston Harbour and the jet effect of water exiting from the Bay, in relation to the proposed discharge of sewage effluent are discussed in a report by Environmental Solutions Ltd.	

	(Environmental Solutions Ltd, 2003).	
Public Health and Safety	***Site Preparation and Construction Phase*** The upgrading is expected to improve safety during the operational phase given the design standards which will improve visibility and standards for speed. In addition, the bridge at this time needs major maintenance, having been heavily utilized over the past twenty-five years. Preparation and construction will involve disturbance of material on the floor of the Hunt's Bay and the adjacent areas of the Kingston Harbour. Concern has been expressed about toxicity of this material. Preparation and construction will also involve	***Mitigation Measures*** 1. To minimise risk to the public the construction activities which will directly affect the movement of traffic and pedestrians, should be properly scheduled and standard construction techniques for sign–posting and flagging should be adhered to. 2. Dust control by wetting is essential to prevent aggravation of the already poor air quality. 3. Unnecessary idling of construction related vehicles should be discouraged. 4. Proper sign posting of speed limits and entrances and exits. 5. Proper disposal of any dredge spoil as recommended and approved by the National

	demolition of the existing bridge, transportation and storage of significant volumes of construction material, and proper disposal of construction spoil and any hazardous waste. Increased levels of fugitive dust and construction noise are also public health issues as the air quality is already deteriorated in this region and noise and activity levels are high.	Solid Waste Management Authority and the National Environment and Planning Agency. 6. Workers exposed to contaminated drainage channels should be given protective gear (gloves, vests, water boots)
	Operation Phase Improper use of Highway ramps, exits and interchanges can result in traffic accidents.	***Operation Phase*** 1. An extensive Highway Public Education Programme should be designed and implemented to make commuters aware of proper procedures on the Highway. This should include aspects related to tolling, lane changing, use of ramps, and access and exits. Enforcement of Highway legislation and procedures will be

		required.
Recreation	Impacts on recreation will be indirect as a result of disruption of traffic and access. This is expected to be short-to medium term and limited to the preparation and construction phases. Application of the toll will increase the cost of transportation to these facilities, but improvement in the quality of the road will reduce travel time. The long-term impact of the toll on these facilities can only be determined after the opening of the toll road.	
Archaeological and Cultural Heritage	*Site Preparation and Construction Phase* If site preparation and construction activities begin without proper archaeological studies and the opportunity for rescue archaeology the following negative impacts could occur: ➢ Increased unwanted public access to existing sites & new sites.	***Site Preparation and Construction Phase*** 1. The Jamaica National Heritage Trust has been involved in discussions about the occurrence of possible sensitive areas along the Highway alignment,

	➢ Increased risk of damage to artefacts. ➢ Increased risk of modifying the integrity of the site. ➢ Destruction of known sites. ➢ Damage to components of the site. ➢ Loss of the context, when moving components of heritage site. ➢ Reduction of value of the heritage components. ➢ Destruction of heritage site and components. ➢ Loss of unknown archaeological sites. ➢ Loss of clues to the understanding of past cultures and historical events. ➢ Loss of unique cultural insight for Jamaica's past.	particularly Passage Fort and Fort Augusta (Appendix VII). 2. The JNHT has been specifically requested to provide information on the listed sites in the project area, in order to determine potential impacts on these sites. 3. The JNHT should be given an opportunity to conduct a Watching Brief during the construction phase and to perform Rescue Archaeology if any artifacts are discovered at the Site of Passage Fort. Fort Augusta is outside the proposed alignment.
	Operation Phase Damage to artifacts and heritage sites can occur if open access is maintained.	***Mitigation Measures*** 1. Any sites discovered should be properly secured to reduce public access and interference.

		2. Heritage sites should be demarcated with interpretive signs.
Relocation of Fisherfolk	Currently, there is illegal occupation of Government-owned lands within the proposed right-of-way along the Causeway. The area is occupied by fisherfolk and is used for residence, a landing beach and vending of fish. Unsanitary conditions prevail and the fisherfolk will have to be removed from the highway corridor.	NROCC has sought to have an orderly removal and relocation of the fisherfolk and their businesses along socially acceptable methods, notwithstanding the absence of a relevant law or regulations. The details of the relevant issues have been outlined to NEPA in a letter from NROCC dated January 22, 2003 (Appendix IV). NROCC is seeking to do the following: 1. Land has been identified in the area known as Portmore Villas and NROCC has approached the national Housing Development Corporation to obtain their assistance in making land available for purchasers. 2. NROCC is in discussions with the Ministry of Agriculture and the Fisheries Division to identify a suitable landing beach on the SW of Hunt's Bay. This area is a small mangrove promontory to the east of the Skeet Club. The Fisheries Division will inform NROCC of the requirements

