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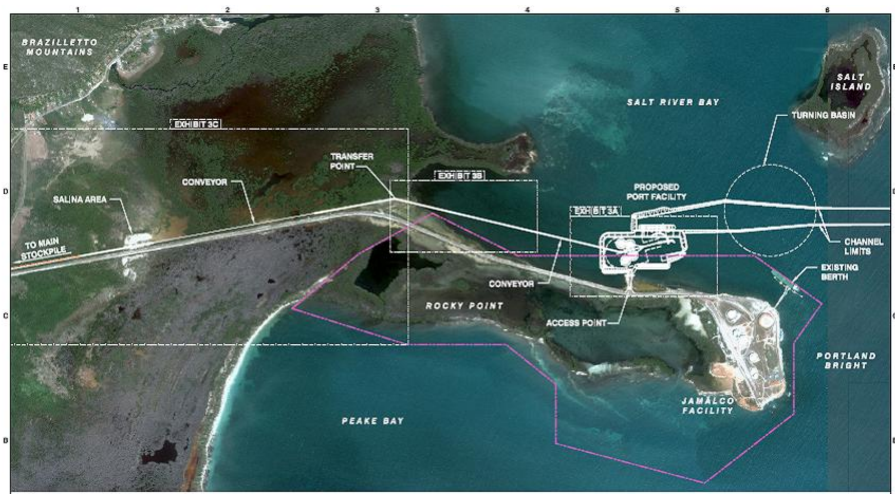
ENVIRONMENTAL IMPACT ASSESSMENT

FOR THE CONSTRUCTION OF
A PORT AND CONVEYOR CORRIDOR

[Prepared for Rinker Jamaica Limited/CEMEX]



Volume I (Rev. 01)

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ENVIRONMENTAL IMPACT ASSESSMENT

FOR THE ESTABLISHMENT OF

A PORT AND CONVEYOR CORRIDOR

AT ROCKY POINT AND BRAZILLETTO MOUNTAIN, CLARENDON

VOLUME I (Rev. 01)

Prepared for:

RINKER Jamaica Limited

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Acronyms

CBD – Convention on Biological Diversity
CCAM – Caribbean Coastal Area Management Foundation
CDMP – Caribbean Disaster Mitigation Project
CEMEX – Cement Company of Mexico
CITES – Convention on International Trade of Endangered Species
dB – Decibel acoustic
dBA – Decibel A-weighting
ECD – Environmental Control Division
ED – Enumeration District
EHU – Environmental Health Unit
EIA – Environmental Impact Assessment
ICZM – Integrated Coastal Zone Management
JAMALCO – Jamaica Alumina Company
JNHT – Jamaica National Heritage Trust
JPSCo – Jamaica Public Service Company
MGU – Marine Geology Unit
ML – Mining Lease
MOA – Ministry of Agriculture
NEPA – National Environment & Planning Agency
NRCA – Natural Resources Conservation Authority
NWA – National Works Agency
NWC – National Water Commission
ODPEM – Office of Disaster Management
PBPA – Portland Bight Protected Area
RO/RO – Roll On/Roll Off
SRC – Scientific Research Council
STATIN – Statistical Institute of Jamaica
ToR – Terms of Reference
UNCED – United Nations Convention of Environment and Development
UWI – University of the West Indies
WINDALCO – West Indies Alumina Company
WISCO – West Indies Sugar Company
WRA – Water Resources Authority

Glossary

Biodiversity "The variability among living organisms from all sources including, among others, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems." (Convention of Biological Diversity, 1992)

Karst Topography that is the result of a complex interplay between climate, topographical, hydrological, biological and temporal factors. Caves are the best-known forms of this characteristic sculpturing of landscape.

Land-Use The nature of human activity on the land and its destination. Significant changes in the land use pattern from, say, agriculture or forest, take place in the process of industrialization, quarrying, urban development etc.

Landscape Scenery as seen in a broad view from one place covering physical, historical, social and biological characteristics of the site and the region.

Life cycle The total set of industrial processes involved in production of a product (e.g., cement), including upstream extraction and processing of materials, manufacturing, distribution, use, and disposition or re-use of waste materials.

PANAMAX – The maximum sized vessels that traverse the Panama Canal (60,000-80,000 tons)

Stakeholder A person or group that has an investment, share, or interest in something, as a business or industry.

Sustainable Development Ability to continually meet the needs of the present without compromising the ability of future generations to meet their own needs.

EXECUTIVE SUMMARY

1 Executive Summary

1.1 Introduction

Jamaica has substantial deposits of high grade limestone suitable for a wide array of end uses. Included among them is chemical, metallurgical and pharmaceutical grade quality, suitable for a number of applications including the manufacturing of construction materials. The main purpose of this EIA is construction materials.

It has been estimated that about 65% of the island, by weight, is made up of limestone and this accounts for 80% of the island's total surface coverage. This makes limestone Jamaica's most abundant mineral resource.

A number of initiatives have been taken over several decades to develop this resource, which will play an increasingly significant role in the national economy as the country's bauxite resources are depleted. Exhaustion of Jamaica's bauxite resources is projected to take place in the next 50 years.

The Government of Jamaica has developed a policy for the extraction of limestone resources. In this regard, the Commissioner of Mines has zoned specific areas for limestone resource development. Limestone resources to be developed are partly located in the Tarentum Industrial Zone in South Clarendon, a designated limestone extractive zone.

In this regard RINKER Jamaica Limited, a Jamaican Company and wholly owned subsidiary of CEMEX, which has been involved in project development work in Jamaica for the past 4 years, is proposing to invest approximately US$300 million in the development of Jamaica's limestone resources which includes mining, processing, transportation and export. This EIA concerns the development of the export facility and associated transportation mechanism (conveyor belt) from the processing plant. This facility will be located adjacent to the 37 year old JAMALCO Rocky Point bauxite-alumina port in Portland Bight on Jamaica's southern coast. The proposed port will link with the existing Brazilletto Quarry (Mining Lease 129) located in the southern sections of the Brazilletto Mountain in Clarendon via a new conveyor corridor.

With sales of over US$25 billion dollars in 2007 and operating in over 50 countries in all continents and conducting trading relations in over 100 countries; CEMEX is the world's third largest producer in cement and a major entity in aggregates and limestone based construction products.

It is proposed to expand the 2.0 million metric ton per year Brazilletto Quarry to 12.0 million metric tons per year to provide processed limestone product for shipment through the Proposed Port to the export market.

The expansion of the Brazilletto Quarry and associated plant will be the subject of a separate application to the National Environment and Planning Agency (NEPA).

The construction of the proposed port and conveyor corridor falls within the prescribed category of projects requiring an environmental impact assessment (EIA).

This EIA addresses the NEPA approved terms of reference for the proposed port and conveyor corridor for which RINKER Jamaica Limited/CEMEX has applied to NEPA for a beach licence and permit to implement this project.

1.2 Project Objective and Conceptual Description

This proposed project entails the following:

1. a proposed port at Rocky Point (adjoining the JAMALCO Rocky Point Port) to export washed, crushed, and sized limestone
2. a conveyor corridor linking the proposed port to the existing Brazilletto Quarry via a limestone processing plant to be sited on ruinate lands (subject of another EIA) on the plains west of the port location

A comprehensive manoeuvrability study was conducted by RINKER to inform and guide the design of the ship channel and the turning basin.

The proposed port and conveyor corridor will require:

a. The dredging of a ship channel and turning basin adjacent to the existing JAMALCO Rocky Point port using the dredge spoil for land reclamation to create the proposed port as well as conduct seagrass mitigation/rehabilitation.
b. Construction of a hooded conveyor system from the port to the Brazilletto Quarry via the proposed plant.

The construction phase for the Proposed Port and Quarry is estimated to take place over a period of 18 – 24 months at a cost of approximately US$300 million dollars. About 400 persons will be employed at peak demand during construction and approximately 90 -150 persons during operations, servicing both the proposed port and the quarry expansion.

1.2.1 *Approach & Methodology*

An interactive approach was undertaken with an interdisciplinary design team and the environmental assessment team. This involved a combination of meetings, desk, literature and field investigations covering all aspects of the NEPA approved Terms of Reference (TOR) (**Appendix I**). The studies involved complete analysis and documentation of all aspects of the proposed project for all components from the planning, design, pre-construction, construction and operation phases. This included the following:

- NEPA's requisite permit application forms and project information forms were completed
- The TOR for the EIA was submitted in draft form and approved by NEPA with appropriate amendments
- Bio-physical surveys were undertaken in the area of the proposed project
- A comprehensive impact assessment was undertaken for actual footprint impacts on the following important biological resources: seagrass and mangroves (See Section 6 of this report). This section also provides specific mitigation measures for impacts to these resources.
- Socio-cultural surveys were undertaken in the area of the proposed projects
- The natural and manmade attributes as well as potential impact receptors of the environment were noted.
- The design and alternative selection as well as the field surveys were guided by the regulatory framework which included international and national policies, conventions, protocols, legislation, regulations and standards.
- Two (2) voluntary public consultations with the potentially affected members of nearby communities of Salt River, Brats Hill, Tarentum, Hayes, Longville Park, Cornpiece, Mitchell Town and Lionel Town were convened and recorded *ad verbatim* and issues raised by the residents addressed in the EIA (See Volume 2 of this EIA).
- Baseline studies were conducted on water, air and noise quality.
- The potential negative and positive impacts were identified and described for the pre-construction, construction and operating phases of the project.
- The methods to avoid or mitigate the potential negative impacts were developed, specifically impact identification and mitigation of seagrass and mangrove impact zones.
- Natural hazards and risks were identified and assessed
- The parameters for and an outline of an environmental management and monitoring plan were developed and the main components expanded as appropriate.
- Major elements of RINKER Jamaica Limited/CEMEX held safety and environmental policies and guidelines as well as their experiences were highlighted.

1.3 Regulatory Framework

The major policies and legislation relevant to the project are as follows:

- Agenda 21
- Natural Resources Conservation Authority (NRCA) Act, 1991
- RAMSAR Convention, 1971
- Wildlife Protection Act, 1945
- Watershed Protection Act, 1963
- Mining Act, 1975
- Minerals (Vesting) Act, 1947
- Quarries Act, 1983
- Town & Country Planning Act, 1987
- Forestry Act, 1937
- Water Resources Act, 1995
- Underground Water Control Act, 1959
- Jamaica National Heritage Trust Act, 1985
- Public Health Act, 1985
- Disaster Preparedness & Emergency Management Act, 1993
- National Solid Waste Management Authority Act, 2001
- Occupational Safety & Health Act, 2003 (Draft)
- Clarendon Parish Provisional Development Order, 1982

1.4 Impact Identification

The following potential negative impacts were identified:

- During construction, clearing activities may result in loss in biodiversity and exposure of topsoil to agents of erosion, if not properly mitigated. Also, loss of vegetation cover will lead to loss of terrestrial habitats thereby affecting terrestrial species. Other losses would be in; loss of hunting grounds and non-timber forest resources, which is a source of income to the people. Additionally, this would result in a change in land-use
- Changes to water quality. Potential for increased turbidity and siltation during construction. Change in the drainage regime.
- Noise and vibration
- Land degradation due to soil erosion, deforestation (removal of fauna/flora through site clearance), and changes in topography, landscape, visual intrusion and changes in hydrology of the area. Land use conflicts, legacy impacts (direct and indirect negative impacts), and disruption to communities by change and influx of newcomers.

  - ✓ A comprehensive impact assessment was undertaken for actual adverse footprint impacts on seagrass and mangrove resources (See Section 6 of this report).
- ➢ Owing to sudden economic activities in the area, there may be a large influx of workers. In addition, an increase in the number of traders and hawkers of food is also expected in the area.
- ➢ Occupational safety and health in terms of dust/exhaust fumes inhalation, effects of noise and vibration, ventilation, and effects of over exertion.

The following positive impacts were identified:

- ✓ Flow of investments to the area (development of the export market for Jamaica's limestone resources
- ✓ Creation of a modern dedicated limestone shipping port
- ✓ Increased employment in the limestone sector (both skilled and semi-skilled) and community development for the study area
- ✓ Direct foreign investment
- ✓ Job creation during construction and operation. The project will provide both direct and casual employment to about 150 persons. Due to availability of income, there could be some positive impacts on lifestyle when the jobs are taken up.
- ✓ Opportunities for commercial activities will be created in the area in the form of increased local sourcing of food, equipment, housing, tools and services.

1.5 Impact Mitigation

Mitigation measures for these possible impacts will be carried out using standard practices and will be done to ensure compliance with the requirements of the. Impact mitigation actions will involve the following:

- Loss of bio-diversity is unavoidable. However, creative conservation will be applied in the replanting of mangrove and seagrass.
  - Section 6 of this report provides specific mitigation measures for impacts to these resources.
- The change in land use is unavoidable. Visual intrusion and negative aesthetic impact, while limited is also unavoidable.
- Change in the natural drainage regime is unavoidable. However, the artificial drainage system is compliant with the design standards of the National Work Agency (NWA).
- Noise and vibration will be controlled through effective equipment selection, maintenance and management.
- Dust will be controlled through appropriate hooding of equipment, covering of stockpiles (as necessary), irrigation and the use of a telescopic ship loader.

- Sediment transport will be minimized through the use of silt curtains and traps during dredging.
- Where possible and practicable the potential positive impacts will be maximized.

In conjunction with discussions with NEPA and other stakeholders, a comprehensive seagrass and mangrove impact assessment and mitigation exercise was carried out. This allowed for design changes (detailed in the Project Description section) to ensure the footprint for the port and conveyor had the least possible impact on these very important natural resources.

1.6 Conclusions:

Design of the project and conducting the EIA have been done in keeping with the requirements of the terms of reference and the regulatory framework. The preferred alternative was selected after careful analysis and evaluation of various alternatives in relation to the ecology, public health and safety, the socio-cultural environment, the need to reduce or avoid potential negative impacts, addressing the basic requirements of an environment management and monitoring plan while identifying the need to support environmental management projects in the area and optimizing the economic benefits that will flow from the project, if permitted.

It should be noted that Rinker Jamaica and JAMALCO have entered into a joint management approach of the entire Rocky Point Peninsula. This is to ensure no piecemeal development of the peninsula and major elements for environmental sustainability as well as crime prevention and protection are in place.

The members of the communities expressed concerns which also guided the EIA process and most importantly were supportive of the project, stating previous and ongoing benefits derived from the brownsite Brazilletto Quarry; especially in light of the benefits that it could bring to members of the community.

1.7 Recommendations:

Given the features of the project and the assessment listed below:

- significant brownsite elements of the project, which provide important baseline information through impacting negatively and positively on the environment for several decades,
- the diligence with which the design has been done in keeping with the regulatory framework and the equally diligent and detailed assessment carried out with major inputs from the potentially affected communities,
- the proposed actions for avoiding and mitigating negative environmental impacts and

- the plan to optimize the social and economic benefits as well as the level of investment and job creation, which will redound to national, social and economic development:

it is recommended that this project be permitted and that the requisite beach licences and permits be issued to RINKER Jamaica Limited with the relevant conditions being stated for sound environmental management and monitoring, in keeping with the stipulations of the project design and EIA and the regulatory framework

DESCRIPTION OF THE PROPOSED PROJECT

2 Description of the Proposed Project

2.1 Introduction

RINKER Jamaica Limited (RINKER) is a wholly owned subsidiary of CEMEX and one of the world's leading manufacturer of limestone derived products such as:

- Aggregate
- Concrete
- Cement
- Asphalt and
- Concrete pipe.

RINKER proposes to establish:

c. a port area inclusive of a small reserve stockpile area at Rocky Point (adjoining the JAMALCO Rocky Point Port) to export washed, crushed, and sized limestone, and
d. a transportation corridor linking the proposed port and the existing Brazilletto Quarry

This application therefore covers the proposed port area inclusive of the small reserve stockpile at Rocky Point and the transportation corridor linking the proposed port to the proposed plant on the plains inland.

RINKER has recently acquired exclusive operating rights from Chemical Lime Company Limited (CLC) for the Brazilletto Quarry. All elements of quarrying will be subjected to a separate application.

Strategically positioned and operating in more than 50 countries across the Americas, Europe, Asia, Africa, Australia and the Middle East and maintaining trade relationships with more than 100 nations; with sales of over US$25 billion in 2007, CEMEX is a global leader in the building solutions industry.

CEMEX strives to advance the well-being of those they serve through their focus on continuous improvement and efforts to promote a sustainable future.

The port facility will facilitate plans for expansion and upgrade of the 2 million ton per year licensed Brazilletto Quarry which currently supplies Rugby Jamaica Limited with its limestone requirements. Limestone in excess of present production will be exported to North and South America.

2.1.1 *Background Information on the Proposed Plant and Quarry*

Ultimately the Brazilletto Quarry will be expanded and upgraded from its present output of 500,000 tons per year on a phased basis to 12 million tons per year of finished limestone aggregate. The current areal extents of the mining leases are shown in **Plate 2-1**. The proposed expanded quarry would be confined to mining lease 129.

Limestone will be sourced from the brownsite Brazilletto Quarry, which has been in operation for more than 10 years. This area is part of the 2,300 hectares of high grade limestone deposit for which Chemical Lime Company Limited currently holds a Special Exclusive Prospecting Licence (SEPL). The proposed port and conveyor corridor are not being done in isolation of the proposed quarry expansion. The Brazilletto Quarry is an existing brownsite operational quarry permitted for 2 million tons per year within ML129. Bearing in mind the purpose of the port facility and the economics associated, Rinker is proposing expanding the existing quarry from the permitted 2 million tons per year to a 12 million ton per year quarry.

Rinker already has an exclusive operating contract with Chemical Lime Company for the Brazilletto Quarry and ML129. The quarry expansion plan calls for a 50-60 year mining lease. The quarry material needed to produce the intended grades of limestone aggregate is found in the westerly half of ML129.

The proposed plant site will be on lands previously used for sugarcane cultivation that is currently ruinate lands south of Brazilletto Settlement and north of Mitchell Town.

Limestone aggregate from the quarry will be transported using a conventional hooded conveyor for stockpiling in proximity to the proposed port facility; where it will be loaded into regularly scheduled vessels up to PANAMAX size, using a high capacity ship loader.

The conveyor corridor is made up of four (4) segments. There are two (2) sections from the quarry to the plant and two (2) sections from the plant to the proposed port. The latter two segments are subject to this EIA.

It is agreed that important species of flora and fauna are located in the Brazilletto Mountain. A flora and fauna assessment has been conducted and will be outlined in the EIA report for the Quarry and Plant. The various endangered and endemic species that were identified will be held in a nursery or relocated as necessary. To reduce the impacts, the expansion will be done on a phased basis.

The loss of flora is a significant unavoidable impact from quarrying. Rinker is prepared to cooperate with NEPA and any other appropriate organizations to identify and implement any reasonable and cost effective mitigation measures to offset the loss of any endangered and endemic species that are region specific that represents a major loss to Jamaica.

The necessity of Alternative 1 is in regards to the availability of lands held by the Sugar Company of Jamaica. This option therefore outlines what route would be taken should lands not be available on the plains for the Proposed Limestone Plant. It is the subject of current discussions and is further detailed in **Appendix X**.

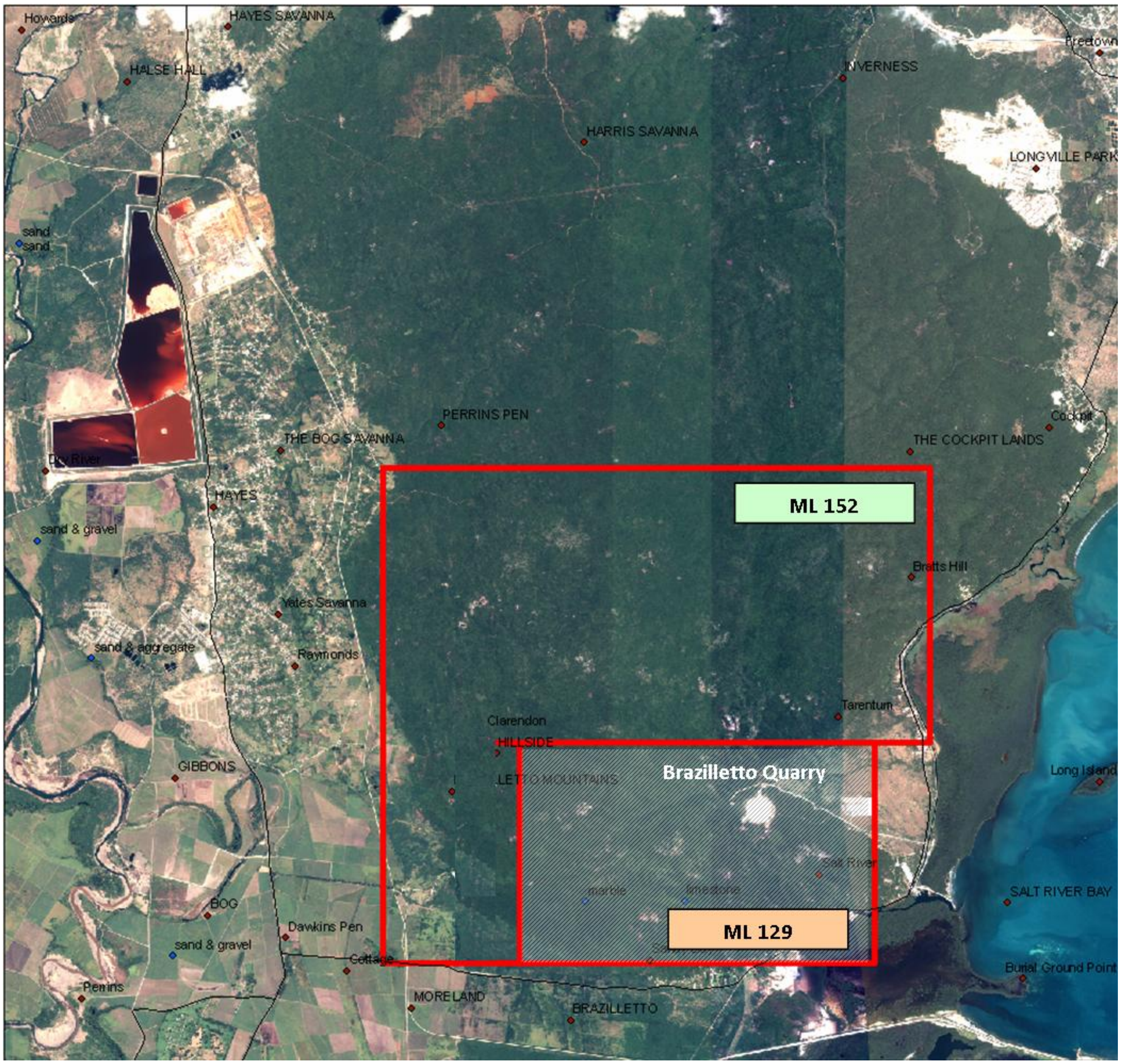


Plate 2-1: Mining Leases for the Brazilletto Quarry

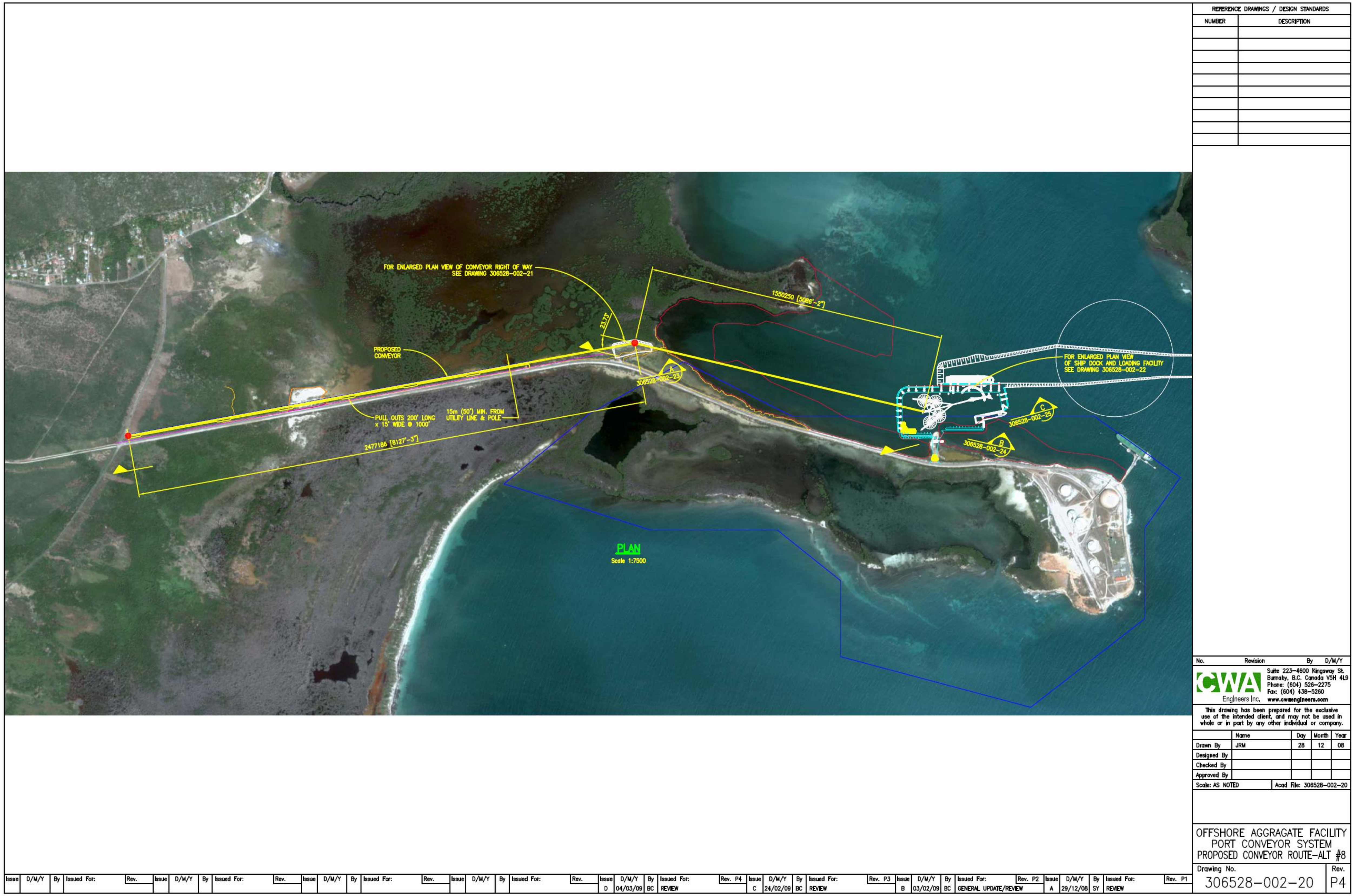


Plate 2-2: Survey of Area of Interest (Rocky Point Peninsula)

2.2 The Proposed Port and Associated Infrastructure Overview

In selecting the proposed site RINKER conducted a detailed survey on Jamaica's North and South Coasts, and found the Brazilletto Mountains and Rocky Point to be the most suitable location. This is addressed in **Section 3.**

Construction of the Proposed Port and its associated works covered in this EIA is estimated to take 18-24 months period. During construction the total number of employees will be approximately 150.

On completion, this approximately US$300 million port and conveyor investment project will employ approximately 90-150 permanent employees and provide other indirect employment. The expansion of the quarry will require additional permanent employees.

The location of the proposed port and transportation corridor is shown in **Plate 2-2** above.

Crushed sized and washed limestone stockpiled at the plant will be transferred onto a conveyor that transports the material to the vessels at port. A reserve of 1.3 shiploads of limestone product ready for export will be housed at the reserve stockpile area at the port using a stacker. This stacker will be capable of reaching the length of the stockpile area. The discharge end of the stacker will also be capable of moving up and down in order to minimise the height that the product will drop, thus minimising dust generation.

The port stockpile is reserved for emergency use in the event the overland conveyor fails and also for topping-off vessels. The vessels will be loaded by reclaiming material at the plant with the use of a reclaim tunnel. This material will be rinsed prior to reaching the port. The rinsing process will eliminate any <200 mesh size particles (dust) in the aggregate which in return reduces any potential dust emissions. The over-land and over-water conveyors employ a mechanism that turns the return side of the conveyor to eliminate any carryback from falling on the ground or in the water.

Limestone for the domestic market (to fulfil Chemical Lime Company current local contracts) will be transported by appropriate freight truck.

Maintenance will be handled internally by trained maintenance technicians with periodic use of external contractors.

All major equipment and components will be maintained in accordance with OEM recommendations and or RINKER/CEMEX Best Practice Standards. Equipment is typically maintained on an operating hours schedule with routine daily/weekly inspection intervals.

All solid waste will be stored in appropriate containment and discarded through the local waste management program

During the construction phase of the project portable chemical facilities will be used to facilitate the employees. Bottled water will be distributed during this phase.

The operating phase of the project will utilize well water supply. At this time a tertiary wastewater treatment system (tertiary treatment) will be commissioned into operation.

In keeping with the NRCA Act of 1991, RINKER/CEMEX is required to conduct an Environmental Impact Assessment (EIA) on the proposed operations. This includes linkages to and from the proposed plant and also the existing Brazilletto Quarry. The revised EIA will be re-submitted to the National Environment and Planning Agency (NEPA), for review and permitting to facilitate implementation of the plans.

A detailed description of all elements of the project during the pre-construction, construction and operational phases has been prepared. The elements analyzed include the infrastructure of the project such as drainage features; roads; waste generation and management; and utility requirements.

The purpose of this EIA is to assess the impacts that may occur from the implementation of this project, inclusive of:

- the proposed dredging works,
- modification to the mangrove and seagrass community,
    - A comprehensive impact assessment was undertaken for actual footprint impacts on the following important biological resources: seagrass and mangroves (See Section 6 of this report). This section also provides specific mitigation measures for impacts to these resources.
- construction activities and operation of the Port and Transportation Corridor at Rocky Point, Clarendon

A ship channel and turning basin will be created by dredging the marine area to facilitate vessel movements at the port. The port facility will be constructed adjoining the existing JAMALCO Rocky Point Port (**Plate 2-2**).

The design of the proposed port facility is being undertaken using engineers that are familiar with the damage done to the existing Jamalco port from previous hurricanes.

The northwestern shoreline of the Rocky Point peninsula was selected for the proposed Rinker Berth. Numerical model studies confirmed that this area is relatively sheltered compared to the adjacent Jamalco pier against hurricane waves which influence the area from a long fetch in the southeast direction. A detailed statistical analysis has been completed to establish the extreme wind and wave conditions for the project site involving 250 hurricanes recorded from 1930 to 2005. Based on the findings of this study, Rinker Facility was designed to withstand a major hurricane such as Ivan (2004) or Dean (2007). The proposed conveyor feeding the ship loader was designed to remain above the maximum wave crest during a severe hurricane. The design height of the conveyor is higher than the previously damaged structures at the adjacent facility. Similarly, the strength of the pile foundations used in the berth structures will be able to withstand major storm events. Only some minor damage to auxiliary structures such as gangways and handrails are expected in the event of a major hurricane. Some rock displacements on the revetment may also take place without presenting any particular risk to the integrity of the structure. Aspects of this detail are further elaborated in the following sections.

The proposed elevation for the port area is 3.0 m (10 feet) above the Mean Sea Level (MLS). Buildings designed for the port area will withstand a wind event with 100 year return interval and seismic zone 2 conditions. They will be fully compliant with the Jamaican Building Codes and the 2003 international Building Code used in ports that experience similar conditions such as Jacksonville in Florida, USA.

The conveyor corridor is also designed to withstand a wind event with 100 year return interval.

The reserve stockpile at the port will be done based on typical DWT of a PANAMAX vessel at design draft of 40 feet. One and half material storage space will be allocated at the proposed port. The material is being washed and sized at the plant and delivered to the port via the conveyor belt. This reduces the potential for dust generation. Additionally, there will be a telescopic shooter that will be used in loading the vessels which will have access to every hold. This is also a mitigation to reduce any potential dust generation.

Prior to the onset of a tropical storm or hurricane the reserve stockpile will be depleted by the last available vessel and conveying operations would have ceased at the quarry and plant. Tie-down operations would be in effect at the various facilities. There would be little or no reserve stockpile at the port during a major storm.

The drainage for the proposed port will utilise a perimeter (south) holding ponds and perimeter berms. Additionally, the drains will be fitted with the required silt screens. The product to be stored is sized and washed limestone. Little silt particles will be generated from this operation. All precautions have been taken into consideration for the design of the port.

The proposed turning basin and ship channel was designed with input from of a marine assessment, Jamalco and the Jamaica Pilots Association (The manoeuvrability study outlined in this EIA). The final alignment presented was evaluated against several parameters, chief among them being:

1. Impact on existing ship movements with the Jamalco port
2. Location of important marine resources such as coral reefs, seagrasses and mangroves (i.e. those least likely to survive any transplanting or providing significant ecosystem benefits that are avoidable)

It is important to note that Rinker Jamaica and JAMALCO have entered into a joint management approach of the entire Rocky Point Peninsula. This is to ensure no piecemeal development of the peninsula and major elements for environmental sustainability as well as crime prevention and protection are in place.

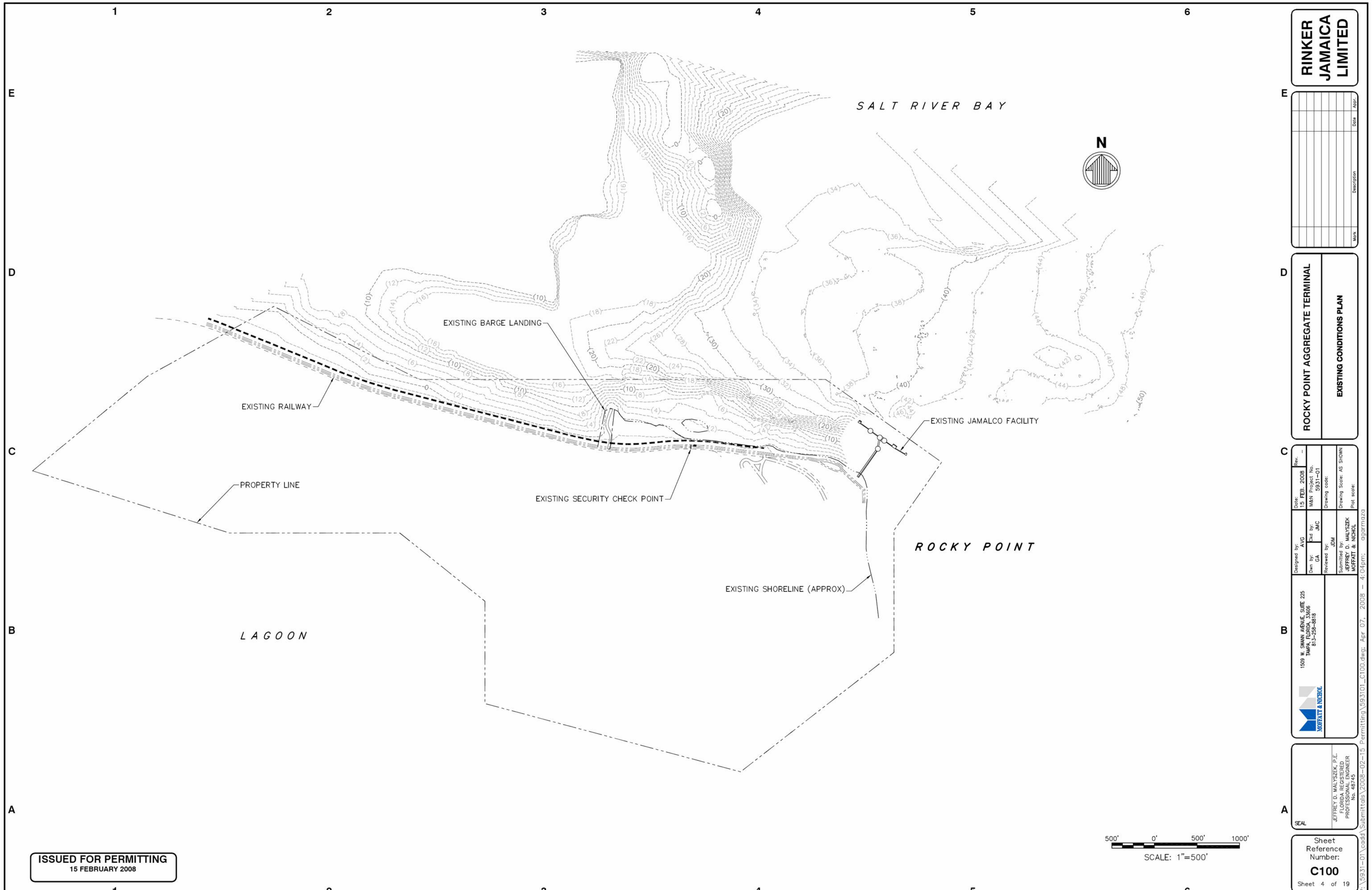


Figure 2-1: The Existing Conditions at Proposed Port Area (showing bathymetry)

2.3 Site Description and Layout

2.3.1 *Port*

Rocky Point is located along Jamaica's south coast approximately at Latitude 17° 49'N and Longitude 77° 09'W.

The Rocky Point Port is located approximately 4.4 km (2.8 mi) to the southeast of the Brazilletto Quarry on a peninsula separating Colon Bay to the north and Peake Bay to the south. The port is reached via a secondary road and a rail operated by JAMALCO.

The proposed Port will be located at coordinates N 129,750 m and E 234,000 m and will be approximately 488 m (1600 ft) long by 213 m (700 ft) wide orientated along an east-west alignment. Shoreline stability will be maintained through the construction of a backfilled sheet pile wall and a perimeter revetment zone.

The finished elevation of the Port area will be approximately 3.0 m (10 ft) above Mean Sea Level (MSL) along the more exposed northern perimeter sloping gradually to the southern perimeter. The crest elevation of the revetment will be 0.9 m (3 ft) higher. The finished surface (armour layer) will consist of approximately 1.83 m (6 ft) thick layer of crushed stone material.

The path of the navigation channel and turning basin that will be created to facilitate berthing of the PANAMAX vessels is shown in **Figure 2-2**. The navigation channel will be approximately one mile long and consists of two straight segments:

- The first segment, oriented in a NE-SW direction, connects the proposed berth to a turning basin.
- The second channel segment will be aligned in an E-W direction and will extend from the turning basin to the 15 meter depth contour within Portland Bight.

The channel alignment has been done in consideration of prevailing wave/wind directions.

The channel width varies, but will be wider than approximately three ship beams, 100 metres (325 feet), at the narrowest section between the channel toes. The channel will be dredged to a depth of 14 metres (46 ft) with respect to the mean lower low water (MLLW) datum. These dimensions of the channel will be sufficient to host the berthing of PANAMAX class vessels with 60,000 Dead Weight Tons (DWT) load capacity drawing a draft of approximately 12.2 m (40 ft).

Depth to sediments and soils presently average 4-20 m below sea level and based on the anticipated area (estimate) to be cleared is approximately 24 hectares (60 acres) and will result in the possible removal of 0.688 million cubic metres (0.9 million cubic yards) of spoil material.

A new elevated conveyor corridor will service the Proposed Port area from the proposed plant.

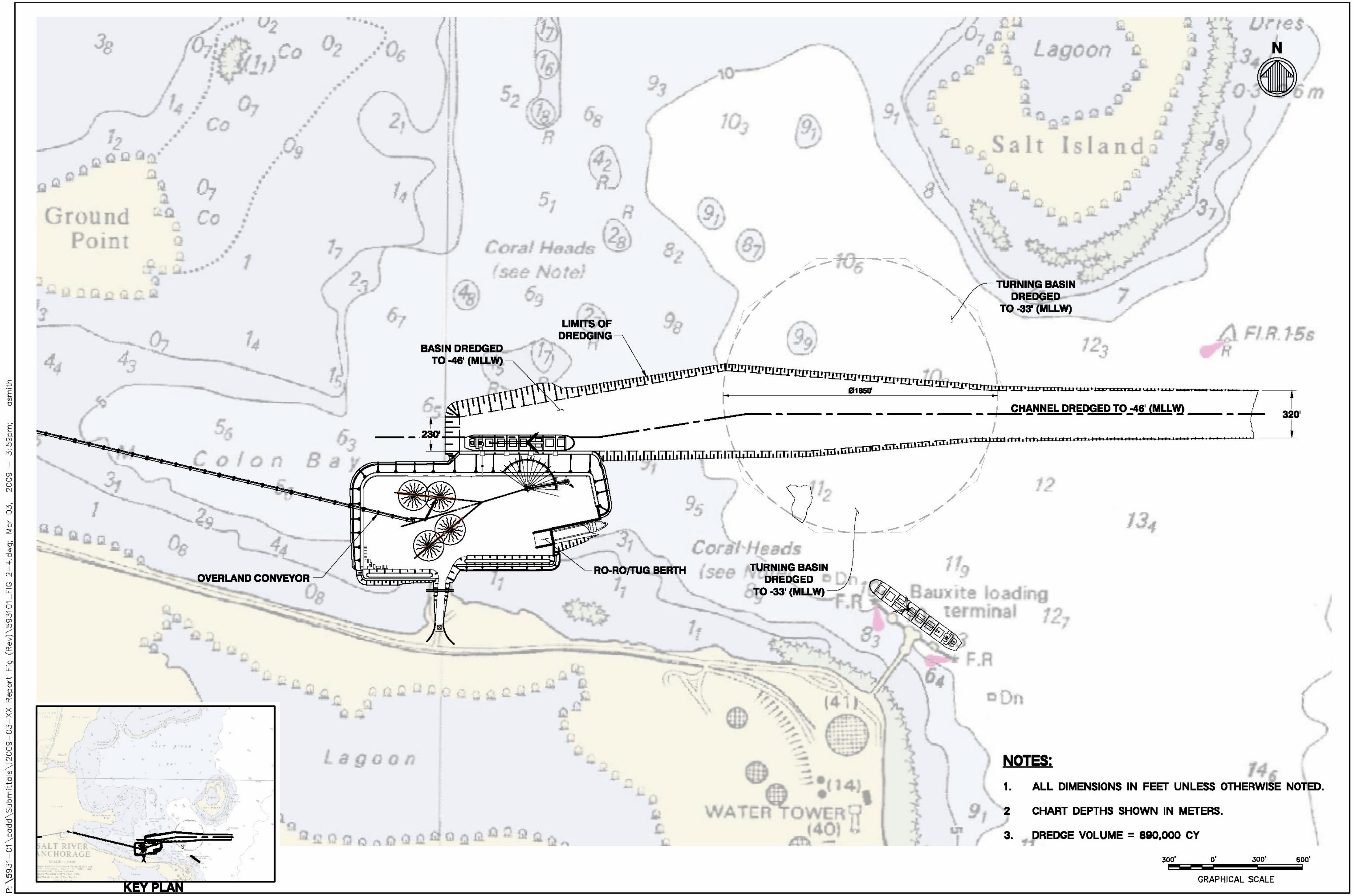


Figure 2-2: Proposed Layout of Channel and Turning Basin

2.3.1.1 Design of Turning Basin

One of the design constraints requires mooring the vessel with the bow facing the ship channel in order to decrease the amount of ship manoeuvring in the case of an emergency. This is a rather common practice for vessels, especially in hurricane prone areas. Therefore, a turning basin was designed in close proximity to the berth to rotate the inbound ship before mooring at the berth as shown in **Figure 2-2** above.

The location of the turning basin was determined to keep both the dredging and the vessel distance to the berth at a minimum. This resulted in the design of a 564 meter (1850 feet) diameter turning basin approximately 610 m (2000 ft) from the berth, at the existing 10 meter (32.8 feet) depth contour. This basin will be utilized exclusively by RINKER/CEMEX vessels since JAMALCO vessels follow a different approach procedure.

The diameter of the turning basin was kept as minimal (2.5 ship lengths) as possible for safe vessel manoeuvring considering the wave/wind exposure and the tug availability. The existing water depth within the proposed turning basin is greater than the design draft under ballasted conditions (maximum 8 meters) so no additional dredging outside the channel limits would be necessary. The turning basin would also be marked to allow 24 hour ship operations.

2.3.1.2 Ship Loader

A quadrant ship loader (**Figure 2-4** and **Figure 2-5**) is selected to reduce the time at berth. This loader will have enough reach to feed all seven hatches of a PANAMAX class design vessel without warping. With a high loading rate of up to 5000 tph, this loader will help to achieve the projected 6-10 million tons per year throughput while maintaining low berth occupancy and demurrage.

The quadrant loader will be supported by a pivot platform and a radial beam. The loader's pivot platform is a pile supported platform. Similarly, the radial beam is a cast in place (CIP) concrete beam supported by 1 m (42-inch) diameter steel pipe piles driven into the bay. This radial beam will support the crane rails and will extend back onto land where the storm tie-downs will be located. The position on land will also serve as the maintenance position so that maintenance activities can be completed while minimising the possibility of dropping products into the bay.

2.3.1.3 Berth Structures

The proposed berth is located along the northern side of the Rocky Point peninsula as shown in **Figure 2-3**. The results of a numerical wave transformation study indicated that this site is less exposed than the existing JAMALCO site to the wave climate. Moreover, the orientation of the berth is such that the moored vessels would be aligned with the prevailing wind and waves.

Therefore, this East-West orientation would further reduce the possibility of wave/wind induced agitation during the loading operations.

A gull-wing pier head configuration as shown in **Figure 2-4** was chosen for the proposed facility. This configuration consists of four breasting dolphins and four landside bollards for mooring lines. Breasting dolphins would be located about 366 m (1200 ft) away from the existing shoreline. The breasting dolphins consist of a cast-in-place concrete pile cap supported on a series of steel pipe piles as shown in Figure 2-5 to Figure 2-16**.** The overall dimensions of the breasting dolphin in the plan are 2.88 square meters (31 square feet). Breasting dolphins would be linked and connected to the ship loader by lightweight bridges.

The landside bollards dolphins consist of 107 cm (42 in) diameter steel pipe piles and a CIP concrete cap as shown in **Figure 2-6**. All four landside bollards would be located on the land-fill area. Fill area around the bollards and the ship loader's pivot will be armoured against wave action as shown in **Figure 2-4**. Mooring hardware includes four fenders installed on the breasting dolphins. The fender type is a single large cell fender with a rubbing board surface with HDPE plastic. A ship mooring analysis was conducted for the proposed berth configuration. A range of wave height, period and directions were considered. The results indicated that the vessel motions as well as loads on mooring lines would remain within allowable limits for the design wind and wave conditions.

A Ro/Ro (Roll on/Roll off) berth was included in the design to bring equipment and material, as well as spare parts, to the site during and after construction of the terminal (**Figure 2-9 - Figure 2-10**). The Ro/Ro berth would be a 30 m (100-ft) wide bulkhead structure in 6.1 m (20 ft) MLLW water depth.