		for the establishment of a Fishing Beach at this point. 3. The Portmore Foundation Ltd. an NGO has obtained a lease from the UDC for the establishment of a market. This market will include a wet area for meat and fish. NROCC has been approached by the Foundation for assistance in establishing the market. 4. Another option still under consideration is a shifting of the alignment north between chainage 191+600 and 192+200. this would result in the fishermen a on the south side of the road remaining where they are, and those on the north side being shifted within the village, and not away from the village. The first three mitigation measures identified would result in improved residential conditions for the fisherfolk, as well as more sanitary facilities for the provision of fish to the public. A shift in the alignment

		would result in minor dislocation to only some members of the fishing village, thereby maintaining their existing conditions.
Sourcing, Transport and Deployment of Fill Material	**Site Preparation and Construction Phase** The main impacts related to the dredging activities are: ➢ Increased levels of suspended sediments ➢ Mixing of different soil layers ➢ Creation of loose spill layers ➢ Disturbance of substrate ➢ Dilution of sediment ➢ Increased levels of noise Capping and other special fill materials will also be sourced from Hill Run Quarry in Hellshire, a licensed quarry which is currently being used by Bouygues Travaux Publics Jamaican Branch for the Old Harbour Bypass Dualization and the Kingston	Although the dredging operations are being carried out by other parties, the following mitigation measures are recommended for implementation as some of the dredge material will be utilised for the Highway construction: 1. Good dredging practice to minimise sediment suspension and dispersal at the dredging site 2. Deployment of a silt barrier south of the dredging operations and across the mouth of the Rio Cobre to prevent sediment transport into Hunts' Bay and further into Kingston Harbour 3. Advise local residents, fishers and other stakeholders, prior to commencement, of the intended dredging operations, associated increase in noise levels and timetable for dredging operations

	to Bushy Park segments of Highway 2000. This material will be trucked into the project area. The main impacts related to the transportation of the earth materials from Hill Run are: ➢ Increased traffic ➢ Movement of heavy vehicles ➢ Hazards from uncovered trucks ➢ Increased levels of fugitive dust	4. Environmental monitoring of the project must be done to ensure the use of silt screens, stockpiling of dredge material at the approved sites and stockpiling in approved quantities 5. Routine surveillance and maintenance of the pipeline In order to minmise the impacts related to haulage of earth materials, the following mitigation measures must be implemented : 1. Public notice about the increased use of the roads for transporting earth materials 2. Use of flagmen and signage where appropriate to alert the travelling public 3. Covering of all trucks with tarpaulins to mimise fugitive dust and airborne particles 4. Wetting of surfaces as appropriate to minimise fugitive dust Stipulation of speed limits for truckers

9.3 POSITIVE IMPACTS

9.3.1 Physical Environment

Vegetative buffers and landscaping will facilitate continued air-shed purification functions.

9.3.2 Biological Environment

Although scrubland, secondary growth and mangroves will be lost in the process of vegetation clearance during site preparation and construction, landscaping along the highway will restore vegetative matter and provide habitats for some species, during the operation phase. Additionally, replanting of mangroves will replace the lost stands.

9.3.3 Social Environment

Relocation of Fisherfolk

Site Preparation and Construction Phase

During site preparation and construction employment will be generated for several categories of workers including casual labourers, skilled and unskilled workers, as well as suppliers of goods and services.

Operation Phase

During the operation of the road it is anticipated that there will be many positive impacts. These will relate to the movement of goods and services in a shorter time, reduction of wear and tear on vehicles, as well as reduction in levels of stress and frustration experienced during traffic congestion. Health and safety are always an issue when a new road is opened with more lanes and with a higher design speed than the existing road. Safety on the roads is expected to improve in the long term, with a more efficient road network and the associated driver education programme to be implemented.

Other possible positive impacts related to cultural heritage, include the discovery of new archaeological sites, opportunities for interpretive sign posting of sites, and increased access for heritage tours.

10.0 Stakeholder Consultations

Public consultations for the project have involved three types of consultations:

- Consultations with Stakeholders
- Community Meetings
- Information Sharing with the General Public/Targeted Groups

Several presentations on Highway 2000 have been held over the last four years, which have been organised by the Development Bank of Jamaica Ltd.. These have included the following sessions at:

- Montego Bay
- Mandeville
- University of Technology
- Jamaica Institute of Environmental Professionals, Kingston
- Chambers of Commerce and Parish Councils
- Lions Club of Portmore

These sessions have involved presentations by the Highway 2000 Project Office on the Highway and other Millennium Projects, the engineering aspects of the Highway, the environmental issues and other issues related to traffic, tolling, and financing.