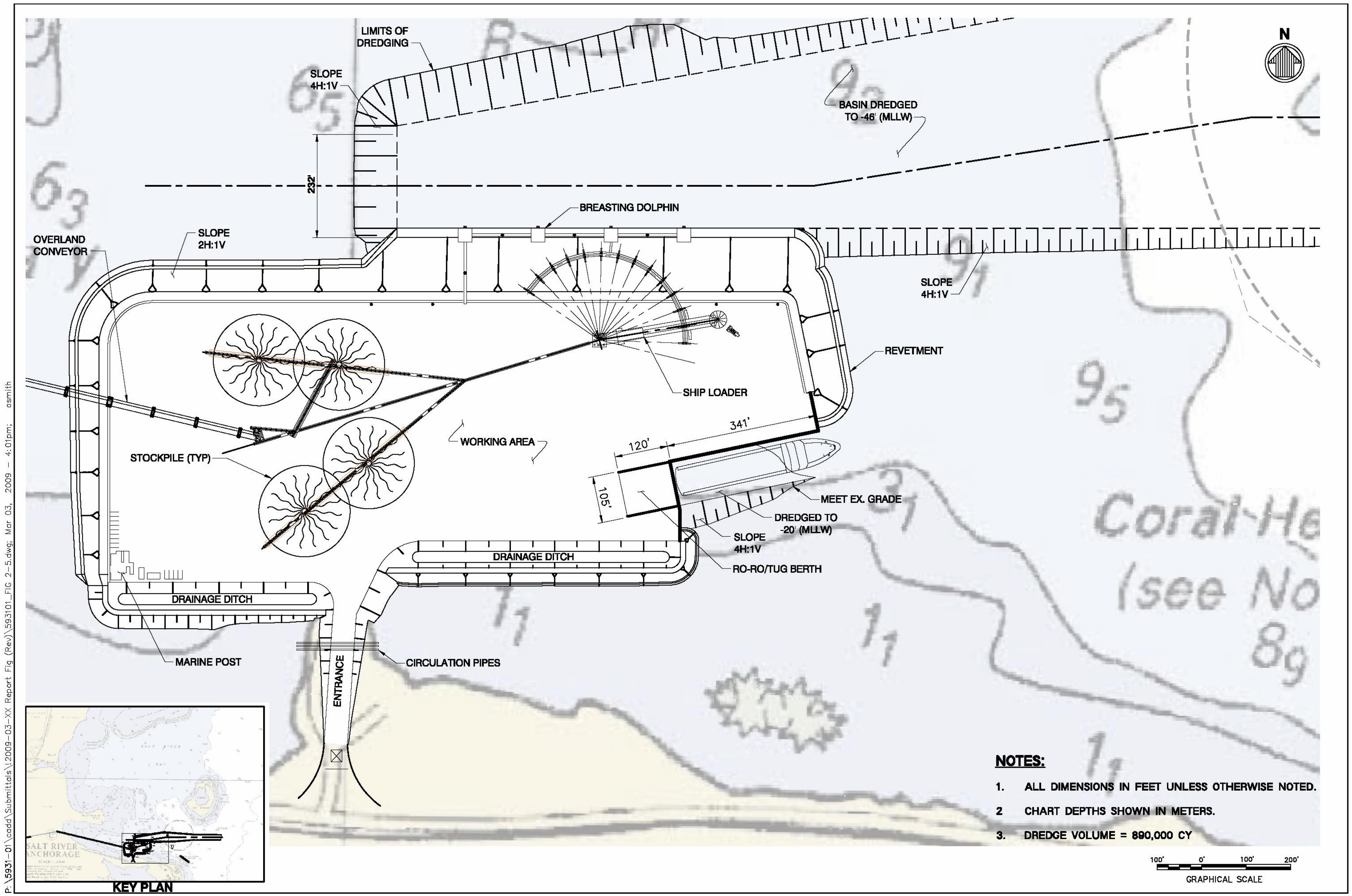


Figure 2-3: Proposed Berth Layout

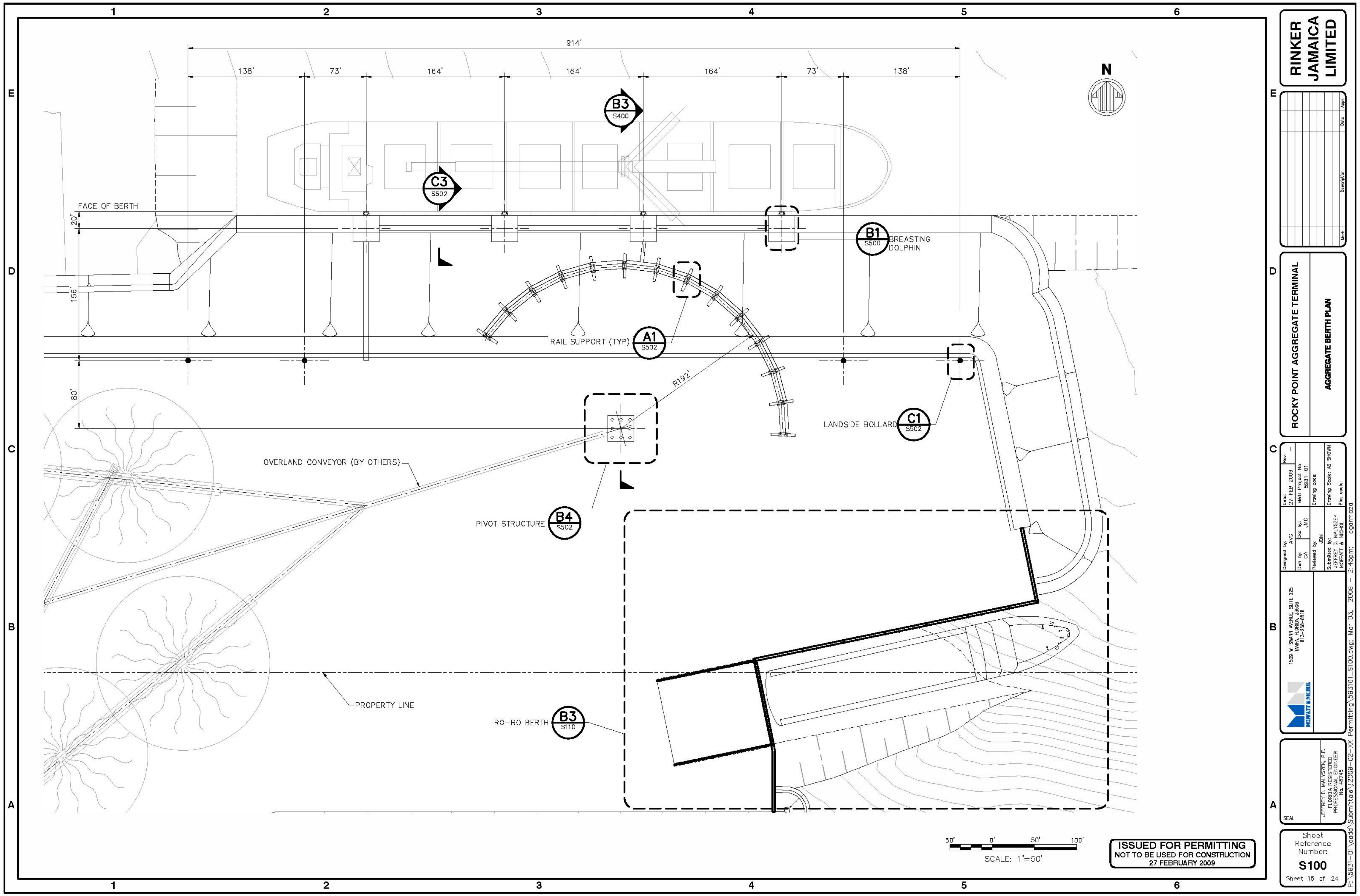


Figure 2-4: Proposed Aggregate Berth Layout

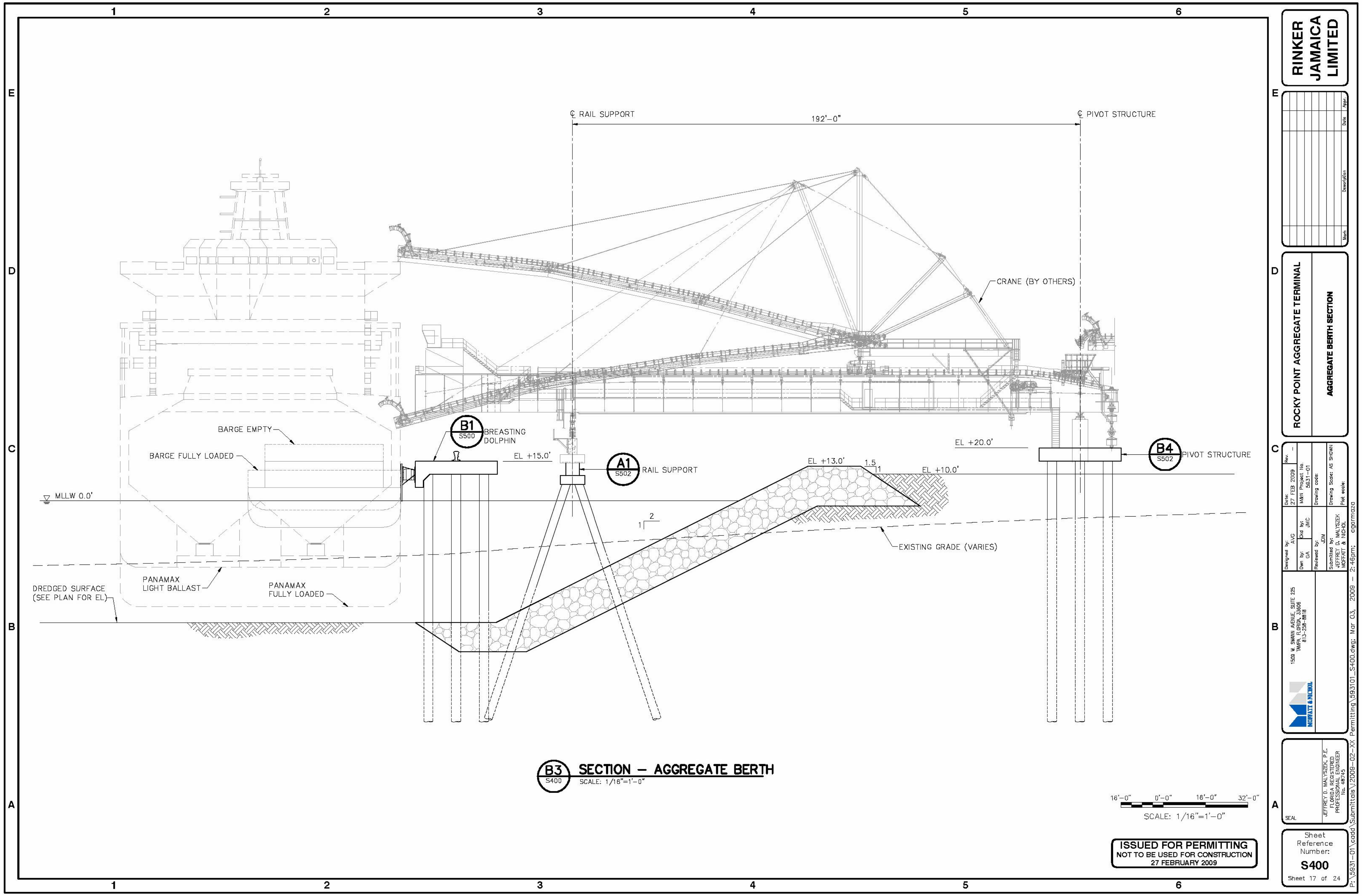


Figure 2-5: Proposed Berth Section

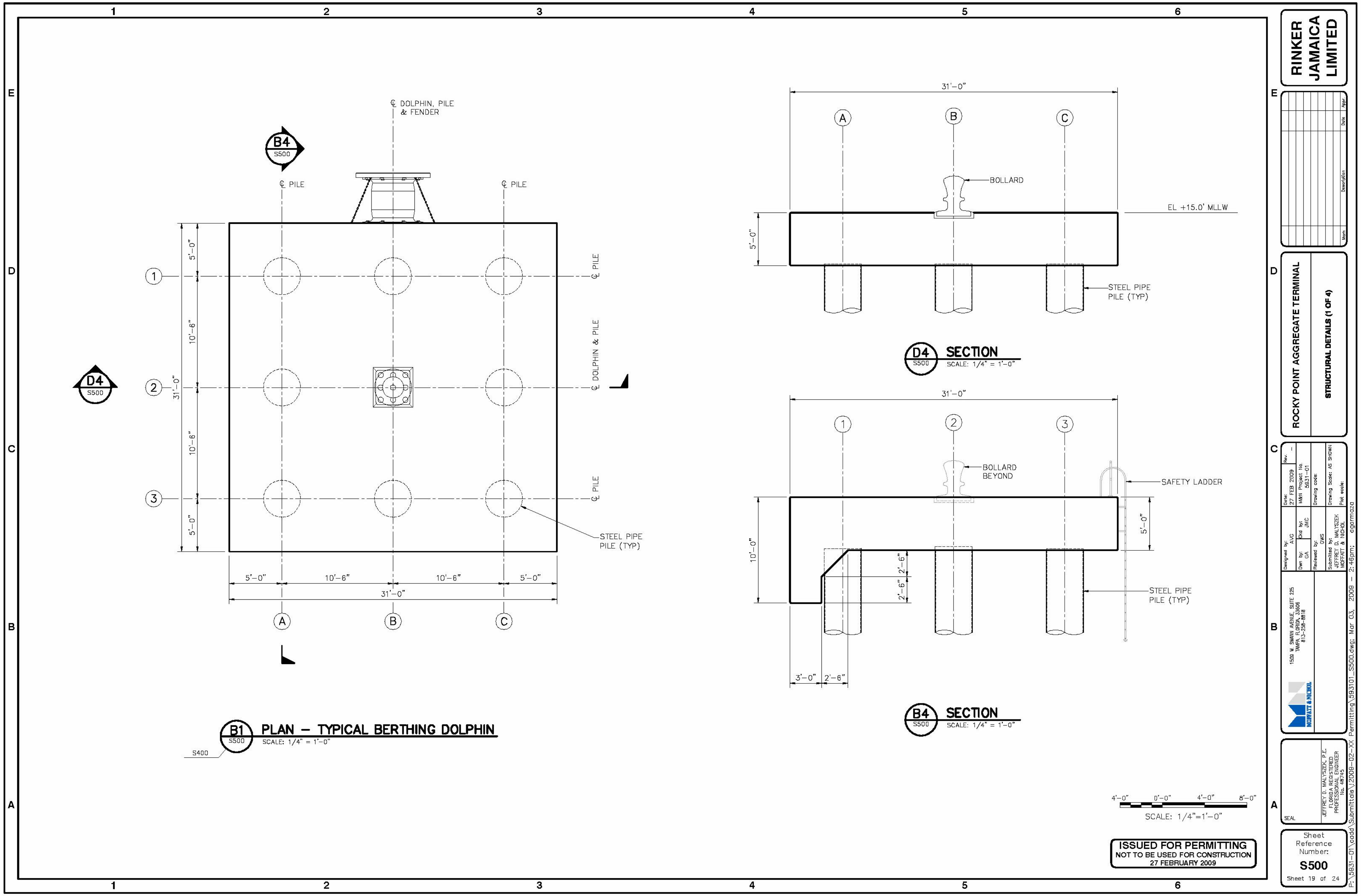


Figure 2-6: Structural Details [Breasting & Mooring Dolphin]

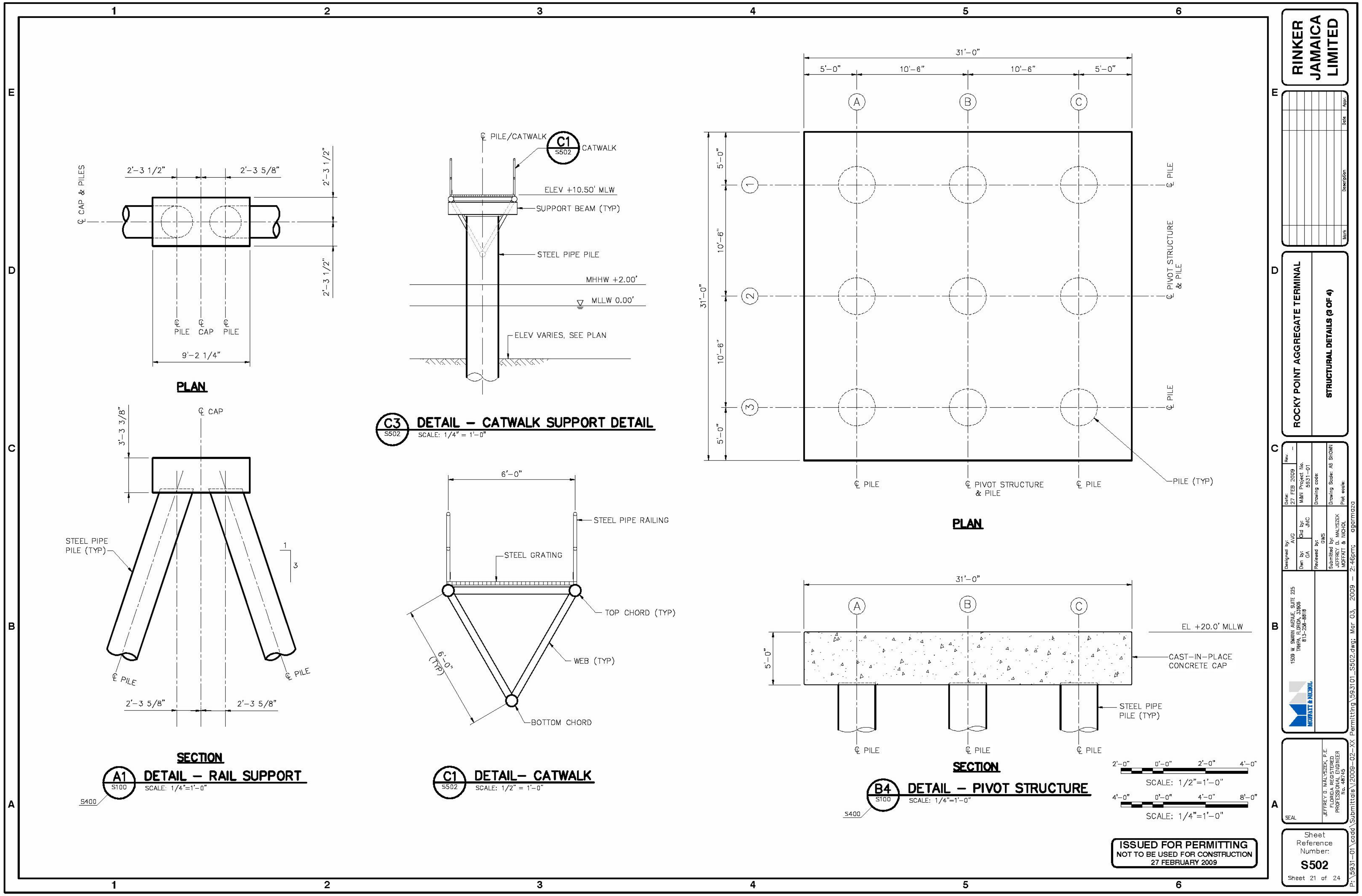


Figure 2-7: Structural Details [Rail Support & Pivot Structure]

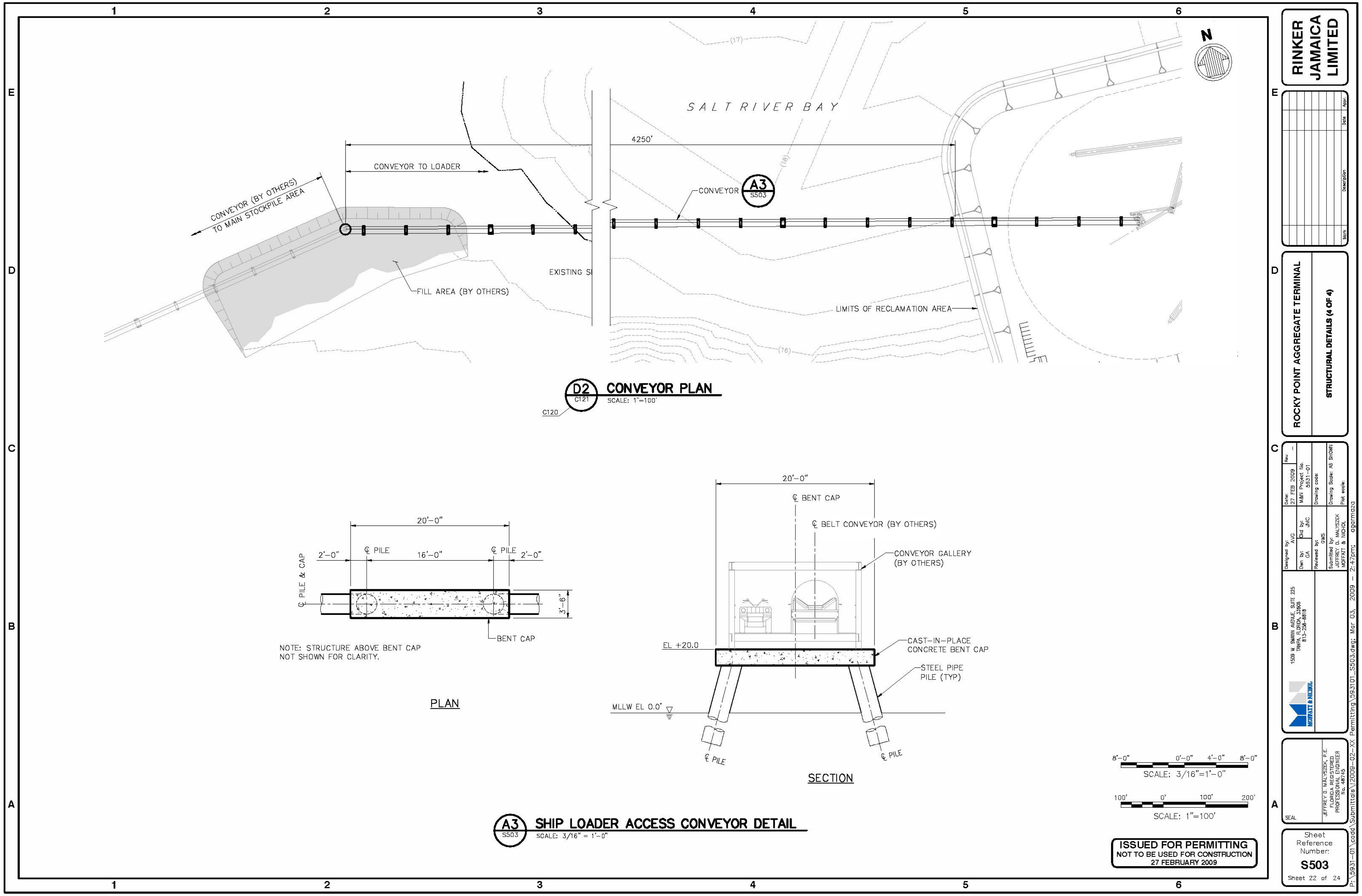


Figure 2-8: Structural Details [Conveyor Plan & Ship Loader Access Conveyor Detail]

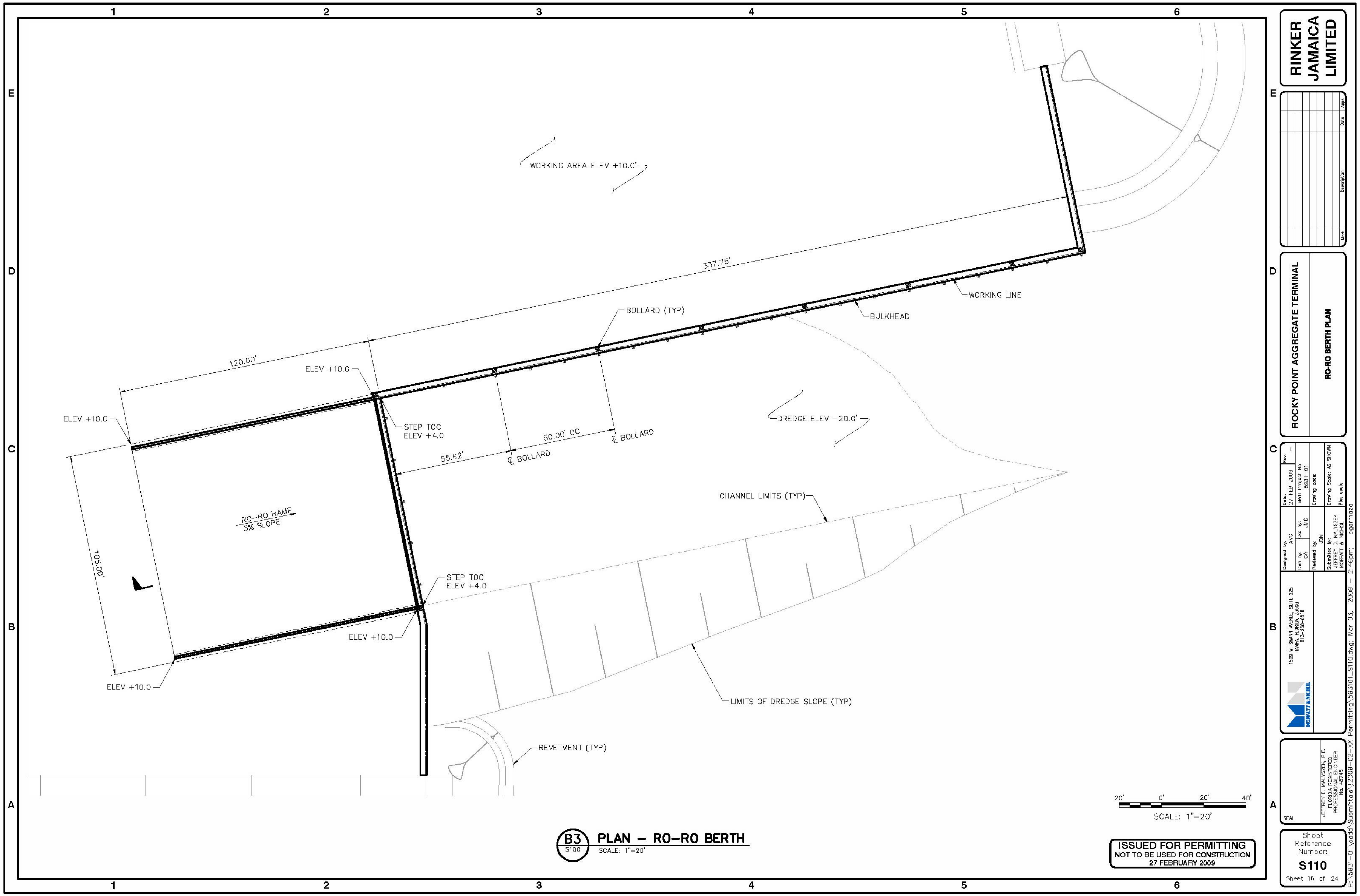


Figure 2-9: Proposed RO-RO Berth Design

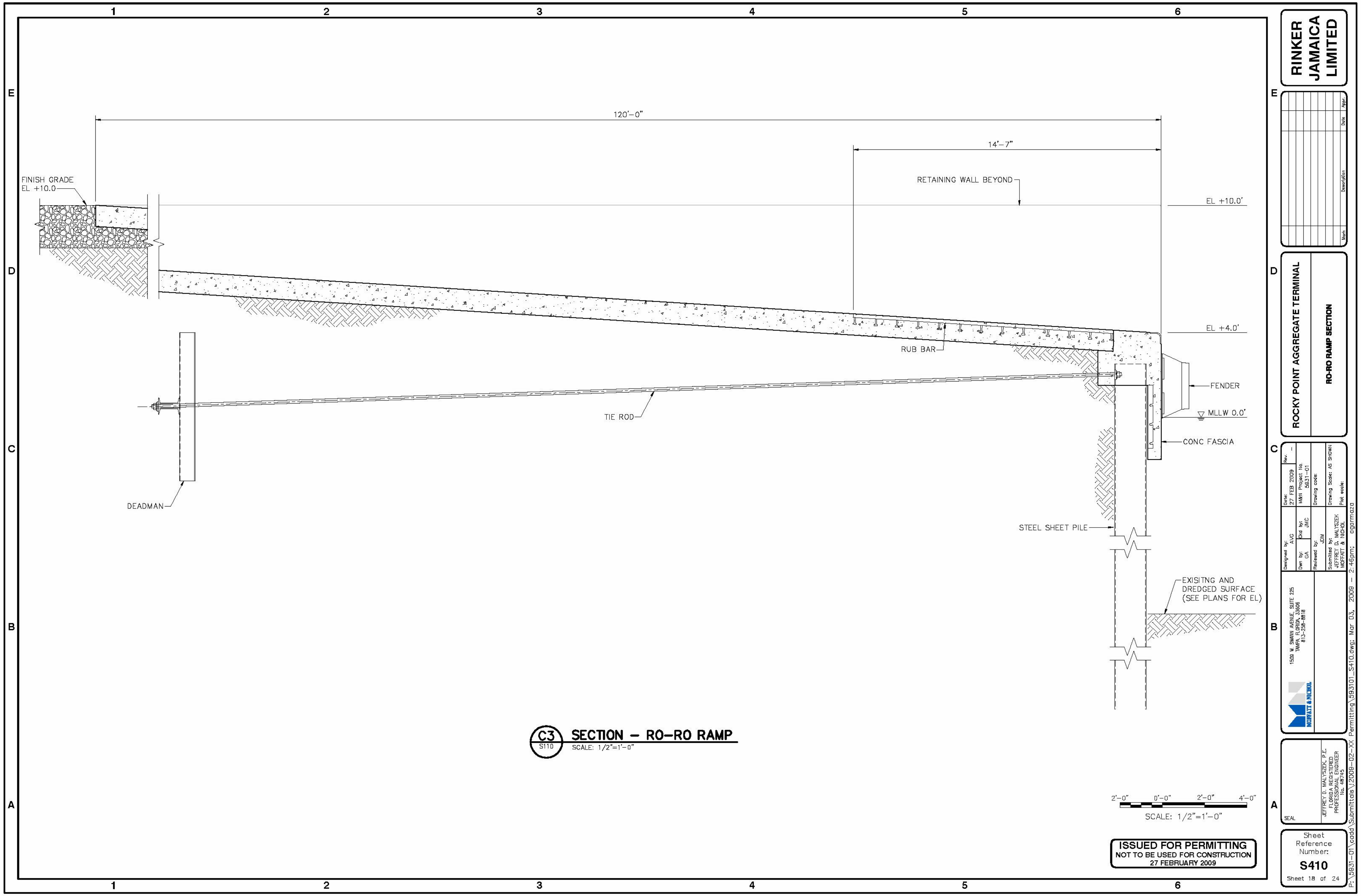


Figure 2-10: RO-RO Ramp Section

2.3.2 *Material & Reserve Stockpile*

2.3.2.1 Processed Material Transfer

Processed limestone product from the mine process plant is collected by a conveyor inside a surge tunnel via feeders located underneath the product stockpiles. Material is loaded onto a covered overland conveyor at a target rate of 5,000 tph. The overland conveyor transfers material from the plant site to the port reserve stockpile area. The conveyor from the plant to the port will only operate when there's a ship in port to be loaded. This equates to 2.5 ships per week, 50 weeks per year. The port schedule is dependent on ship arrival and departure within 22 hours.

The preferred gradations and specification requirements for aggregate is outlined below:

	Amounts finer than each laboratory sieve (square openings), % weight					
Size / Number	**Nominal size, square openings**	**25 mm (1 in)**	**12.5 mm (1/2 in)**	**9.5 mm (3/8 in)**	**4.75 mm (no. 4)**
4	37.5 to 19 mm (1 ½ to ¾ in)	20 to 55			
57	25 to 4.75 mm (1 in to no. 4)		20 to 55 (target = 39)		
67	19 to 4.75 mm (¾ in to no. 4)			20 to 55 (target = 39)	
89	9.5 to 1.18 mm (3/8 in to no. 16)				20 to 55 (target = 39)

2.3.2.2 Reserve Stockpile Top-Up Area

Aggregate from the plant will arrive at the port area reserved for stockpiling via the covered overland conveyor. As the product reaches the reserved stockpile area, it can continue directly to the ship or be diverted to the travelling stacker which can stockpile on either side of the conveyor, at a target rate of up to 5,000 tph.

The decision as to which location the product is sent to will be determined in the following priority:

- Send material directly to ship in order to avoid double handling;
- Send material to a material product classification stockpile; and
- Send material to a new location on the stockpile not currently containing any product.

Product discharge height will be kept as low as possible in order to minimize product degradation and potential creation of dust. Dust suppression, with the use of water spray, will be targeted to key locations in order to further minimize the risk of dust emission.

2.3.3 *Conveyor Corridor*

The final design for the associated conveyor corridor is based largely on comments generated by NEPA in discussion in November 2008. The previous alternative as outlined in the Analysis of Alternatives section (Section 3) showed a proposed conveyor corridor bisecting the foothills of the Brazilletto Mountain and the Salt River community to enter the plains prior to turning east towards the proposed port. The habitat dynamics that would be impacted have been considered and the design now allows for routing of the conveyor corridor further west away from the residential communities. This design also reduces the impact of fragmentation on the foothills.

This EIA concerns the conveyor corridor between the plant site and the proposed port. As discussed earlier in this section, the environmental permits applicable to this EIA are based on the conveyor corridor between the plant and the proposed port, as well as, all works associated with the establishment of the proposed port such as dredging.

As proposed, the conveyance mechanism is approximately 4 km (13,000 ft) in length and 1.5 m (60 in.) wide. The conveyor will be elevated along the corridor especially where it is required to pass above roadways, cross difficult terrain (tidal flats), and over water. The conveyor belt is proposed to be approximately 1.37 m (4.5 ft) wide and for maintenance purposes, will have an unpaved walkway on one side and an unpaved walkway and roadway on the other where the conveyor is at grade. In elevated sections, the conveyor will have access walkways adjacent to the conveyor.

Figure 2-11 to **Figure 2-15** below outlines the sections of the conveyor corridor from the proposed Plant to the Proposed Port.

The total conveyor system consists of two (2) overland segments and one (1) over-sea segment. For the purpose of this report only two (2) segments are included: the overland segment from the proposed plant that links to the over-sea segment to the port. The height of the conveyance system will vary based on the underlying topography and engineering requirements. As it crosses the Salt River Main Road to Mitchell Town road (in the vicinity of the proposed plant), it would be approximately 4.3 m above the surface of the road. At the transfer points between the overland and over-sea conveyors, a transfer building with a footprint of approximately 5 m x 5 m and a height of 6 to 8 m will be installed.

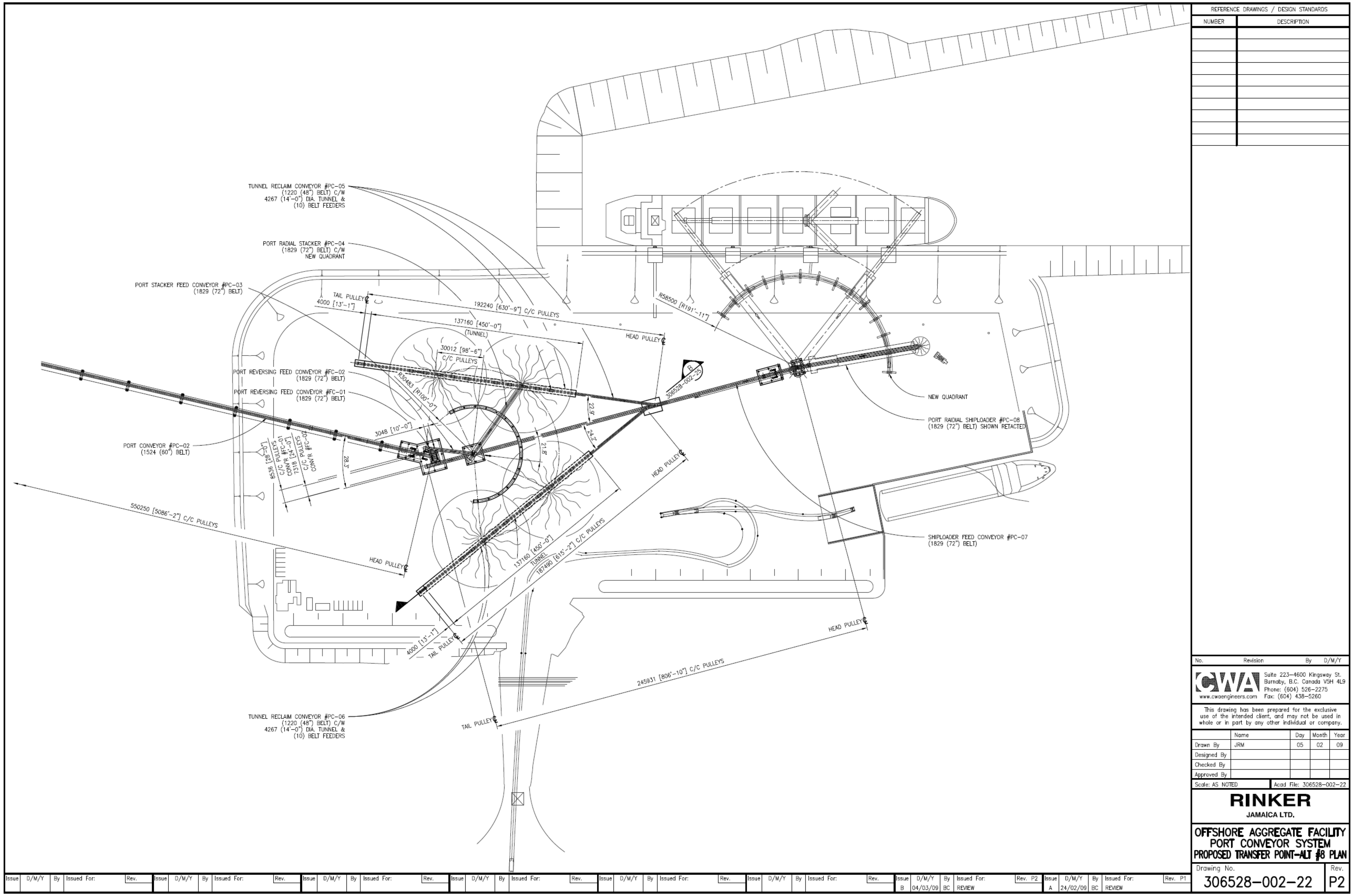


Figure 2-11: Conveyor Corridor Port End (Showing Reserve Stockpile Area)

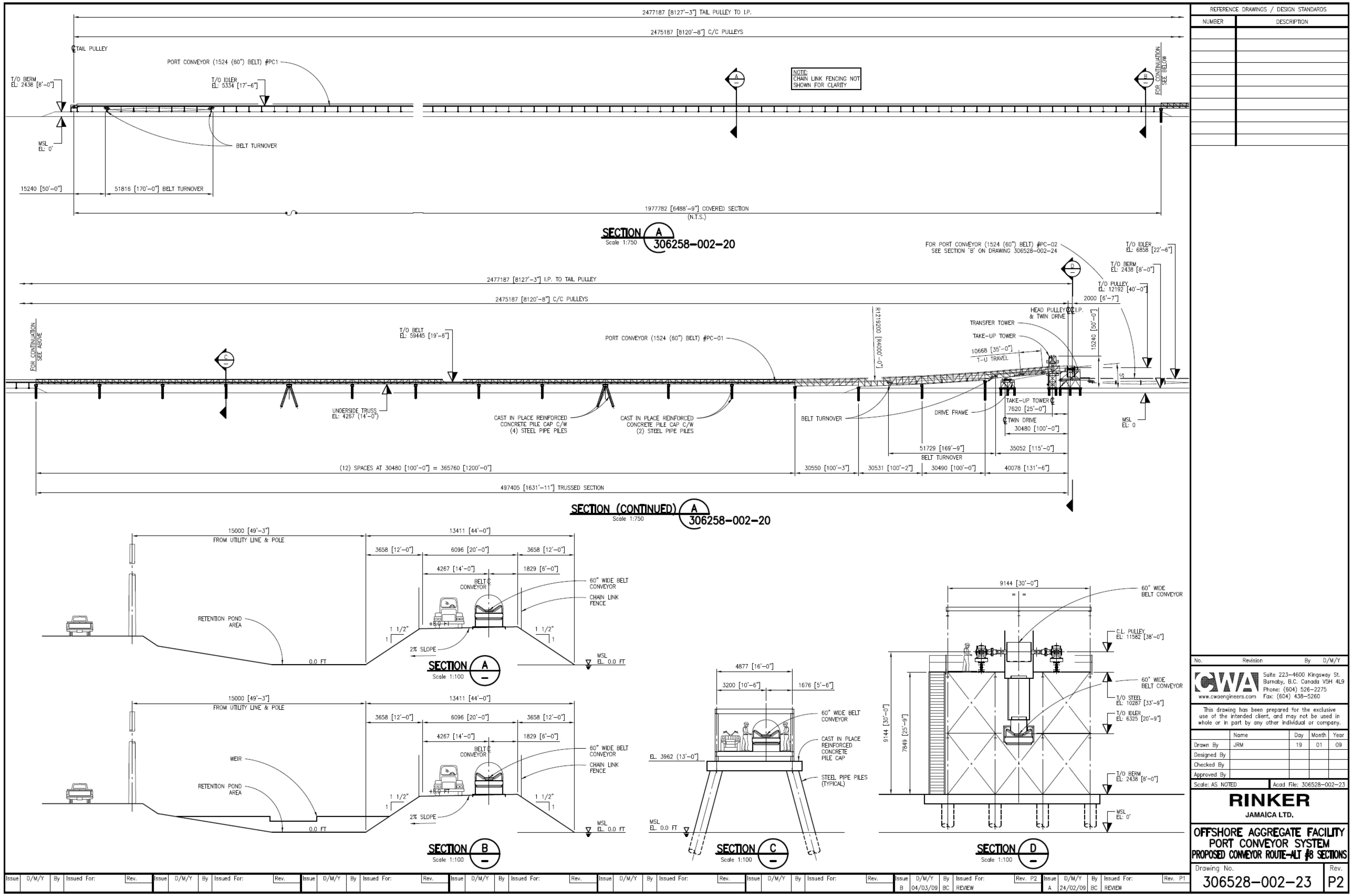


Figure 2-12: Cross section of Conveyor Corridor (Between Proposed Plant & Angle Station)

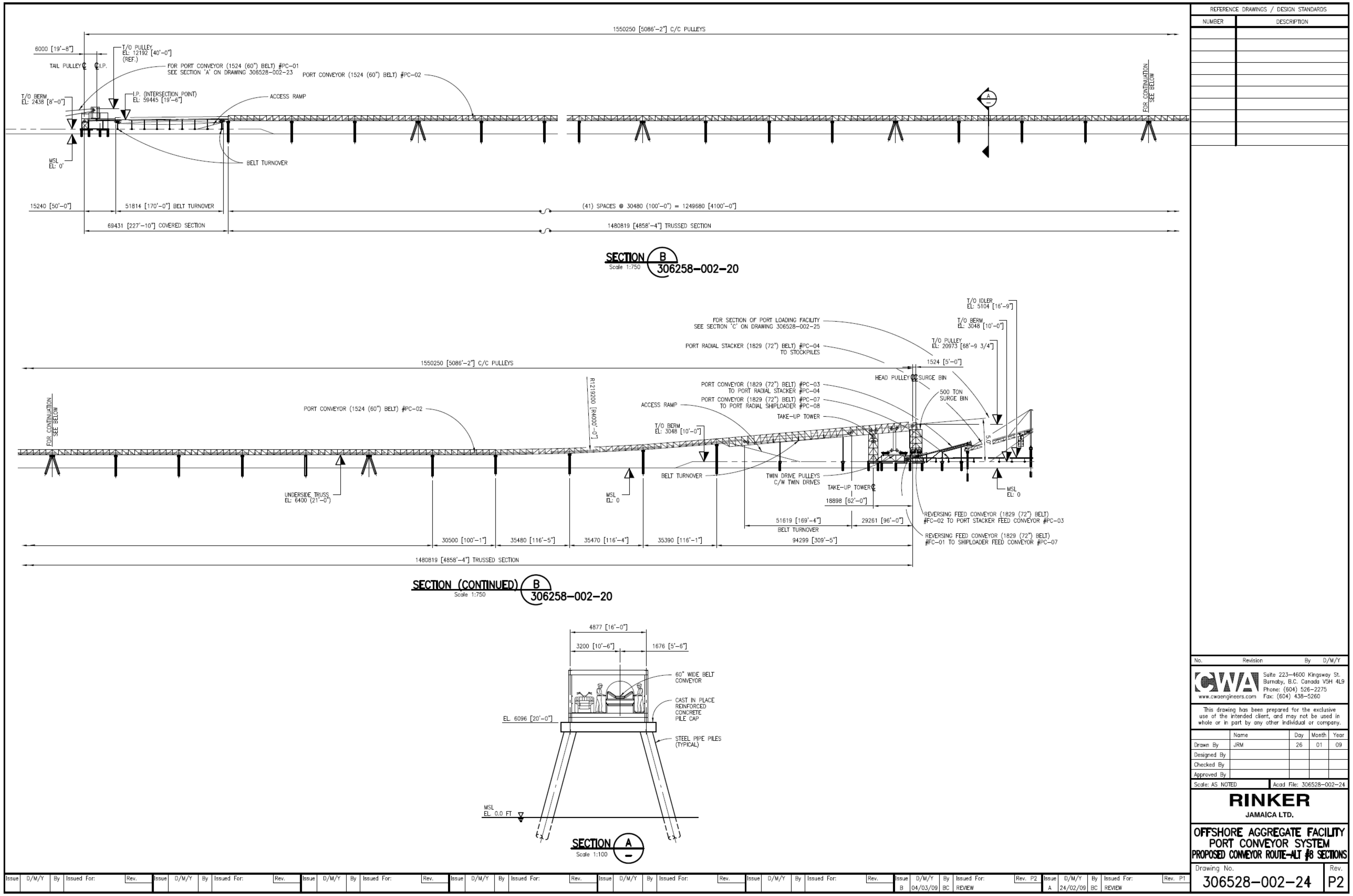


Figure 2-13: Cross Section of Conveyor Corridor (Angle Station to Port)

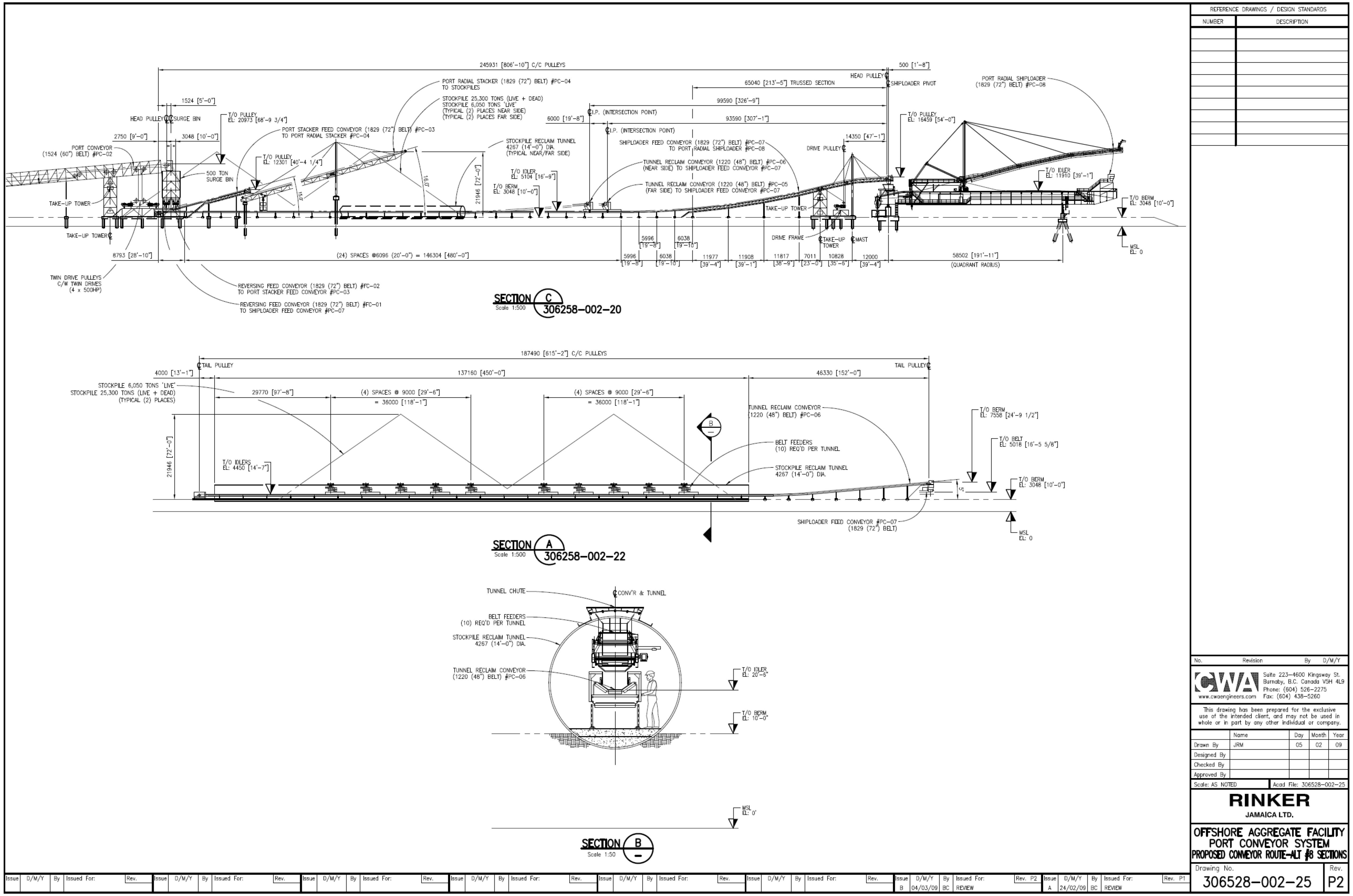


Figure 2-14: Cross Section at Reserve Stockpile to Ship (via Stacker)

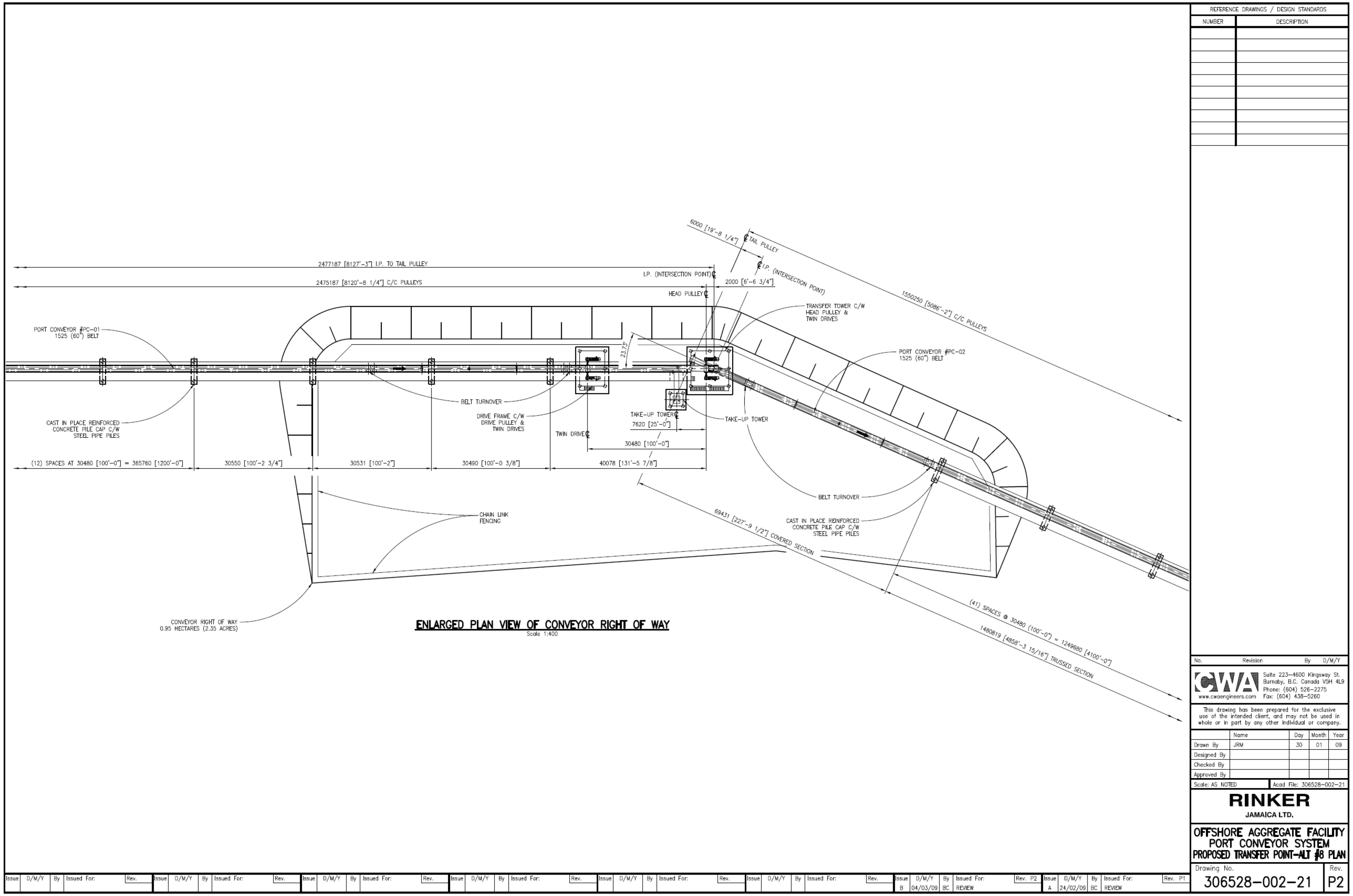


Figure 2-15: Conveyor Angle Station (Right of Way)

A Forest Retention Plan is proposed to allow the management of visual resources to be compatible with the existing and proposed activities. Specifically, the dry savannah and mangrove forested areas north of the Rocky Point Peninsula road will be retained as much as possible; the only modification being the conveyor system. The Proposed Action will not be further modified to decrease the visual impact below the existing visual quality.

The system will be installed with minimum impact on the environment and surrounding communities through the use of limited access roads and road easement of at least 15 m. All access roads and easements will be rehabilitated immediately upon completion of construction except for the gated access at various sections to allow maintenance.

The proposed operation schedule is for continuous daily operation. The system is designed to transport 5000 ton per hour of limestone. In comparison it would require 200 haulage trucks of 25 ton capacity every hour to match that performance, which is unrealistic. This option is the preferred alternative due to the lower environmental, security, health and safety risks, as well as, low maintenance cost (over the anticipated lifespan of the operations) and the fact that it meets the material handling requirements.

The entire length of the conveyor will be hooded to protect against the effects of wind and rain. Where the system crosses a roadway the conveyor will be fully enclosed, to reduce impacts such as noise and dispersion.

Summary:

- Belt width – 1.37 (4.5 ft)
- Speed – 700 fpm
- Idler spacing – 1.2-1.52 m (4-5 ft)
- Capacity – 5000 stph

Conveyor sections that cross roads will be fully enclosed to minimize noise (Typical overland conveyor shown below - **Plate 2-3**).

Plate 2-3: Typical Covered & Elevated Conveyor [Port Canaveral - USA]

2.3.3.1 Basic Conveyor Safety

The information contained below shall be used as guidelines for safe operation and maintenance of typical belt conveyors. The following general guidelines are not extracted directly from, and cannot take the place of, the more complete and detailed information available in the ANSI Standards B20.1 and B15.1 to which RINKER/CEMEX subscribes internationally.