10.1 Consultations with Stakeholders

Consultation and interviews have been held with relevant stakeholders including government agencies and ministries, property owners, business enterprises and potential commuters. During the SEA process consultations were also held with various groups including environmental scientists with specific expertise, and other relevant professionals, as well as with Environmental Non-Governmental Organizations/Community Based Organizations and Government Agencies. In addition, Expert Consultations were held with stakeholders and specialists in related disciplines.

NROCC and Environmental Solutions Ltd. have facilitated several Stakeholder Meetings which have included the following agencies and organisations:

- ✓ Portmore Citizens' Association
- ✓ Portmore Foundation Ltd.
- ✓ Civil Aviation Authority
- ✓ Airports Authority of Jamaica
- ✓ Port Authority of Jamaica
- ✓ Jamaica Railway Corporation
- ✓ Urban Development Corporation
- ✓ National Works Agency
- ✓ Ministry of Agriculture
- ✓ Fisheries Division

10.2 Community Meetings

A community meting was held in Portmore in 2002 under the auspices of the Lions Club of Portmore, to advise the citizens of the area about the proposed highway 2000 development for the Causeway alignment and bridge.

10.2.1 EIA Hearing

One community meeting is scheduled for Portmore, to present the findings of the Environmental Impact Assessment, as required by the National Environment and Planning Agency (NEPA). The results of this community meeting will be submitted as a separate report, to NEPA, but will still form a part of the EIA process.

10.3 Communications Schedule

A Communications Schedule was prepared by the Development Bank of Jamaica Ltd. and included the following:

- ✓ Print Media – Supplements
- ✓ Radio
- ✓ Internet

10.4 Future Public Meetings

If a permit for the proposed highway construction is obtained from the National Environment and Planning Agency (NEPA), meetings should be held with the relevant stakeholders (including residents, community groups and business enterprises) to present a construction schedule and to seek cooperation of management and staff. It is essential that commuters be apprised of the construction plans so as to gain their cooperation and to enable them to plan for possible additional "travel to work" time during the construction period. Meetings with residents will also assist possible community relations, which are essential to the smooth functioning of this project. Environmental Management of the construction phase should also be discussed with relevant stakeholders.

11.0 Monitoring Programme

If a permit is granted for the proposed project, and before site preparation and construction activities begin, TransJamaican Highway Ltd. should submit a Monitoring Programme to NEPA. The aim of the Monitoring Programme is to ensure compliance with relevant legislation, implementation of the mitigation measures and long-term minimization of negative environmental impacts. The Monitoring Programme should include a Construction Plan and Schedule with a description of any proposed phasing of activities, recommended Mitigation Measures and proposed methods of compliance. The Monitoring Programme should also include an Inspection Protocol; planned Supervision of Site Preparation and Construction Activities and implementation of Post Construction Monitoring. During construction fortnightly reports should be submitted to NEPA as well as a final summary report of the effectiveness of the mitigation measures.

12.0 SUMMARY AND CONCLUSIONS

The Highway 2000 Project is one of the Government of Jamaica's landmark Millennium Projects. Phase 1A of the project includes construction of a highway from Kingston to Sandy Bay incorporating the recently constructed Old Harbour Bypass, construction of the Portmore Causeway and Bridge and upgrading of the Dyke Road. The section from Kingston to Bushy Park requires construction of a four-lane toll highway with an interchange at Mandela Highway and at Spanish Town.

The highway alignment passes mainly through scrubland and sugar cane lands across the southern St. Catherine plans, crossing the Rio Cobre and several smaller streams and gullies. There are no areas of primary vegetation and the highway will not dissect any settlements.

Although some potential negative impacts have been identified for the project, the majority are short-term direct impacts related to the site preparation and construction phases. Many of the negative impacts identified can be successfully mitigated. Potential negative impacts that have been identified include the risk of flooding. Engineering designs for major structures have been specified for a 100 year event and this should mitigate against potential flooding in minor and major events. The highway passes through mainly crown lands although there are some parcels of privately owned land. Land acquisition and utilities negotiations are being managed by the National Roads Operating and Constructing Company (NROCC). Land acquisition is approximately 90% complete.

There are several positive impacts associated with the project. These include improved efficiency in travel time and travel costs, greater movement of goods and services, improved access to remote areas, support of new developments and employment opportunities. Implementation and enforcement of the mitigation measures recommended and on-going public communication are however, required to ensure successful project execution with minimum negative impacts on the environment.

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