Safety, Operation, and Maintenance of Belt Conveyors:

1. This conveyor is designed to start and stop automatically. Warning start-up horns shall be installed to alert operators of impending start-up of the conveyor.
2. The area where the conveyor is installed shall be restricted to authorized personnel who are adequately trained in the operation and performance of the conveyor. Warning signs shall be posted in the area of the conveyor. All persons shall be barred by appropriate means from entering an area where falling material may present a hazard. Warning signs and barricades shall be used.
3. At no time shall the conveyor be used to handle material other than what was originally specified. The design capacity rating and belt speed shall not be exceeded. Belt conveyors, when appropriately designed, installed, and operated, will perform continuously and dependably with as few as one or two operators. One basic requisite is that the material being handled by the conveyor has the originally specified physical properties and is fed uniformly and at the design rate.
4. The conveyor shall not be operated at any time with any guards removed. Guards, safety devices, and warning signs will be maintained in their proper positions and in good working order. No one should be allowed to ride on a moving or operable conveyor. Poking at or prodding material on the belt or any component of a moving conveyor shall be prohibited.
5. The conveyor is equipped with pullcord cables and safety switches along accessible sides. The conveyor shall never be operated with the safety switches disconnected or bypassed out of the automation system's motor control circuits. Performance of a system shall be continuously monitored by a combination of modern electrical controls, built-in safety sensors and devices, closed-circuit TV, and other signal systems.
6. The conveyor drive shall be stopped and locked out before performing any maintenance on the conveyor, including lubrication of bearings, adjustment of the belt cleaners, etc. Where it is impractical to lock out the conveyors prior to performing a maintenance activity, such as during lubrication of the idlers on the overland conveyor, the conveyor shall be stopped and operations personnel notified in advance of beginning the activity. Conveyors shall not be re-started until it is verified that the maintenance crew is clear of the area. Special lubricating equipment and lube extensions shall be installed so as to permit lubrication of an operating conveyor without any foreseeable hazards.

7. Good housekeeping is a prerequisite for safe conditions. All areas around the conveyor shall be kept free of debris, obstacles or spilled material. Depending on the length and complexity of the conveying system, one or perhaps two trained mechanics should patrol the system at regular intervals to detect any conditions or components that need attention. The surrounding areas shall be kept free of obstructions or materials that could impede ready access and a clear view of such safety equipment on a regular basis. The checkup should include all mechanical and electrical operating equipment, plus the structures, walkways, ladders, stairs and access ways. A "walking inspection" of a belt conveyor system is a good means by which well-trained maintenance personnel can often detect potential problems from any unusual sounds made by such components as idlers, pulleys, shafts, bearings, drives, belts, and belt splices.
8. Good lighting contributes to a safe working environment.

2.3.4 *Dredging Works*

Construction of the proposed RINKER berth at Rocky Point requires dredging an approximately 1524 m (5,000 ft) long navigation channel extending from the 14 m (46 ft), MLLW depth contour in the offshore areas to the proposed berth. A recent bathymetric survey conducted by CEAC (2007) indicated that a small area near the main ship channel entrance needs to be dredged. The dredged material will be dewatered and contained in an on-site Dredged Material Containment Area (DMCA) located adjacent to the proposed berth. Following completion of dredging and filling of the DMCA, the containment area will be beneficially reused to create a work area. This section outlines the methodology and design practices that will be used during the dredging and the construction of the DMCA including the containment dike and protective rock revetment.

The foreshore will be dredged using a hydraulic dredge and/or mechanically operated clamshell dredge to provide sufficient draft so that the loaded vessels will not run aground on their entry to the dock. The origin coordinates for this area can be considered as 129,750 N and 234,000 E; coordinates are based on reference station Rocky Point Pier Coordinates 129,806.33 N, 234,870.15 E.

Dredging will be done, as much as possible, using locally available equipment including those utilised by JAMALCO for maintenance dredging. This may include barge mounted cranes with large buckets for removal of spoil.

Alternatives for management of dredged materials are anticipated to include:

1) On land backfilling for proposed port infrastructure

2) Discard the spoil at an approved dump site on land, or at a facility specifically authorised for land filling of dredge spoil

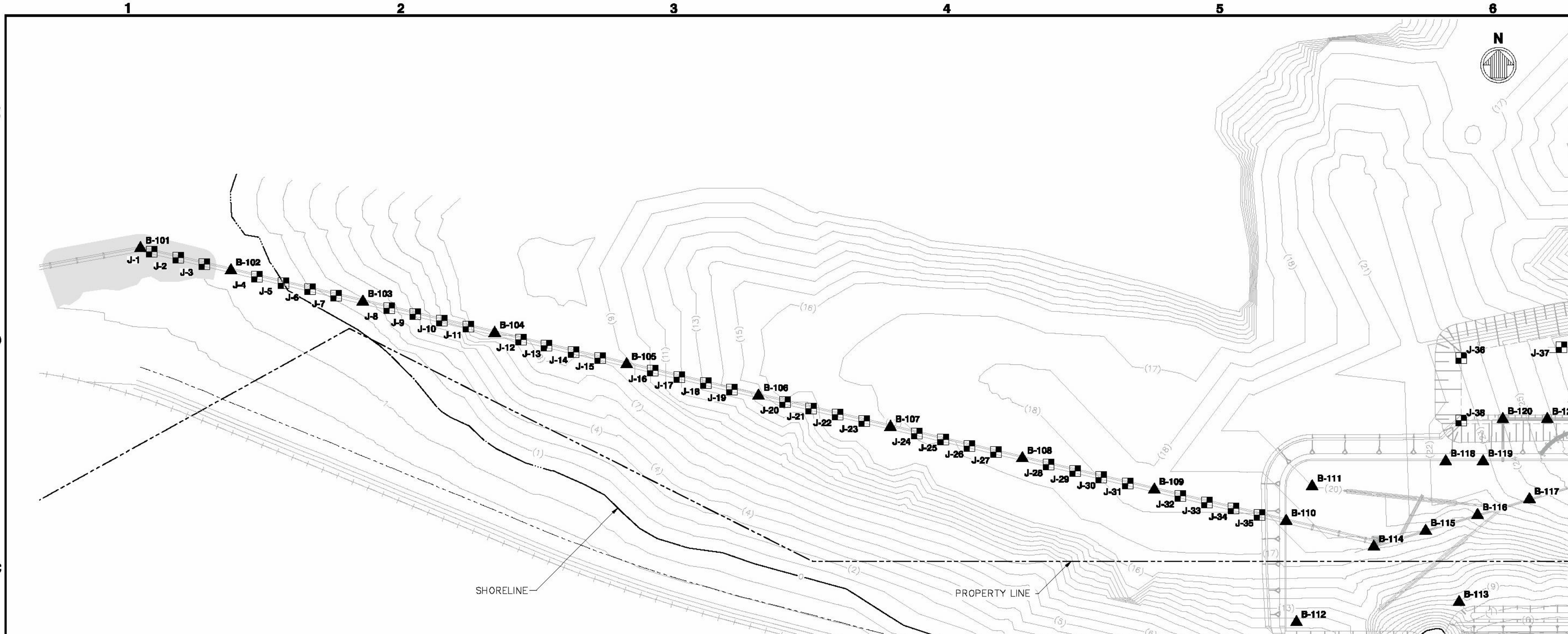
Alternative 1 will be used in conjunction with crushed aggregate to finish area for the proposed port. Alternative 2 is proposed for use in conjunction with proposed mitigation for seagrass in the immediate area west of the proposed port, as outlined in the Impact Identification and Mitigation section of this report (Section 6).

Near-shore construction may include such heavy construction activities as infilling, sheet pile wall installation, rock fill installation, and intake/outfall canals and/or pipe installation. These activities will be managed in a way to minimise the risks to the marine environment. Important features include shoreline integrity, habitat, water quality, and aesthetic qualities. Protective measures will include measures for spill control, runoff management, erosion control, sediment control, and other means of protection.

2.3.4.1 Methodology

The proposed berth design includes dredging of approximately 24 hectares (60 acres) of bay bottom to a depth of -14 m, MLLW. The volume of material to be dredged is approximately 0.688 million cubic metres (0.9 million cubic yards). Dredging will be conducted by a hydraulic dredge and/or mechanically using a clamshell dredge depending on the available equipment, schedule and cost. Dredged material will be transferred by barge or pipeline to the DMCA.

Golder Associates (2005) performed geotechnical analyses near the project site. The analyses indicate the presence of granular material extending 30-40 feet below the sea bottom which then transitions to clayey material. Additional geotechnical testing will be conducted as outlined in **Figure 2-17** to further determine the grain size/composition of the bay bottom material. Geotechnically suitable material will be placed in the DMCA for use as fill on site. Unsuitable material will be disposed of in an approved off-site disposal facility. Once the DMCA is completed, additional clean fill material may be added to provide necessary elevation against wave overtopping.



JET PROBE POINT TABLE

POINT #	LATITUDE	LONGITUDE
J–1	N17° 49' 27.09"	W77° 09' 49.07"
J–2	N17° 49' 26.87"	W77° 09' 48.06"
J–3	N17° 49' 26.66"	W77° 09' 47.05"
J–4	N17° 49' 26.22"	W77° 09' 45.03"
J–5	N17° 49' 26.00"	W77° 09' 44.02"
J–6	N17° 49' 25.79"	W77° 09' 43.01"
J–7	N17° 49' 25.57"	W77° 09' 42.00"
J–10	N17° 49' 24.70"	W77° 09' 37.96"
J–11	N17° 49' 24.48"	W77° 09' 36.95"
J–8	N17° 49' 25.13"	W77° 09' 39.98"
J–9	N17° 49' 24.91"	W77° 09' 38.97"
J–14	N17° 49' 23.61"	W77° 09' 32.92"
J–15	N17° 49' 23.39"	W77° 09' 31.91"
J–12	N17° 49' 24.04"	W77° 09' 34.94"

JET PROBE POINT TABLE

POINT #	LATITUDE	LONGITUDE
J–13	N17° 49' 23.83"	W77° 09' 33.95"
J–18	N17° 49' 22.52"	W77° 09' 27.87"
J–19	N17° 49' 22.30"	W77° 09' 26.86"
J–16	N17° 49' 22.96"	W77° 09' 29.89"
J–17	N17° 49' 22.74"	W77° 09' 28.88"
J–22	N17° 49' 21.43"	W77° 09' 22.82"
J–23	N17° 49' 21.22"	W77° 09' 21.81"
J–20	N17° 49' 21.87"	W77° 09' 24.84"
J–21	N17° 49' 21.65"	W77° 09' 23.83"
J–26	N17° 49' 20.34"	W77° 09' 17.77"
J–27	N17° 49' 20.13"	W77° 09' 16.76"
J–24	N17° 49' 20.78"	W77° 09' 19.79"
J–25	N17° 49' 20.56"	W77° 09' 18.78"
J–30	N17° 49' 19.26"	W77° 09' 12.73"

JET PROBE POINT TABLE

POINT #	LATITUDE	LONGITUDE
J–31	N17° 49' 19.04"	W77° 09' 11.72"
J–28	N17° 49' 19.69"	W77° 09' 14.74"
J–29	N17° 49' 19.47"	W77° 09' 13.74"
J–34	N17° 49' 18.17"	W77° 09' 07.68"
J–35	N17° 49' 17.95"	W77° 09' 06.67"
J–32	N17° 49' 18.60"	W77° 09' 09.70"
J–33	N17° 49' 18.39"	W77° 09' 08.69"
J–36	N17° 49' 23.76"	W77° 08' 59.05"
J–37	N17° 49' 24.19"	W77° 08' 55.21"
J–38	N17° 49' 21.47"	W77° 08' 59.02"

BORING PROBE POINT TABLE 150 FEET BELOW MLLW

POINT #	LATITUDE	LONGITUDE
B–101	N17° 49' 27.21"	W77° 09' 49.50"
B–102	N17° 49' 26.44"	W77° 09' 46.04"
B–103	N17° 49' 25.35"	W77° 09' 40.99"
B–104	N17° 49' 24.26"	W77° 09' 35.95"
B–105	N17° 49' 23.17"	W77° 09' 30.90"
B–106	N17° 49' 22.09"	W77° 09' 25.85"
B–107	N17° 49' 21.00"	W77° 09' 20.80"
B–108	N17° 49' 19.91"	W77° 09' 15.75"
B–109	N17° 49' 18.82"	W77° 09' 10.71"
B–110	N17° 49' 17.73"	W77° 09' 05.66"
B–111	N17° 49' 19.01"	W77° 09' 04.68"
B–112	N17° 49' 14.04"	W77° 09' 05.22"

BORING PROBE POINT TABLE 150 FEET BELOW MLLW

POINT #	LATITUDE	LONGITUDE
B–113	N17° 49' 14.84"	W77° 08' 59.03"
B–114	N17° 49' 16.83"	W77° 09' 02.30"
B–115	N17° 49' 17.43"	W77° 09' 00.33"
B–116	N17° 49' 18.03"	W77° 08' 58.36"
B–117	N17° 49' 18.63"	W77° 08' 56.38"
B–118	N17° 49' 19.97"	W77° 08' 59.60"
B–119	N17° 49' 19.99"	W77° 08' 58.17"
B–120	N17° 49' 21.54"	W77° 08' 57.44"
B–121	N17° 49' 21.56"	W77° 08' 55.74"

LEGEND:

- JET PROBING LOCATION
- ▲ BORING 150 FT BELOW MLLW

NOTES:

1. ELEVATIONS REFERENCED TO MEAN LOWER LOW WATER (MLLW).
2. ALL DIMENSIONS IN FEET UNLESS OTHERWISE NOTED.
3. CONTOUR DEPTHS SHOWN IN FEET.
4. PROPOSED WORK SHOWN FOR REFERENCE ONLY.
5. CONTRACTOR SHALL PERFORM BORINGS SHOWN AND SUBMIT LOGS TO THE ENGINEER FOR REVIEW PRIOR TO JET PROBES. ADDITIONAL BORINGS MAY BE REQUIRED BASED ON THE EVALUATION OF THE INITIAL BORINGS.

200' 0' 200' 400'
SCALE: 1"=200'

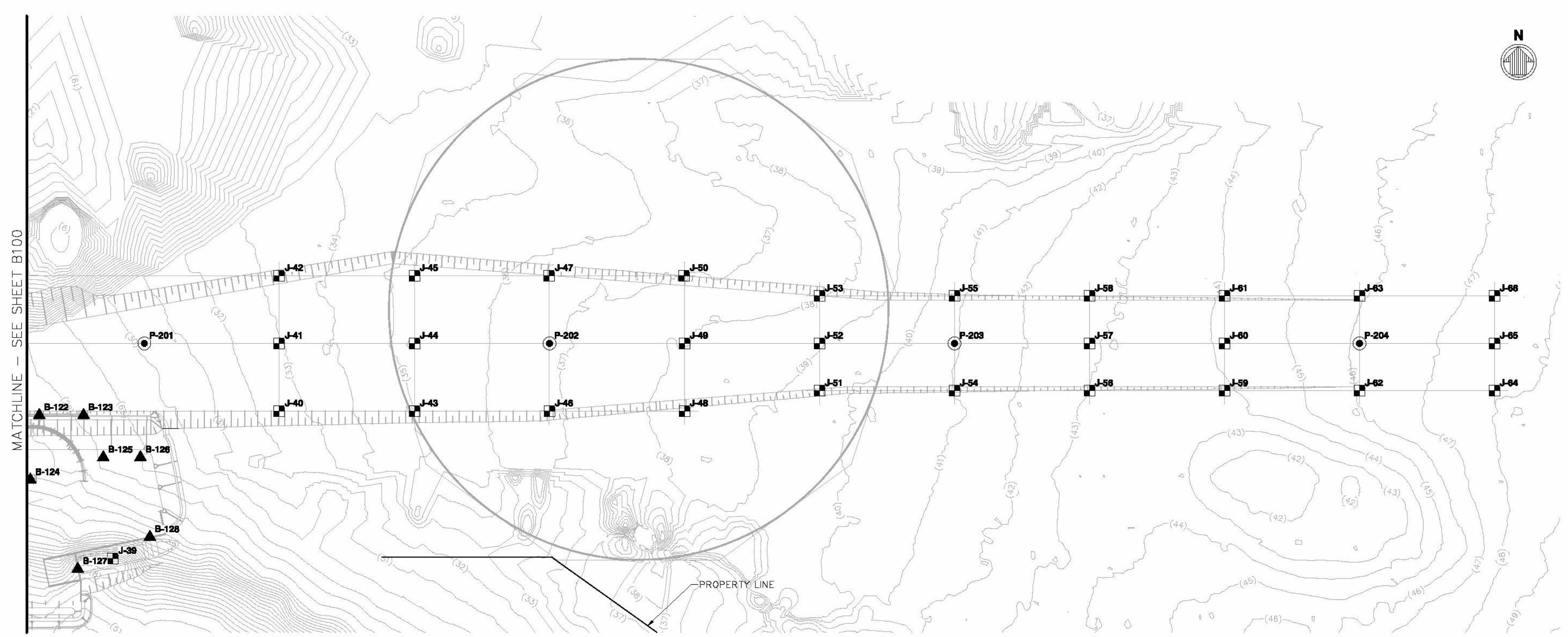
ISSUED FOR PERMITTING
NOT TO BE USED FOR CONSTRUCTION
27 FEBRUARY 2009

RINKER JAMAICA LIMITED

ROCKY POINT AGGREGATE TERMINAL
MARINE BORING LOCATIONS PLAN (1 OF 2)

Sheet Reference Number: **B100**
Sheet 4 of 24

Figure 2-16: Proposed Jet Probe and Borehole Locations for the Conveyor Corridor (Marine Extent) and Port



LEGEND:

- JET PROBING LOCATION
- BORING 150 FT BELOW MLLW
- BORING 50 FT BELOW MLLW

NOTES:

1. ELEVATIONS REFERENCED TO MEAN LOWER LOW WATER (MLLW).
2. ALL DIMENSIONS IN FEET UNLESS OTHERWISE NOTED.
3. CONTOUR DEPTHS SHOWN IN FEET.
4. PROPOSED WORK SHOWN FOR REFERENCE ONLY.
5. CONTRACTOR SHALL PERFORM BORINGS SHOWN AND SUBMIT LOGS TO THE ENGINEER FOR REVIEW PRIOR TO JET PROBES. ADDITIONAL BORINGS MAY BE REQUIRED BASED ON THE EVALUATION OF THE INITIAL BORINGS.

JET PROBE POINT TABLE

POINT #	LATITUDE	LONGITUDE
J–39	N17° 49' 16.36"	W77° 08' 51.15"
J–40	N17° 49' 21.83"	W77° 08' 44.84"
J–41	N17° 49' 24.31"	W77° 08' 44.87"
J–42	N17° 49' 26.79"	W77° 08' 44.90"
J–43	N17° 49' 21.89"	W77° 08' 39.66"
J–44	N17° 49' 24.37"	W77° 08' 39.69"
J–45	N17° 49' 26.84"	W77° 08' 39.72"
J–46	N17° 49' 21.94"	W77° 08' 34.49"
J–47	N17° 49' 26.90"	W77° 08' 34.55"
J–48	N17° 49' 22.00"	W77° 08' 29.31"
J–49	N17° 49' 24.48"	W77° 08' 29.34"
J–50	N17° 49' 26.96"	W77° 08' 29.38"
J–51	N17° 49' 22.80"	W77° 08' 24.15"
J–52	N17° 49' 24.54"	W77° 08' 24.17"

JET PROBE POINT TABLE

POINT #	LATITUDE	LONGITUDE
J–53	N17° 49' 26.27"	W77° 08' 24.19"
J–54	N17° 49' 22.86"	W77° 08' 18.98"
J–55	N17° 49' 26.33"	W77° 08' 19.02"
J–56	N17° 49' 22.91"	W77° 08' 13.80"
J–57	N17° 49' 24.65"	W77° 08' 13.82"
J–58	N17° 49' 26.38"	W77° 08' 13.84"
J–59	N17° 49' 22.97"	W77° 08' 08.63"
J–60	N17° 49' 24.71"	W77° 08' 08.65"
J–61	N17° 49' 26.44"	W77° 08' 08.67"
J–63	N17° 49' 26.50"	W77° 08' 03.50"
J–62	N17° 49' 23.03"	W77° 08' 03.45"
J–64	N17° 49' 23.08"	W77° 07' 58.28"
J–65	N17° 49' 24.82"	W77° 07' 58.30"
J–66	N17° 49' 26.55"	W77° 07' 58.32"

BORING PROBE POINT TABLE 150 FEET BELOW MLLW

POINT #	LATITUDE	LONGITUDE
B–122	N17° 49' 21.58"	W77° 08' 54.04"
B–123	N17° 49' 21.60"	W77° 08' 52.34"
B–124	N17° 49' 19.22"	W77° 08' 54.36"
B–125	N17° 49' 20.06"	W77° 08' 51.57"
B–126	N17° 49' 20.08"	W77° 08' 50.14"
B–127	N17° 49' 15.97"	W77° 08' 52.50"
B–128	N17° 49' 17.16"	W77° 08' 49.75"

BORING PROBE POINT TABLE 50 FEET BELOW MLLW

POINT #	LATITUDE	LONGITUDE
P–201	N17° 49' 24.25"	W77° 08' 50.04"
P–202	N17° 49' 24.42"	W77° 08' 34.52"
P–203	N17° 49' 24.59"	W77° 08' 19.00"
P–204	N17° 49' 24.76"	W77° 08' 03.48"

SCALE: 1"=200'

ISSUED FOR PERMITTING
NOT TO BE USED FOR CONSTRUCTION
27 FEBRUARY 2009

RINKER JAMAICA LIMITED

ROCKY POINT AGGREGATE TERMINAL
MARINE BORING LOCATIONS PLAN (2 OF 2)

MOFFATT & NICHOL

Sheet Reference Number: B101
Sheet 3 of 24

Figure 2-17: Proposed Jet Probe and Borehole Locations for the Port, Turning Basin and Ship Channel

2.3.4.2 Dredge Spoil Handling and Disposal

2.3.4.2.1 Turbidity Control

To meet NEPA Standards for water quality, turbidity curtains will be installed prior to dredging and the construction of the proposed marine structures and rock armour shoreline stabilization to contain suspended sediment within the work area. Turbidity monitoring will be performed during dredging and construction. Dredging work will be altered or temporarily suspended when turbidity readings exceed the background readings by more than the allowable limit specified by local permitting agency NEPA standard for TSS is all times <150 mg/l and monthly average of 50 mg/l.

2.3.4.3 Dredged Material Containment Area

The proposed dredged material containment area is designed to accommodate the expected volume of dredged material from the approach channel and berth. The containment area encompasses approximately 12 hectares (30 acres) and accommodates approximately 0.84 million cubic metres (1.1 million cubic yards) of material at the designed crest elevation of +3.0 m (+10 feet) MLLW. A perimeter riveted dike is proposed to contain the material during initial placement.

2.3.4.3.1 Perimeter Dike

The proposed perimeter dike design geometry includes toe protection, a core constructed of crushed rock from nearby quarry, a rubble mound revetment on the side slope, and a horizontal crest armoured with rock (outlined in subsequent sections). The dikes are designed to withstand a major storm event including elevated water levels and waves.

Toe protection is normally an integral part of the revetment structure and is designed to prevent undermining of the revetment by wave and/or current-induced scour. At shallow areas, the toe serves as a berm which helps to limit wave run-up and overtopping. The protective revetment serves to hold the dike core in place and is often comprised of several layers of rock armouring. In addition, the dike crest is armoured to protect against wave overtopping.

2.3.4.3.2 Geotechnical Factors

The main geotechnical factors that should be evaluated in the design of the containment dikes include:

- Macro-instability of slopes due to failure along circular or straight sliding surfaces
- Settlements and horizontal deformations due to the self weight of the structure
- Micro-instability of slopes caused by groundwater seepage out of the slope face
- Piping or internal erosion due to seepage flow underneath the structure

- Liquefaction caused by erosion (flow down the side slopes) or by cyclic loading wave actions or earthquakes
- Erosion of revetments at the outer slopes (or underwater slopes) due to unstable filters or local failure of top layer elements

The design conditions most germane to the overall planning of the dike designs are: (1) slope stability which dictates maximum allowable combinations of side slopes and structure heights and (2) settlement which influences the initial and final crest elevation of the dike. The preliminary geotechnical assessment indicates that an outer revetment slope of two horizontal to one vertical (2H: 1V) is feasible. Undercutting and replacement of foundation soil material may be required at some locations along the dike alignment.

2.3.4.3.3 Dike Height - Wave Run-up and Overtopping

The containment dike is designed to protect the reclamation area against erosion due to high water levels and waves. This often requires the structure height to be well above the maximum level of wave run-up during storm events. However, based on the nature of the facility some overtopping may be allowed and the design requirements are evaluated in terms of allowable overtopping.

Wave run-up, and more importantly, overtopping computations allow an objective means for evaluating the level of protection (i.e. allowable overtopping) offered by various dike height and armour protection combinations. In addition, wave overtopping computations provide a rational means for evaluating the relative risk of dike breaching and subsequent failure.

To evaluate the level of protection offered by a given dike configuration, it is necessary to establish limiting values of allowable overtopping. Critical or allowable overtopping discharge rates for coastal dikes and revetments are published by the United Kingdom (UK) Construction Industry Research and Information Association (CIRIA) and the Netherlands Centre for Civil Engineering Research and Codes (CUR). Similar values have also been published by Goda (2000), which are used in this study and are summarized below:

Table 2-1: Critical or allowable overtopping discharge rates for coastal dikes and revetments (Goda 2000)

Structure Type	Surface Armouring	Overtopping Rate (Litres/ms^{-1})
Type I: Coastal dike	Concrete on front slope, soil on crown and back slope	5
Type II: Coastal dike	Concrete on front slope and crown, soil on back slope	20
Type III: Coastal Dike	Concrete on front slope,	50

Structure Type	Surface Armouring	Overtopping Rate (Litres/ms^{-1})
	crown and back	
Type IV: Revetment	No pavement on ground	50
Type V: Revetment	Pavement on ground	200

Overtopping computations were used to develop required crest elevations for a "Type V: Revetment" with the assumption that the compacted sand fill inside the dikes serves as pavement. The crest elevation of the revetment was set to +4 m (+13 ft), MLLW with revetment slope and crest width specified as 1V:2H and 6 m (20 ft), respectively. This revetment configuration reduces the required fill volume while providing adequate slope protection and maintaining wave overtopping within the allowable limits.

2.3.4.3.4 Armour Stone

Armour stone sizes were computed using industry standard procedures proposed by van der Meer (1988) as outlined in Coastal Engineering Design Manual (CEM). Narrowly graded armour stones from nearby quarries will be used to create the stabilizing revetment on the perimeter dike of the DMCA. The east end of the dike is subject to higher waves compared to the areas further west. Therefore, armour rock size will be gradually reduced along the containment areas towards west. The above armour stone requirements assume that the armour layer for the dike revetments will consist of two layers of placed rock, which is an industry standard design practice.

2.3.4.3.5 Toe Scour Protection

Toe scour protection is the supplemental armouring that is placed in front of the revetment, laying on the sea floor that prevents wave energy from scouring and undercutting the front slope. Failure of the toe will generally lead to failure throughout the entire structure. Factors that affect the severity of toe scour include wave breaking, wave run-up and rundown, wave reflection and grain size distribution of the beach or bottom materials.

The toe will consist of an armour layer two stones thick above a layer of quarry run stone. The designed toe may provides additional protection to the structure by reducing overtopping as some waves will break on the toe at shallower depths prior to reaching the side slope.

2.3.4.3.6 Underlayers and Filters

Revetments are constructed with an armour layer and one or more underlayers of decreasing size. Revetments also often have a geotextile fabric separating the core of sand or clay from the underlayer stone. The geotextile fabric prevents fine grain sand from washing through the fabric. Similarly the underlayer stones should not be washed through the armour. The underlayer stone is designed to be in the range of 1/10 to 1/15 the weight of the armour weight which is consistent with the recommended rock sizes given in the CEM (2004). This results in a relatively large underlayer which has two advantages. First, a large underlayer permits surface interlocking with the armour. Second, a large underlayer gives a more permeable structure and therefore has an influence on the stability of the armour layer.

2.3.4.4 DMCA Operations

The Dredge Material Containment Area (DMCA) is designed to retain solids while allowing water used to pump the material to be released. Solids settle out from the dredge inflow by gravity. Clarified water is then discharged. The DMCA includes a clarifying pond connected to the primary containment area by an adjustable weir controlling the flow of water.

Prior to the scheduled commencement of inflow, the contractor will verify that all necessary preparations have been made to receive dredged material. This includes installation of the weir boards at the spillway. The weir crest elevation is set to a suitable elevation to accommodate the volume of settled solids expected plus the depth of pond required for adequate settling of suspended solids.

As inflow begins, the material will flow into the primary containment area with the spillway closed. The primary containment area will gradually fill and the pond elevation will rise to the established weir crest elevation. The suspended solids from the initial slurry settled out by gravity prior to water being released into the clarifying pond.

Water passing over the weir into the clarifying pond will not be removed from the clarifying pond until the measured turbidity meets the permitted levels. “Clean” water with turbidity equal to background levels will then be discharged out of the clarifying pond. Should the turbidity readings exceed the allowable limits, discharge operations shall be suspended immediately until such time that the cause of excessive turbidity has been identified and turbidity in the clarifying pond meets allowable limits.

Figure 2-18 - Figure 2-25 outlines the proposed reclamation plan, dredging plan and dredging sections for this development.

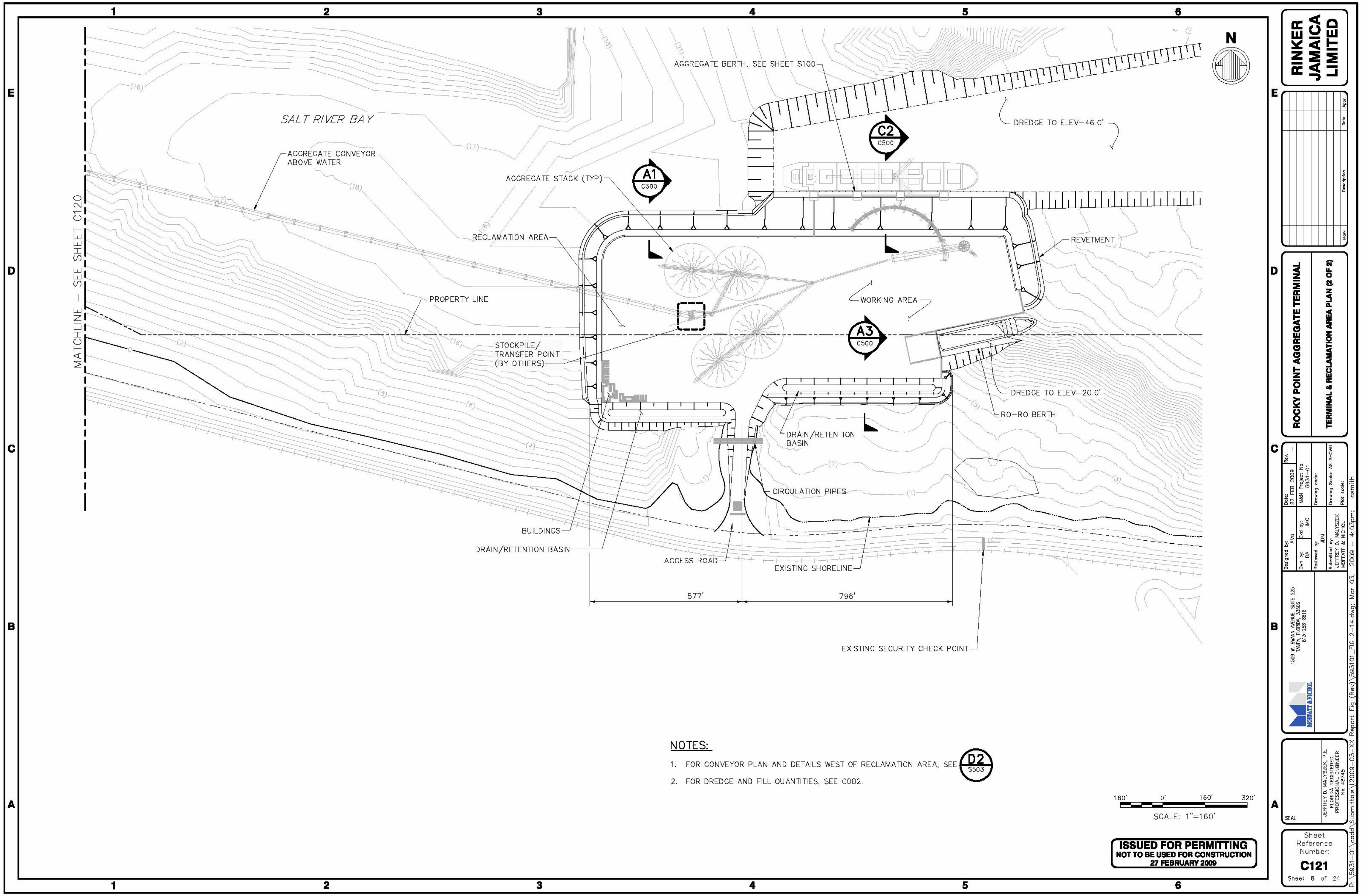


Figure 2-18: Proposed Terminal and Reclamation Areas

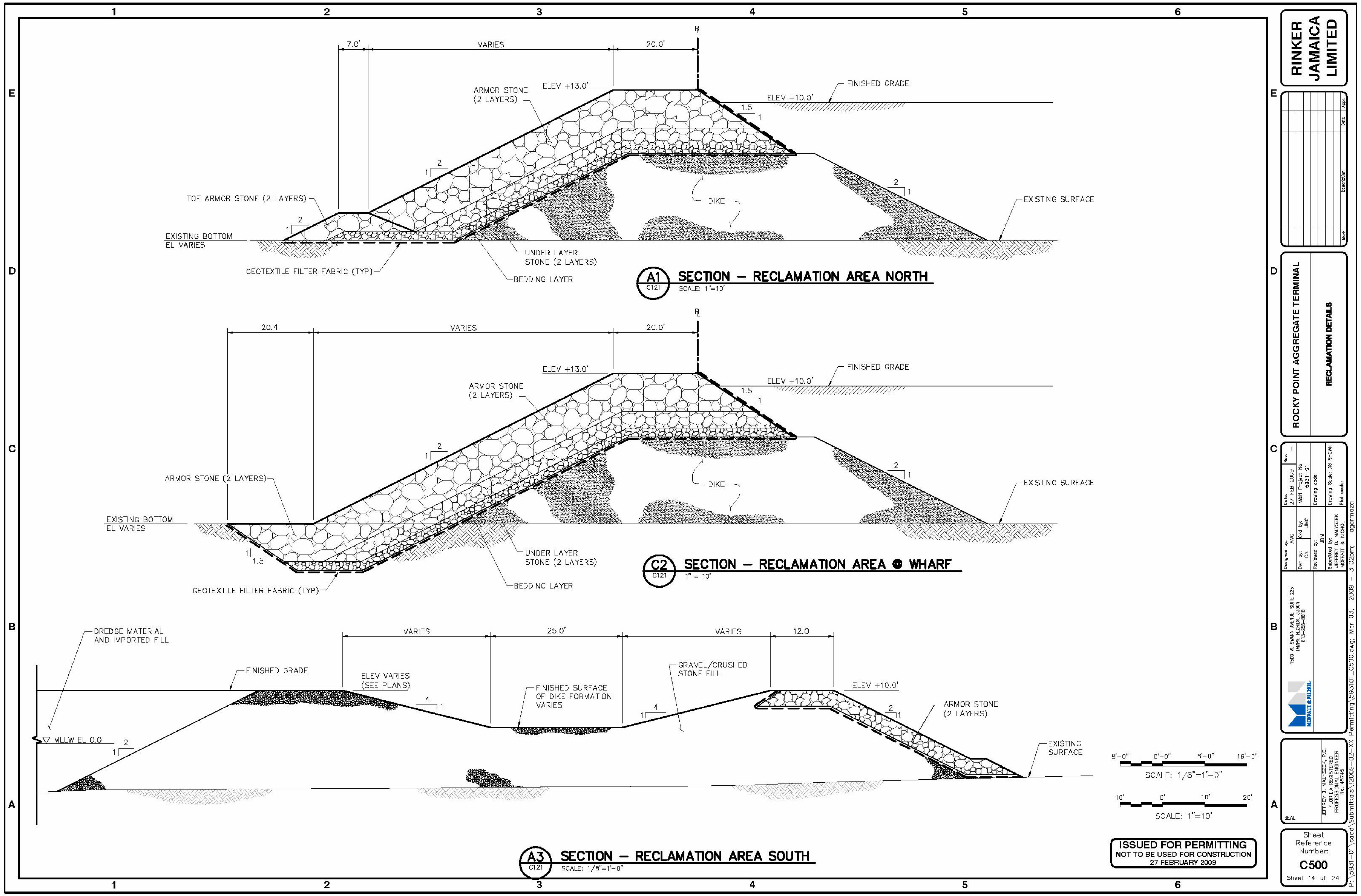


Figure 2-19: Reclamation Details

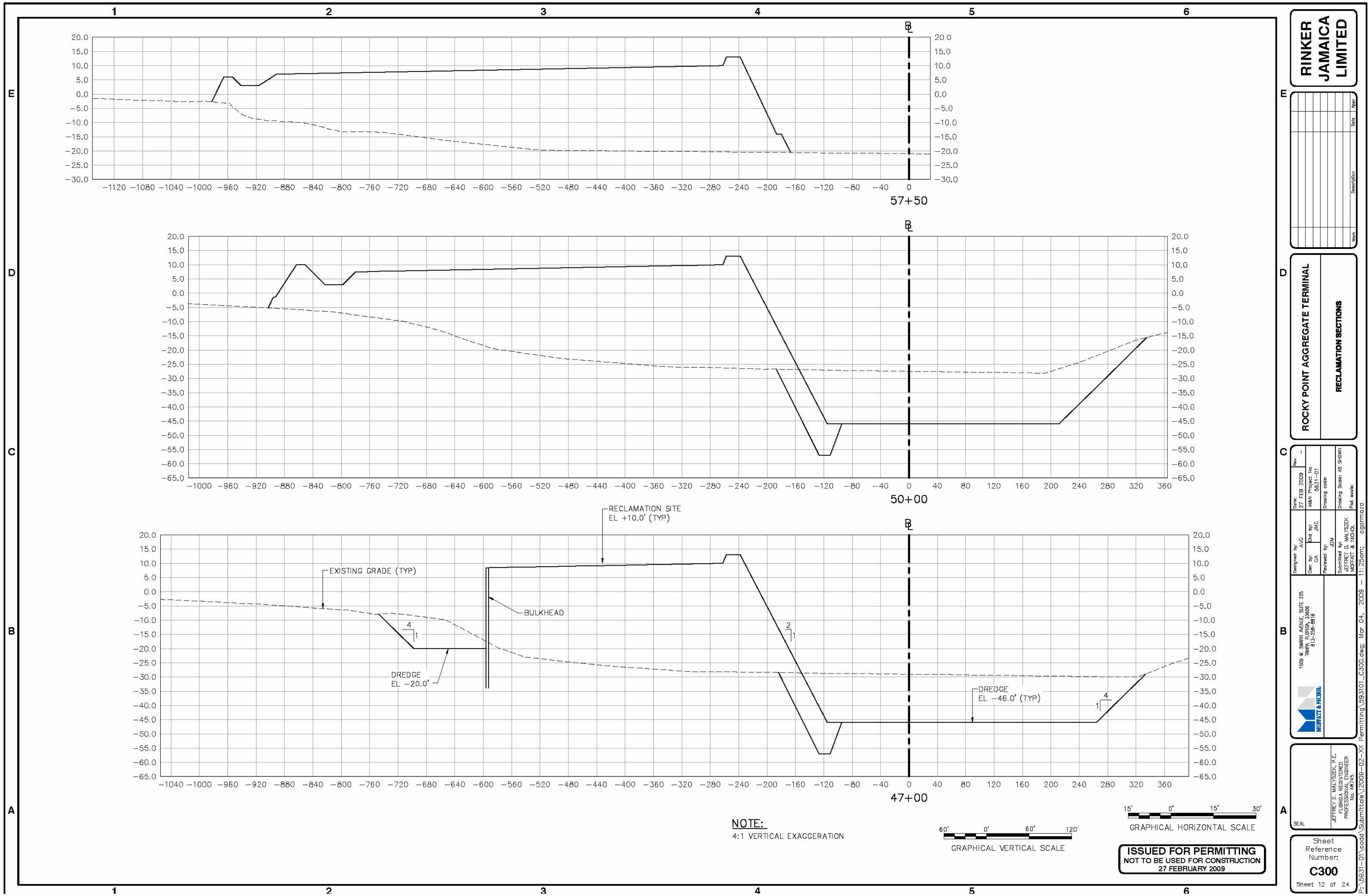


Figure 2-20: Reclamation Sections

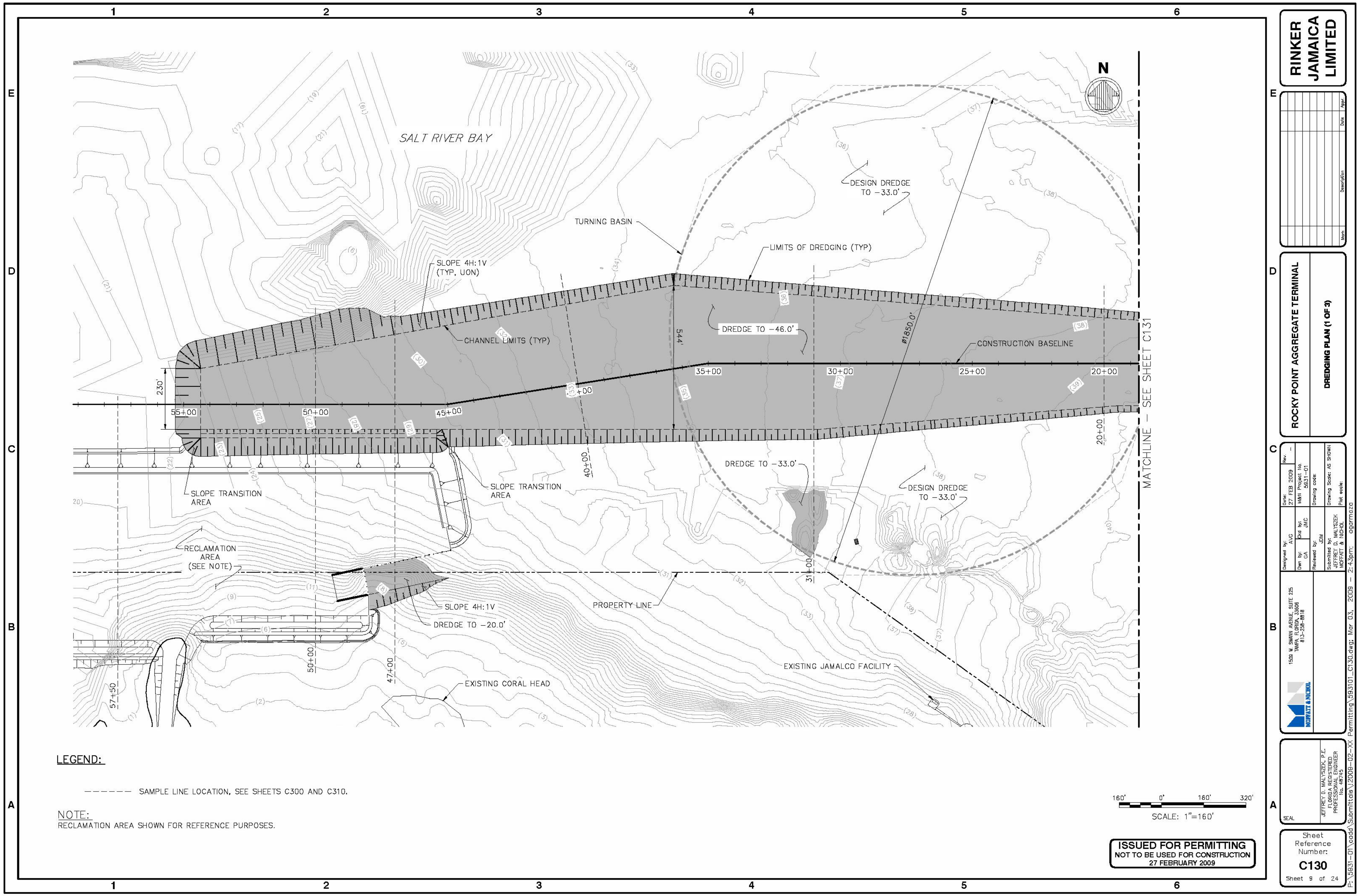


Figure 2-21: Proposed Dredge Plan (1 of 3)

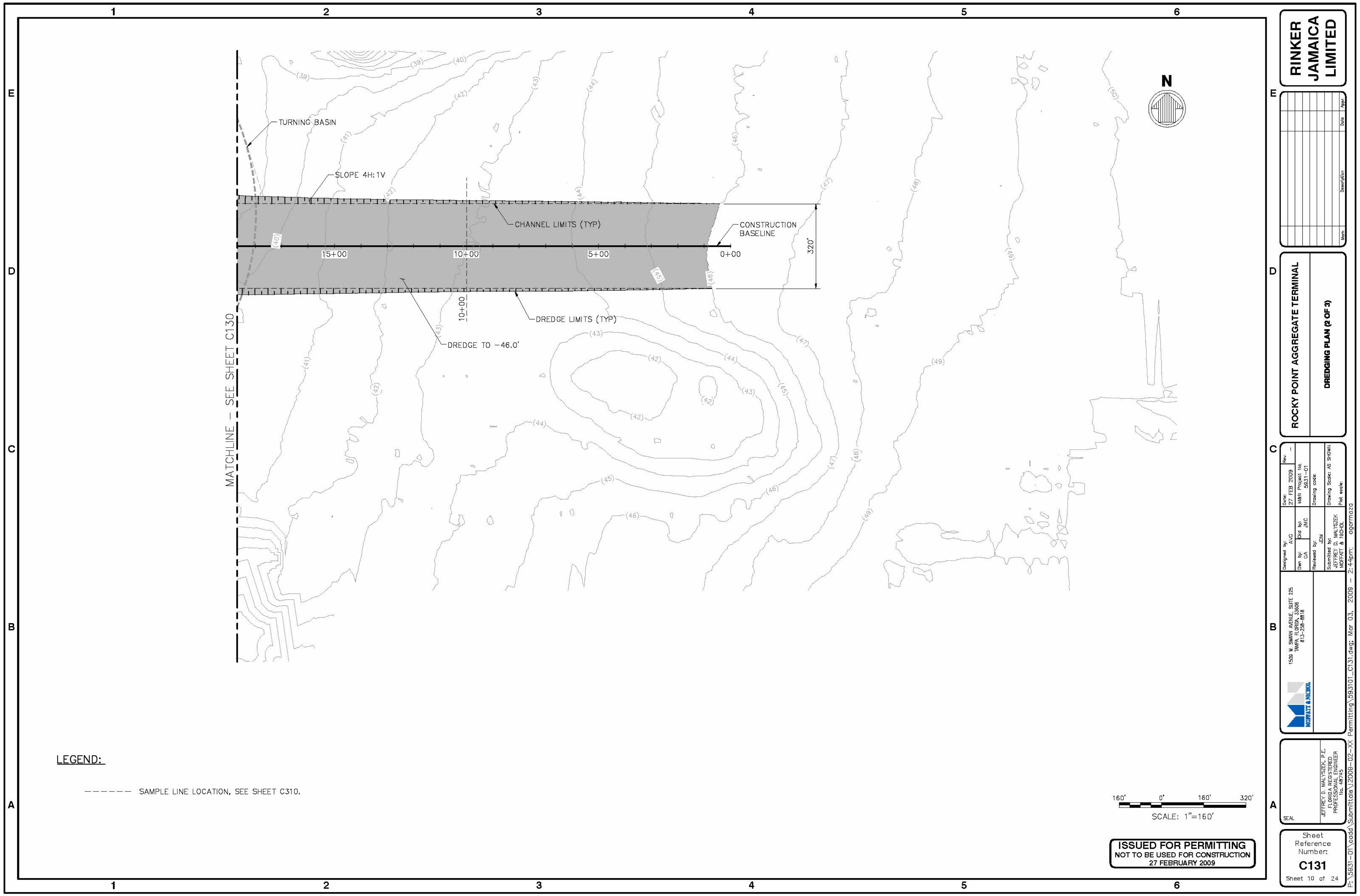


Figure 2-22: Proposed Dredge Plan (2 of 3)

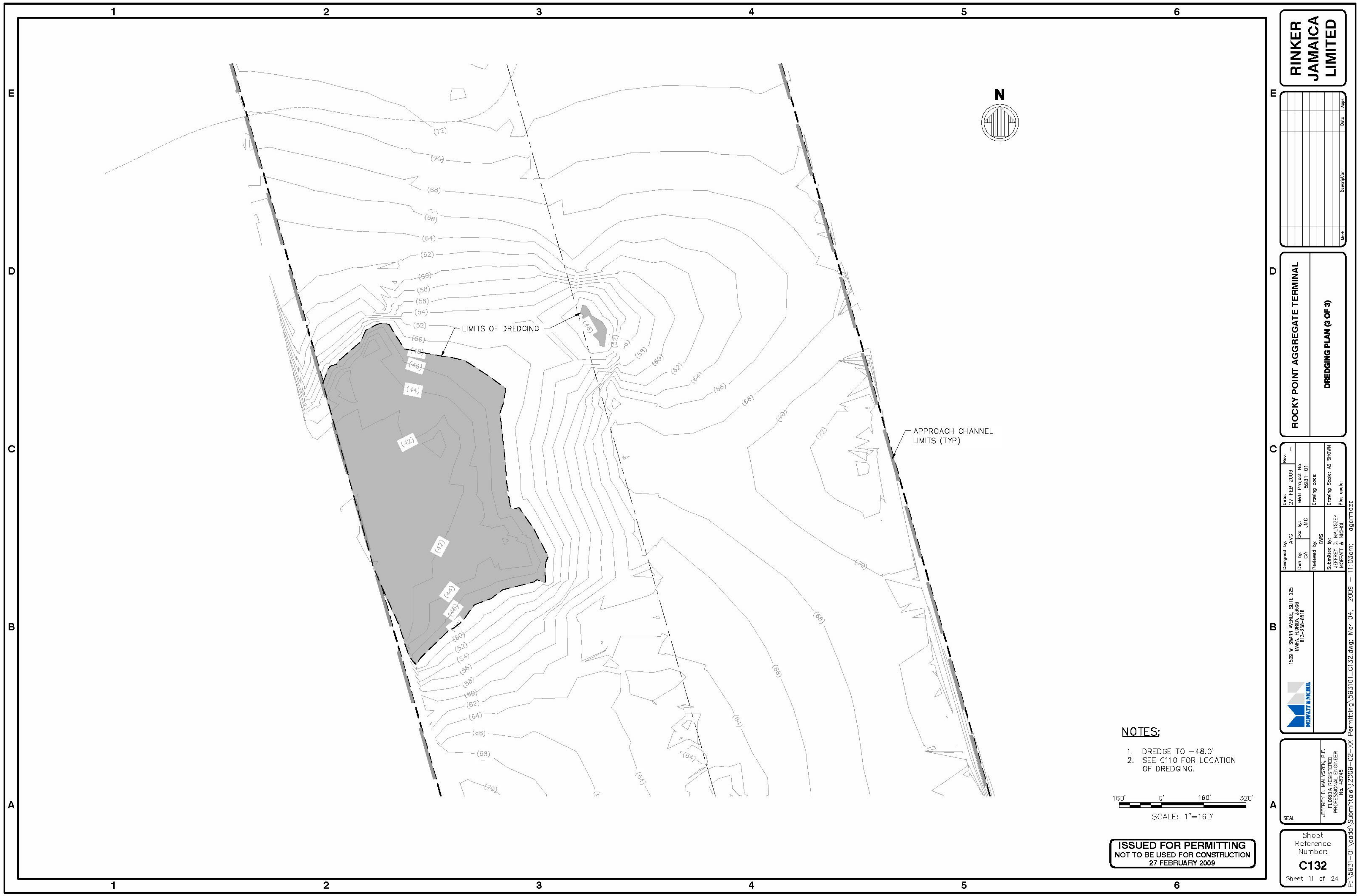


Figure 2-23: Proposed Dredge Plan (3 of 3)

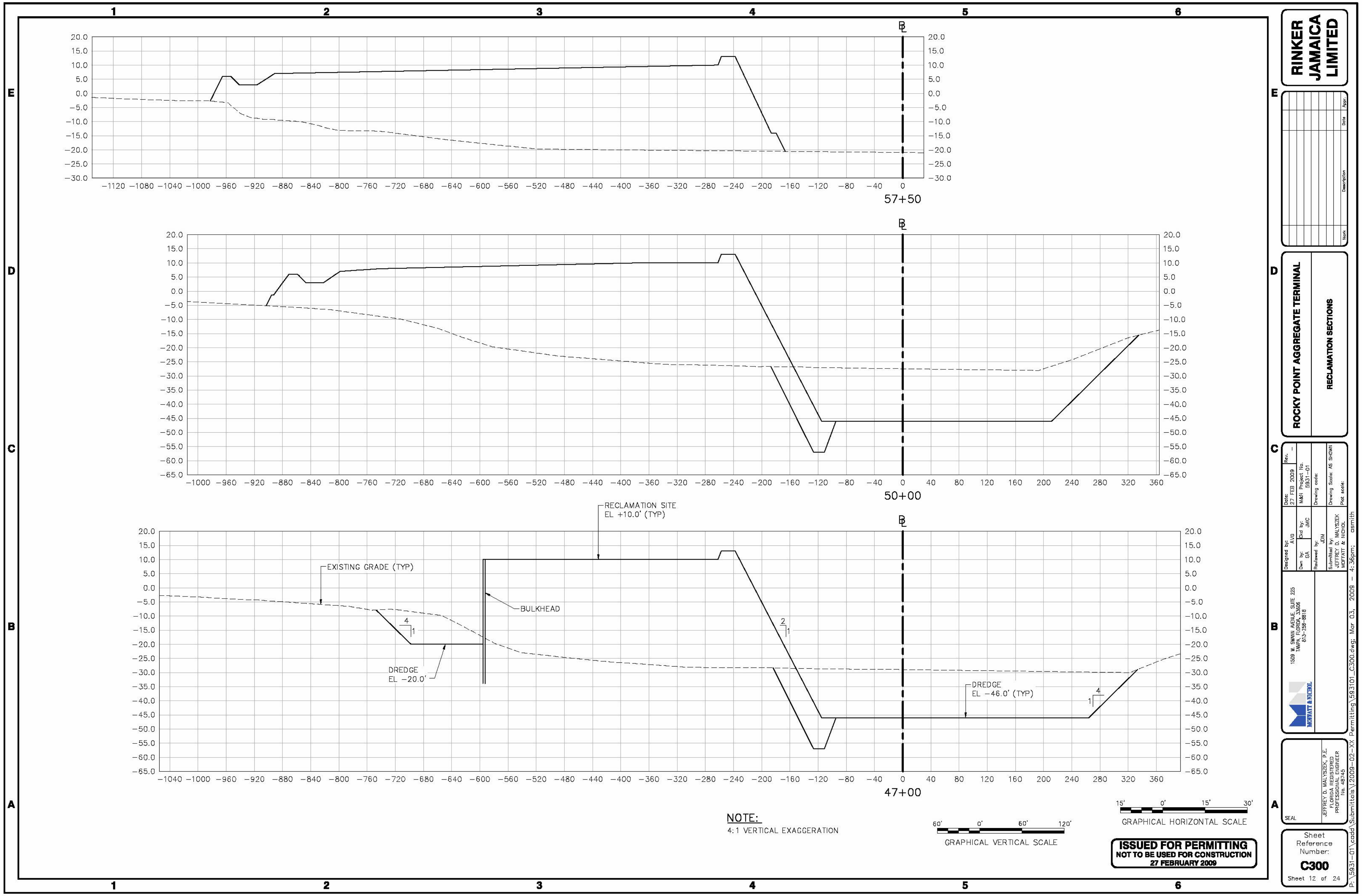


Figure 2-24: Proposed Reclamation Sections

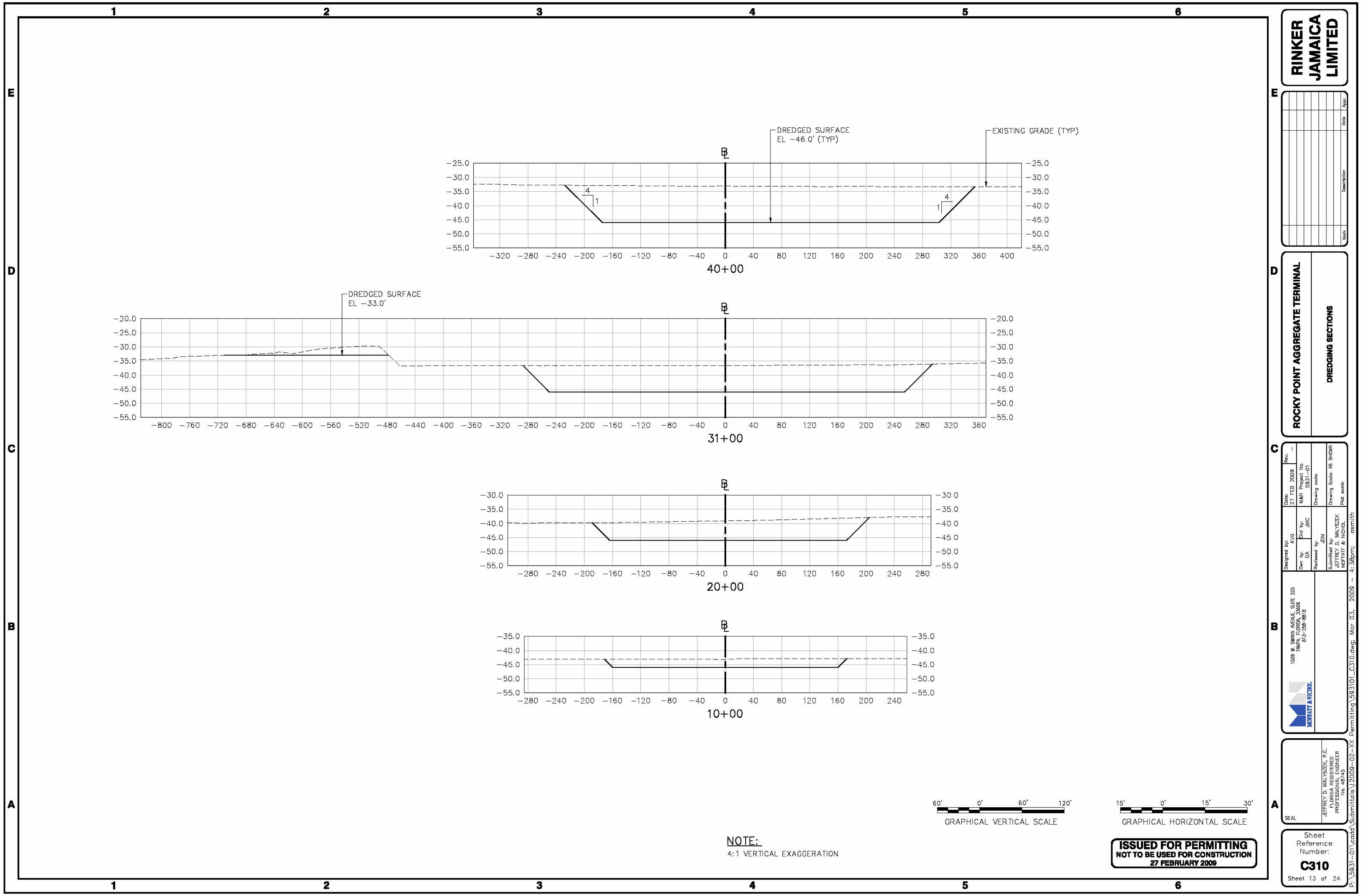


Figure 2-25: Proposed Dredge Sections

2.3.5 *Modifications to Beach/Foreshore/Mangrove*

The site for the Proposed Port is an uninhabited coastal area composed primarily of mangroves adjoining a secondary roadway that extends toward the main Rocky Point Port location and a seagrass plant community in the surrounding embayment.

The modifications to this area include:

- dredging of the near-shore and offshore areas to construct Port and access channel to the proposed berth
- a conveyor belt along the peninsula road

This project calls for various permits and licences under the NEPA Act of 1992 due to proposed modifications to the nearshore and offshore waters (dredging and land reclamation) and the mangrove and seagrass plant communities. All applicable licenses have been or will be applied for and will be obtained prior to implementation. Known licences and permits required are as follows:

1) An Environmental Permit
2) Beach licences
    - Port and Harbour Development
    - Dredging
    - Land Reclamation
    - Structures to be placed on the foreshore or floor of the sea (Pylons, revetment etc.)
3) Permit for Conveyor Belt System
4) Permit for Wetland Modification
    - Mangrove Modification
    - Seagrass Modification
5) Permit for Wastewater Holding System

Specific impacts and mitigations for seagrass and mangrove are addressed in Section 6. Protective measures will include measures for spill control, runoff management, erosion control, sediment control, and other means of protection. This is further elaborated on in Section 8 of this report.

Present site land-use is outlined in the following plates:

Plate 2-4: Present Site Use

Plate 2-5: Barge Docked at Proposed Site for Port

2.3.6 *Drainage*

The site is disturbed and has been backfilled with crushed limestone/marl and naturally drains itself. The site currently has natural drainage that does not result in ponding or flooding in the area; it drains well and is relatively flat. The site itself has never undergone any of these events as further explained in the Hydrology and Natural Hazard section of this report.

The new dock area will be comprised of dredged spoil and compressed backfill, and will allow for natural draining during rainfall events. The adjoining Salina[1] will also assist with the drainage particularly during storm events through natural means. The presence of mangroves in close proximity will assist in the protection of the shoreline. Generally, soil in the area is made of sand or gravel which greatly assists in percolation of water. There are no natural flow pathways for storm water to reach the sea during periods of rainfall which will be maintained and/or improved upon.

No significant hardtop will be laid down in the form of asphalt except Ro-Ro ramp and a 21 m (70 ft) wide apron along the Ro-Ro berth.

Retention ponds are designed for storm water collection at the port (south side) and along the at-grade conveyor corridor. These retention ponds will collect storm water run-off. Runoff gauges will be installed inside the retention ponds to monitor fines (silt) build up so it can be removed accordingly.

[1] Salina: An area of upper intertidal lands characterized by extreme flatness and salt levels. When moist periods and greater tidal amplitudes return these favor mangrove re-occupation.

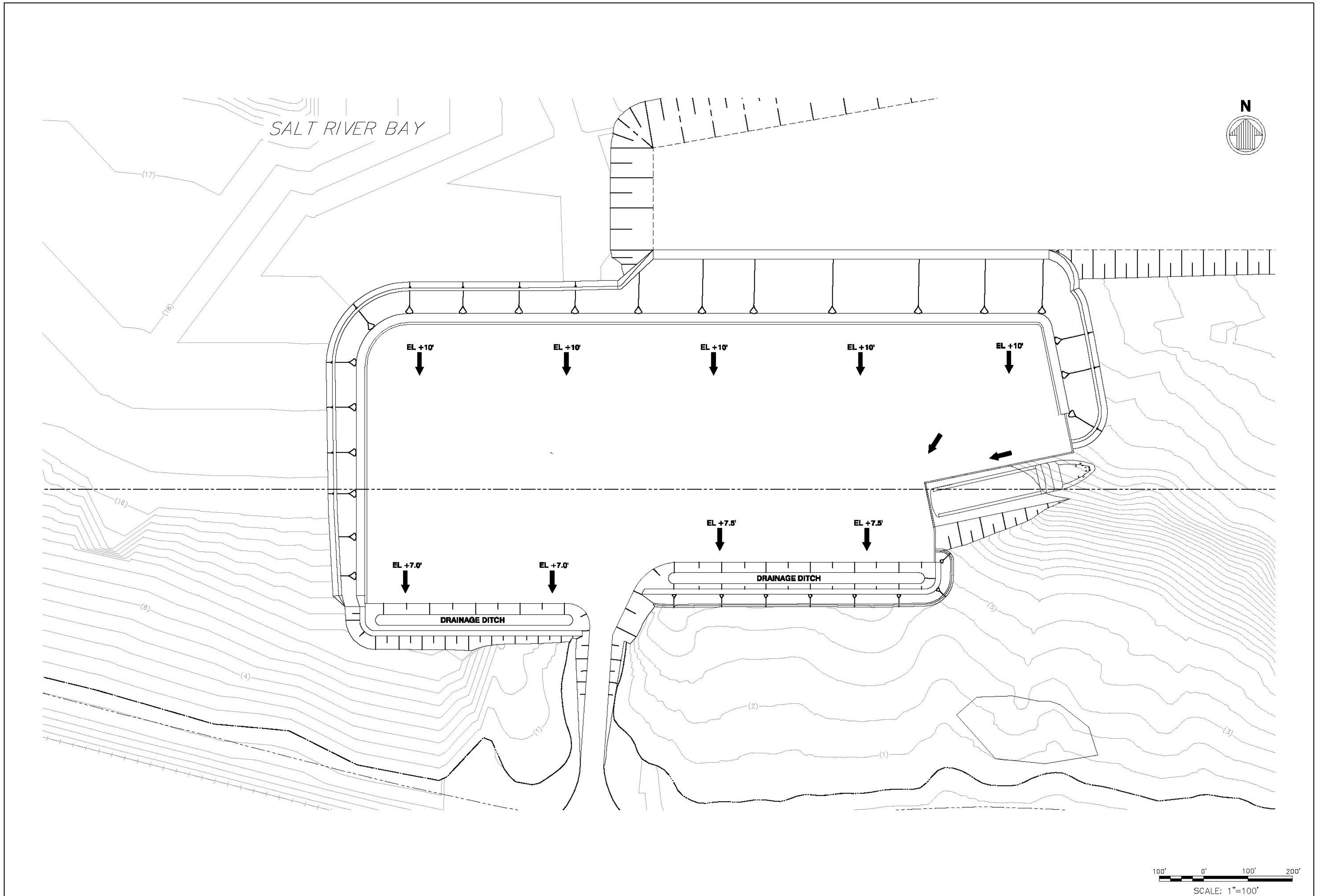


Figure 2-26: Proposed Drainage Plan

2.3.7 *Summary Potential Impact of Ambient Resources and Natural Disasters Rationale*

The design of the proposed port facility is being undertaken using engineers that are familiar with the damage done to the existing Jamalco port from previous hurricanes.

The northwestern shoreline of the Rocky Point peninsula was selected for the proposed Rinker Berth. Numerical model studies confirmed that this area is relatively sheltered compared to the adjacent Jamalco pier against hurricane waves which influence the area from a long fetch in the southeast direction. A detailed statistical analysis has been completed to establish the extreme wind and wave conditions for the project site involving 250 hurricanes recorded form 1930 to 2005. Based on the finding of this study, Rinker Facility was designed to withstand a major hurricane such as Ivan (2004) or Dean (2007). The proposed conveyor feeding the ship loader was designed to remain above the maximum wave crest during a severe hurricane. The design height of the conveyor is higher than the previously damaged structures at the adjacent facility. Only some minor damage to auxiliary structures such as gangways and handrails are expected in the event of a major hurricane. Some rock displacements on the revetment may also take place without presenting any particular risk to the integrity of the structure.

The designs were also done based on previous surge heights of hurricanes to have affected the area, especially Hurricanes Ivan and Dean. The designs allow for some amount of contingency, and take into consideration the economics of designing with a wind event of 100 year return interval. Global warming and climate change assumptions were also evaluated. A similar basis has been used for designing the conveyor corridor.

The reserve stockpile will be done based on the typical DWT of a Panamax vessel at design draft of 40 feet. The material is being washed and sized at the quarry and delivered to the port via the conveyor belt wet. This reduces the potential for dust generation. Additionally, there will be a telescopic shooter that will be used in loading the vessels which will have access to every hold. This is also a mitigation to reduce any potential dust generation.

Prior to the onset of a major storm the reserve stockpile will be depleted by the last available vessel and conveying operations would have ceased at the proposed plant. Tie-down operations would be in effect at the various facilities. There would be little or no reserve stockpile at the port during a major storm.

The drainage for the proposed port will utilise a perimeter (south) holding pond and perimeter berms. Additionally, the drains will be fitted with the required silt screens. As outlined previously within the project description of the document, the product to be stored is sized and washed limestone. Little silt particles will be generated from this operation. All precautions have been taken into consideration for the design of the port.

Figure 2-2 as represented in this EIA document is the final proposed configuration. The proposed turning basin and ship channel was designed with input from of a marine assessment, Jamalco and the Jamaica Pilots Association (The manoeuvrability study outlined in the EIA). The final alignment was evaluated against several parameters, chief among them being:

1. Impact on existing ship movements with the Jamalco port
2. Location of important marine resources such as coral reefs, seagrasses and mangroves (i.e. those least likely to survive any transplanting or providing significant ecosystem benefits that are avoidable)

Based on a marine assessment conducted in the area in 2004[2] the coral reefs adjacent the Jamalco terminal was under stress. This coral reef system is not the same as the patch area close to the proposed Rinker project. The area in question is a launch point for various marine vessels including barges. The depth of the water is on average 4.5 feet. The area is more prone to turbidity than the area adjacent the terminal. There are only a handful of coral heads in the area in question and these corals are covered largely in algae. Only one or two are in a “fair” state. Relative to those adjacent the terminal mentioned in the 2004 study, they are in relatively “poor” health.

A more recent study, the Jamalco Barge EIA submitted in January 2007, in the same area slated for development also indicated the poor visibility in the area and the general paucity of any corals that could be negatively affected.

The water quality in the area was defined in the same Barge Dock EIA as follows:

The following parameters were evaluated within a 100 m radius (of marine waters) of the proposed project area at Rocky Point, Clarendon:

- *Total and Faecal coliform*
- *Total suspended solids*
- *Phosphates*
- *Nitrates*
- *Oil and Grease*

[2] Jamalco Efficiency Upgrade EIA, 2004, Conrad Douglas & Associates Limited.

The results as given by Poly-Diagnostics Centre Ltd for phosphates, oil and grease, total and faecal coliform, and total suspended solids all fall within acceptable NEPA standards as seen below. The value for nitrates was slightly elevated.

It should be noted that when compared with NEPA's trade effluent standards and the National Ambient Water Quality Standard for Freshwater; these values are all within limits and are exceedingly low. NEPA has no standard for marine water bodies along any of Jamaica's coast.

Table 2-2: Analysis of Key Parameters of the Marine Waters in the Immediate Vicinity of the Proposed Project Site at Rocky Point, Clarendon

PARAMETERS	METHOD	RESULTS	NEPA STANDARD
Phosphate as PO_4 / (mg/L)	Colorimetric (Spectrophotometric) Method # Hach 8048 Page 537 2nd Edition	0.029	0.001 - 0.055
Phosphate as PO_4-P / (mg/L)		0.009	
Nitrate as NO_3 / (mg/L)	Colorimetric (Spectrophotometric) Method # Hach 8039 Page 400 2nd Edition	2.480	0.001 – 0.081
Nitrate-Nitrogen NO_3-N / (mg/L)		0.560	
Total Suspended Solids / (mg/L)	Gravimetric Method # Hach 8158 Page 605 2nd Edition	20.000	All times <150 mg/l Monthly average 50 mg/l
Oil & Grease as HEM / (mg/L)	Gravimetric n-Hexane Extractable Method # Hach 10056 Page 877 3rd Edition	2.290	10
Total Coliform / (MPN/100 mL)	Multiple-tube Fermentation Technique	2.000	$4.8 \times 10^1 – 2.56 \times 10^2$
Faecal Coliform / (MPN/100 mL)		2.000	$<2.0 – 1.3 \times 10^1$

When compared with the more recent Rinker marine water quality assessment it can be noted that coliform (both faecal and total) levels have been a problem in the area. It is hard to identify the exact source of this pollution. However, it may be a function of river transport, sewage waste disposal system in the area (largely septic pits) and coastal currents.

The corals adjacent to the Jamalco pier do not appear to have suffered greatly from the *ad hoc* maintenance dredging that has been done since the facility was built.

A drainage plan is being prepared along with building designs for submission to the Clarendon Parish Council and NWA respectively for approval.

Section 4 outlines the existing environmental setting of the region as well as its natural hazard vulnerability.

2.4 Utility Requirements

2.4.1 *Electricity Demand*

Electricity requirements will be sourced from the national grid. A 69 kV power line is located in proximity of the project area – the JPS Old Harbour/Monymusk 69 kV line. A 20 MVA 69/24 kV substation will be built to connect with the JPS grid. A preliminary letter of intent was submitted to JPS to which RINKER received favourable reply indicating connectivity potential (**Appendix III**). No problem is expected with this utility.

The routing of the conveyor corridor along the Peninsula road was informed by a JPS requirement of a 15 m setback from the existing utility poles and transmission corridor. The designs are in compliance with this requirement.

Table 2-3 below outlines the energy requirements per build-out phase.

Table 2-3: RINKER Jamaica Limited Power Requirement - Per Build-out Phase

RINKER JAMAICA LIMITED BRAZILLETTO PROJECT 4/3/2008 JRA *POWER REQUIREMENTS - PHASES I, II, & III - HORSEPOWER*									
	PHASE I (4m ton/yr Plant)			PHASE II (8m ton/yr Plant)			PHASE III (12 m ton/yr Plant)		
	Connected Horsepower (HP)	Consumed Horsepower (HP)	Avg. Hours per Day (Hrs)	Connected Horsepower (HP)	Consumed Horsepower (HP)	Avg. Hours per Day (Hrs)	Connected Horsepower (HP)	Consumed Horsepower (HP)	Avg. Hours per Day (Hrs)
Plant	**4308**	**2585**	**14**	**7658**	**4978**	**14**	**12558**	**8791**	**14**
Stockpiling / Transport	**3302**	**2311**	**4**	**4160**	**2912**	**8**	**4160**	**2912**	**12**
Ship Loading	**2160**	**1512**	**4**	**2160**	**1512**	**8**	**3360**	**2352**	**12**
Total Horsepower	***9770***	***6408***		***13978***	***9402***		***20078***	***14055***	

2.4.2 *Water Supply*

This phase of the project requires very little water since all aspects of this phase are based on a dry operation. Any water required will be supplied using trucks with temporary onsite storage.

This is similar to the current method of supplying water to the Jamalco Port.

2.5 Maritime Transportation Corridor

2.5.1 *Marine Traffic*

This section is based on information contained in a RINKER Traffic Study conducted by Moffat & Nichol (M&N). It should also be noted that these results were also reviewed with the Port Authority and the Pilots Association.

The primary purpose of this study was to predict the impacts of proposed RINKER vessel traffic on existing and future traffic calling on the JAMALCO loading terminal. To estimate potential impacts on traffic, a discrete event, probabilistic simulation model using the Extend software (Version 6.0.7) was developed.

The model was developed to represent the material factors that affect the existing and proposed traffic levels and terminal operations. From the opening screen of the model, simulations can be run and saved, or the six main component blocks of the traffic system can be viewed (**Figure 2-27)**. These main blocks indicate the order of operations within the model. These six blocks are:

1. Vessel Arrivals: vessels are generated and arrive at the ship channel entrance, approximately 2 nautical miles (nm) offshore. Vessel arrivals are generated using a normal distribution with a mean inter-arrival time and a standard deviation, to account for variations in transit time to Rocky Point.
2. Berth Availability & Environmental Constraints: inbound vessels check for berth availability and environmental constraints on transit.
3. Transit Protocols: inbound vessels then check for vessels already transiting outbound, or for those already waiting (for weather or other reason) to travel outbound.
4. Pilot/Tug Join & Transit: after all operational and navigational conditions have been satisfied; pilots and tugs (depending on the scenario) are called and meet the vessels, followed by transit to the proper terminal.
5. Terminals: vessels arrive at their respective terminals, and begin the loading process. The various activities, including loading, are simply represented in the model by a time (duration) spent at the berth. Upon completion of the loading and post-loading activities,

environmental and transit checks are made, and when conditions are met, pilots and tugs join the vessels before commencing the outbound sail.

6. Outbound Transit: this block represents the transit from the terminals to the ship channel entrance.

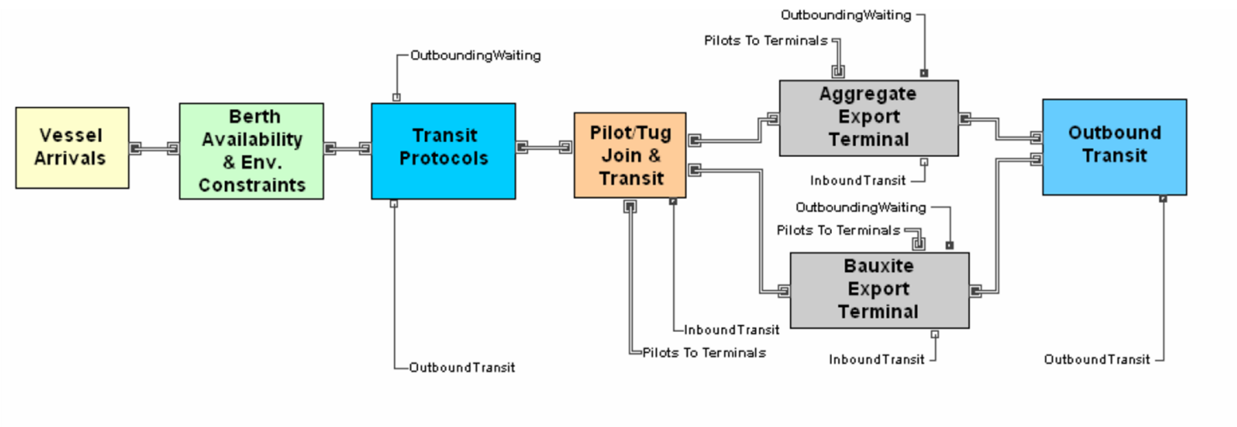


Figure 2-27: Primary Component Blocks of the Traffic System

The simulation model is set up to check that specific environmental limits are not exceeded during various operations including channel transit, manoeuvring into or out of berth, berthing and cast-off. The primary environmental limit affecting transit through this region is wind (and subsequent waves). Tides and visibility are not believed to impact vessel traffic in the region. Specifically, the following environmental conditions are checked throughout the simulation.

- For simulations of the 'Present Conditions' (JAMALCO terminal traffic only), wind must be less than 18.5 knots while vessels are transiting, manoeuvring, berthing, or casting off.
- For simulations of 'Intermediate and Future Conditions' (JAMALCO and RINKER Terminals), winds greater than 20 knots will require 2 tugs to assist in manoeuvres. Vessels may not transit, manoeuvre, berth, or cast off when winds exceed 30 knots.
- JAMALCO vessels may transit during daylight only, from 6am to 6pm (13 total hours per day).

To represent wind-related delays incurred by vessels, a 30 year record of hourly-averaged wind data (1975 – 2005) was obtained from the NCDC weather station at the Kingston Airport (NCDC, 2006). This data record contained gaps making processing and use of the full time-history in the model difficult. Instead the time series record for a shorter period of 8 years (1975 – 1982) was used in the model.

Based on a comparison of the frequency distribution of wind speeds over these two periods, it was determined that the 8 year period from 1975 to 1982 appropriately represents the longer term record. A comparison of cumulative probability distributions for the 8-year subset (1975 to 1982 – blue line) and for the total 30 year period (red line) is shown in **Figure 2-28**. The cumulative probability distributions give the percent of time that winds are below a specified speed. For example, in **Figure 2-29**, the curves show that 50% of the time winds are below 8 - 9 knots.

In general the curves follow one another fairly well. At 18.5 knots, which represents the transit limit under the Present Conditions, the 8 year and 30 year distributions give similar cumulative frequencies, 85.1 and 87.4% respectively. At 30 knots, which is the wind limit for transit in the intermediate and future scenarios, both the 8 year and 30 year distributions show essentially the same frequency of approximately 99.8%.

Meetings with the marine terminal operator at the JAMALCO terminal indicate that other environmental factors such as fog and rain may affect terminal operations, although not significantly. For this reason rain and fog are not considered in the simulations. Potential delays due to hurricanes were not considered in the simulations as well.

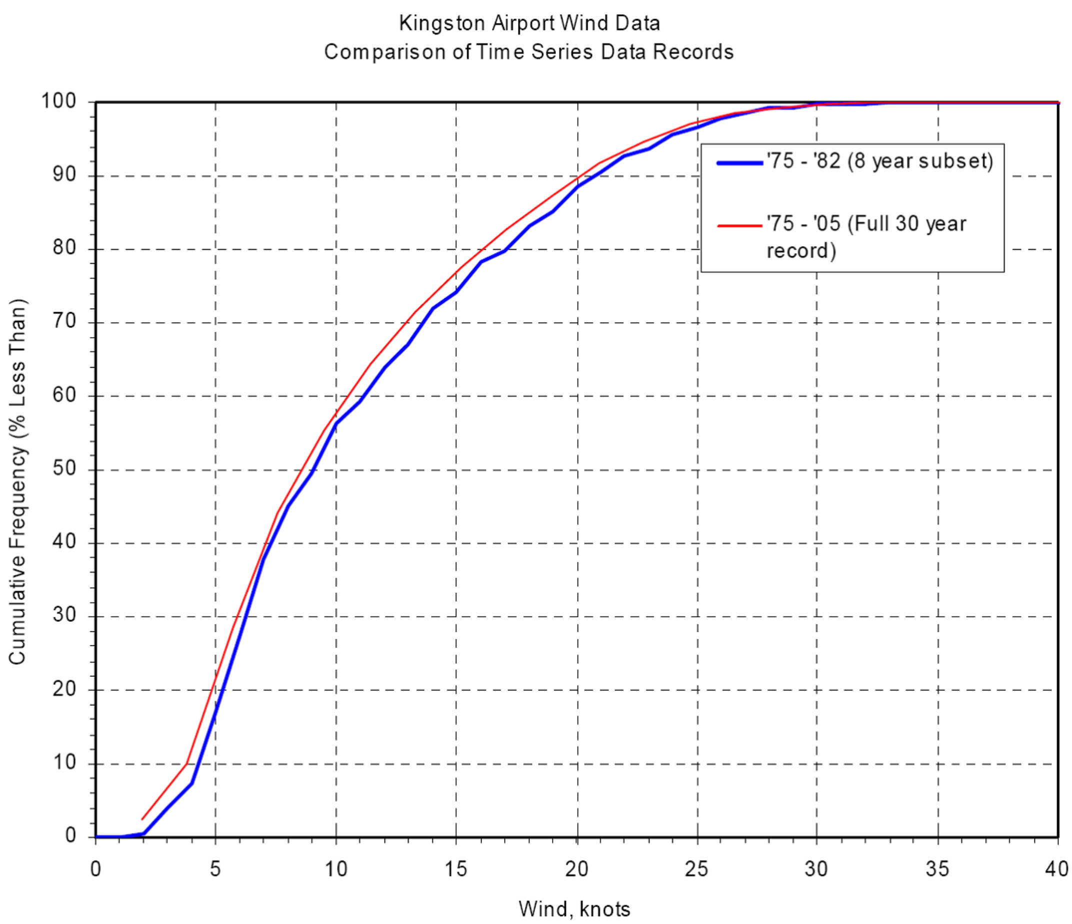


Figure 2-28: Distribution of Wind Durations

The model simulated inbound and outbound transit of vessels to and from the proposed RINKER Terminal and the existing JAMALCO Terminal, and durations of operations at berth at the two facilities. The vessels were introduced into the simulation at the ship channel entrance approximately 2 nautical miles from the existing JAMALCO Terminal, where their inbound transit begins. They exited the simulation after completing the loading operations at berth and their outbound transit.

A vessel traffic model was developed to represent the present levels of shipping and operations at the Salt River corridor. The model included various operational, traffic, and environmental criteria that govern vessel transit. The marine traffic model was run a number of times to simulate various levels of future increases in shipping at the JAMALCO and RINKER facilities, and changes in traffic regulations where appropriate, in order to predict their impacts.

Based on the results, the following conclusions were made:

- The present conditions show longer average individual vessel delays than do the intermediate and future conditions because in the intermediate and future scenarios JAMALCO vessels are essentially unrestricted by high wind with the addition of tugs. In the present condition tugs are not available, and vessels commonly incur delays during winds in excess of 18.5 knots. Under the Intermediate and Future Conditions, vessels incur delays when winds exceed 30 knots, which is a rare occurrence.
- Independent of the scenario, environmental delays including wait for daylight comprise a large fraction of the total delay incurred by JAMALCO Vessels. The average expected wait for daylight (3 to 4 hours) is large relative to all other delay types. Allowing JAMALCO vessels to transit at all hours of the day would be an effective means of increasing throughput at the JAMALCO terminal.
- JAMALCO delays (in particular, berth availability delays) increase at a higher rate when more than 12 JAMALCO vessels per month call at the terminal. Thus, at the present estimated at-berth times, berth availability delays will be incurred beyond 12 vessels per month.
- JAMALCO berth utilization rates increase with the number of JAMALCO vessels in the simulation. A noticeable rise in berth utilization is observed at 12 JAMALCO vessels per month. At 12 vessels per month, the berth utilization rate is approximately 50%. The level of 12 vessels per month also corresponds to the point at which berth availability delays begin to increase at a higher rate.
- The doubling of traffic at RINKER has little impact on RINKER or JAMALCO traffic. Even under the highest levels of vessel traffic (16 RINKER and 14 JAMALCO vessel calls per month) the impacts of RINKER vessels on JAMALCO traffic delays are minor. RINKER vessels cause delays to JAMALCO vessels on the order of a fraction of an hour,

small relative to the total average JAMALCO delay of approximately 10 hours, which is primarily due to environmental limits and berth availability (at 12 or more JAMALCO vessels per month). The simulations indicate that an increase in JAMALCO traffic has the greater impact on JAMALCO operations.

Table 2-4: Traffic Model Study Basis Summary (per Design Basis Report)

INPUT PARAMETER	VALUE / DESCRIPTION
Simulation Cases	
	1. **Present Conditions**: - RINKER Vessels: None - JAMALCO Vessels: 3.5 alumina plus 3.0 tanker vessels/month 2. **Intermediate Conditions**: - RINKER Vessels: 8 vessels/month - JAMALCO Vessels: 5 levels of traffic - 6.5, 8, 10, 12, 14 vessels/month 3. **Future Conditions**: - RINKER Vessels: 16 vessels/month - JAMALCO Vessels: 4 levels of traffic - 8, 10, 12, 14 vessels/month
General	
Operational/Traffic Regulations	1. Only one vessel may be at berth at a time at each terminal. 2. Only one vessel may transit or manoeuvre in the channel and turning basin at a time. 3. Vessels transit on a 'first come-first served' basis. **4.** 4. Vessel schedules are not coordinated between RINKER and JAMALCO Terminals.
Transit Route & Times	General: Transit begins at pilot boarding area approximately 2 nm offshore, at the entrance to the navigation channel, and ends at the turning basin adjacent to the terminals Inbound Activity: 1. POB to Turning Basin (2nm at 5 knots) ~ 0.5 hours 2. Turn Vessel & Final Approach (manoeuvring) – 0.5 hours 3. Berthing, All Lines Fast, Documentation – 1 to 1.5 hours 4. Total – 2 to 2.5 hours Outbound Activity: 1. POB, Documentation, Release Lines, Cast Off – 1 to 1.5 hours 2. Outbound Channel Transit~ 0.5 hours 1. 3. Total – 1.5 to 2 hours

INPUT PARAMETER	VALUE / DESCRIPTION
Vessel and Loading Characteristics	Loading Rates/Time at Berth: JAMALCO Vessels Alumina Vessels: 17,000 – 38,000 DWT vessels loading at 1,000 tons per hour (26 to 47 total hours at berth) Tankers: 200,000 – 300,000 bbls loading at 10,000 bbls per hour (29 to 39 total hours at berth) RINKER Vessels: 70,000 DWT vessels, assumed 16 hours, including a slight variation at modern loading terminal
Pilot and Tug Resources	1. All vessel transits inbound and outbound require 1 pilot 2. Only one pilot is available. 3. For the Present Conditions scenario, no tugs are available for transits; thus no transit during winds that exceed 18.5 knots (approx. 14.2% of the time). 4. For other scenarios, 2 tugs are required inbound or outbound during winds that exceed 20 knots. No transit when winds exceed 30 knots. 5. Pilot commute times: a. Between terminals: 0.5 hours b. b. Between terminal & pilot boarding area: 1.0 hours
Environmental Constraints	
Wind	Present Conditions scenario: Wind >= 18.5 knots: no vessel transits/manoeuvring (14.2% of time) Intermediate & Future Conditions scenarios: Winds >= 18.5 knots (JAMALCO) & 20 knots (RINKER): tugs are required for transit/manoeuvring Winds >= 30 knots: no vessel transits/manoeuvring (0.26% of the time)
Hurricanes	Currently not modelled
Daylight Travel	JAMALCO Vessels: Restricted to travel only during daylight hours, between 6am – 6pm (13 total hours per day) RINKER Vessels: No night restrictions
Tides	No known restrictions
Waves	No explicit wave restrictions; however, waves can be considered implicit within the wind criteria
Visibility	No known restrictions

2.5.2 *Marine Vessel Manoeuvring*

This section is based on information contained in a RINKER Materials – Desktop Vessel Manoeuvring Simulations Study conducted by Moffatt & Nichol (M&N).

Moffatt & Nichol (M&N) was contracted by RINKER Materials to perform an analysis of the manoeuvrability of a bulk carrier through a proposed channel and turning basin towards a berth at Rocky Point, Jamaica. The manoeuvres were preformed without tugs where possible for wind speeds up to 20 knots. Higher, 30 knot, wind speeds were also examined with the use of tugs.

A vessel manoeuvre simulation case is determined to be a success when the vessel navigates its course with little or no deviation from its intended track. A case is considered unsuccessful if the vessel drifts off course dramatically or runs aground, or outside the channel boundaries.

The result of various cases simulated leads to the conclusion that tug assistance will be required to complete the manoeuvre under wind conditions greater than 20 knots. For wind speeds less than or equal to 20 knots, the manoeuvre can be performed using the ship's power, rudder and bow thrusters. The bow thrusters were used throughout the turning manoeuvre to aid in directing the vessel. As winds approach 20 knots, tug assistance allows for a more controlled manoeuvre. In the cases simulated, both the outbound and inbound transiting and berthing vessel remain within the channel boundaries at a minimum of 350 ft from the centre of the JAMALCO berth.

Tug assisted departure was also modelled, and indicates that manoeuvres can be completed with winds up to 30 knots without the use of tugs for outbound transits.

For this study, M&N utilized the fast-time, autopilot simulation software SHIPMA developed by

MARIN (Maritime Research Institute Netherlands) to perform a detailed computer-based simulation of the manoeuvres required for the design vessel to safely transit the proposed channel and turning basin.

The SHIPMA software uses a mathematical description of the hydrodynamics of a given vessel to simulate the manoeuvring of the ship in approach channels and harbours. The hydrodynamic vessel description includes vessel response to current forces, turning radius, maximum engine speeds and rudder angles. In model formulation and hydrodynamics the software is very similar to the full mission bridge simulators used for pilot training. The fast time simulator uses an autopilot algorithm in place of the human pilot to simulate control of the vessel. While the autopilot routine is no substitute for a human pilot, it does allow a large number of manoeuvring simulations to be conducted quickly and for less expense.

The model uses the autopilot to control the vessels propeller, rudder, bow thruster and tugs. The hydrodynamic model accounts for shallow water effects, bank suction effects, and forces due to winds, currents, and waves. The desired manoeuvre is described by specifying the coordinates of an ideal track line. For each segment of the track, the user specifies desired vessel speed and orientation, the number and power of tugs, and the autopilot settings. The autopilot settings control such factors as pilot reaction time, look ahead distance, primary control method (rudder, propeller, bow thruster or tugs), and the program then steps through the manoeuvre with the autopilot routine determining the required propeller speed, rudder angle, and tug commands.

Fast-time simulations can act as a screening tool to identify the most critical conditions. In the case of the present study, the tool is used to evaluate limiting environmental conditions in which the manoeuvre can be performed with out tug assistance, as well as assess the size and placement of the ship channel, turning circle, and berthing area.

2.5.2.1 Model Input

2.5.2.1.1 Design Vessels

The vessel selected for the manoeuvring simulations is a 738 ft (225m) LOA bulk carrier. Standard hydrodynamic ship models of these vessels were obtained from MARIN. The principal dimensions of the vessel models are given in **Table 2-5**.

Table 2-5: Particulars of the bulk carrier

	Sophie Oldendorff	SHIPMA module Bulk Carrier (loaded)	SHIPMA module Bulk Carrier (ballasted)
LOA	225.0 m	225.0 m	225.0 m
LBP	-	217.0 m	217.0 m
Beam	32.18 m	32.2 m	32.2 m
Moulded Depth	19.51 m	17.8 m	17.8 m
Draft	12.8 m	12.0 m	7.0 m
Deadweight	60,000 tons	60,759 tons	60,759 tons
Frontal Wind Area	-	668 m^2	797 m^2
Lateral Wind Area	-	2286 m^2	3410 m^2
Bow Thruster	1777 hp	1777 hp	1777 hp

The mathematical vessel models provided by MARIN describe the hydrodynamic and handling characteristics of the ships used in the simulations. The models are based on measurement data from model tests and validated with model manoeuvring tests. The models can be used for the whole speed range between slow astern to full speed ahead during normal manoeuvring.

2.5.2.1.2 Tug Characteristics

Two conventional tugs were used for the analysis wherever was necessary. Wind conditions above 20 knots wind speed required tugs. The tugs modelled are conventional power train tugs with 3,000 hp or approximately 30 tons bollard pull. The sizes of these tugs were determined by an empirical formula which is dependant on ship windage area, and environmental wind speed to provide an approximate required tug force.

2.5.2.1.3 Bathymetry and Hydrodynamics

The bathymetry is on based data points obtained by digitizing Admiralty charts for the West Indies, Jamaica South Coast area. These digitized bathymetric points are then meshed with the proposed channel and turning circle. The channel is modelled at -46ft (MLLW) while the turning circle is modelled at -33ft (MLLW).

2.5.2.1.4 Waves

Waves were transformed from offshore wave heights calculated in a previous numerical model study conducted by M&N. Using shoaling and refraction coefficients developed by this model, wave heights and directions were scaled from a uniform offshore wave height of 3.5 m (11.4 ft) with an 8 second period; resulting in wave heights of up to 1 m (3.28 ft) around the proposed RINKER site. **Figure 2-29** presents an example of the wave grid modelled. The offshore 3.5 m wave height selected for this operational manoeuvring analysis is exceeded only 6% of the time.

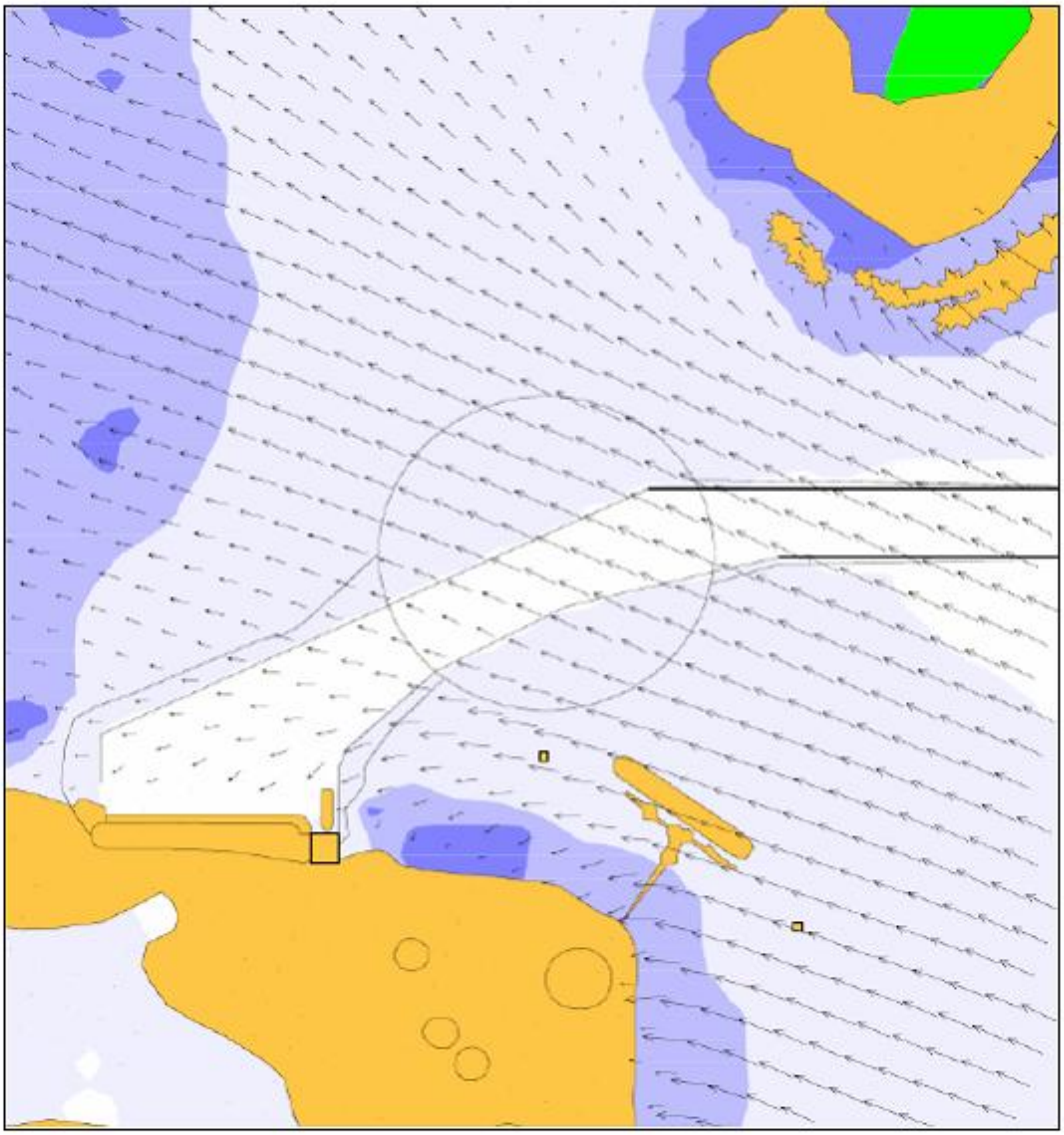


Figure 2-29: Wave grid as modelled in SHIPMA simulation; based on 3.5m offshore wave height with 8 second period.

2.5.2.1.5 Winds

Predominant winds for the area blow from the east through southeast. Local pilots have indicated that winds from the north and south are of interest and were therefore included in this study. Winds speeds of 20 and 30 knots were examined to determine the feasibility of manoeuvring the ballasted ship to the berth with and without the use of tugs. The higher wind speeds are typical maximums for vessel transit in confined channels. The allowable wind speed for transit is up to the pilot s discretion or port director

2.5.2.2 Simulation Methodology

The SHIPMA simulations are used to determine the feasibility and limitations of manoeuvring a bulk carrier to berthing at the proposed RINKER Materials terminal. A vessel manoeuvre simulation case is determined to be a success when the vessel navigates its course with little or no deviation from its intended track and remains within normal rudder and engine control envelopes; marginal when the vessel could still complete the manoeuvre, however travelled outside of the turning basin limits; and unsuccessful when the vessel cannot maintain its desired track and drifts off-course or travels outside the allowable underkeel clearance (10% of draft). The model also checks allowable underkeel clearance (accounting for squat and hydrostatic draft) and halts the simulation if the underkeel clearance is under the limit.

Each simulation covers some approximately 2.5 km (1.55 miles) of distance travelled from the entrance to the berthing area. The vessel begins its course just offshore inside Portland Bight and travels into the proposed channel at approximately 4-5 knots. The vessel then slows as it travels into the turning basin and orients its stern towards the berth. The bulk carrier then backs into the proposed terminal location at speeds less than a knot.

A simpler manoeuvre is performed for outbound transit, since the vessel s bow is already facing the outbound direction when leaving berth. The ship uses its bow thruster to push off the berth, and then begins to gradually pick up speed as it exits the channel. As the ship nears the end of the defined track path, it is travelling at approximately 5 knots.

Figure 2-30 - **Figure 2-33** depict basic transit manoeuvres for both inbound and outbound transits, along with corresponding rudder control and ship speed. **Figure 2-32** shows that for inbound transit most rudder usage is required to manoeuvre the carrier into the turning basin, and is limited to ±35 degrees. The rudder is then used to guide the carrier towards the berth, without the use of tugs. **Figure 2-33** shows for outbound transit the rudder usage is required to navigate the two bends in the track, while ship speed gradually increases. **Figure 2-34** shows that for inbound transits where tugs are not used, the bow thruster is consistently used at up to 60% of the maximum thrust available.

Figure 2-35 presents distances from the edge of the manoeuvring channel to the JAMALCO alumina loading terminal, which range from 196 ft 350 ft, depending on location of measurement. Throughout all carrier simulations, the bulk carrier never travels outside the channel and maintained, as a minimum, the distances shown.

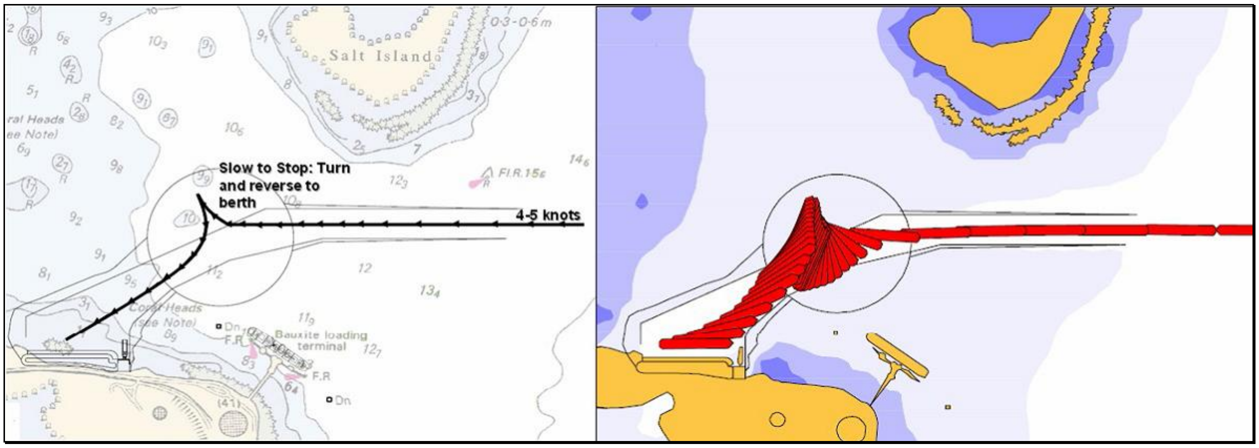


Figure 2-30: SHIPMA Vessel Track Configuration for Inbound Manoeuvre

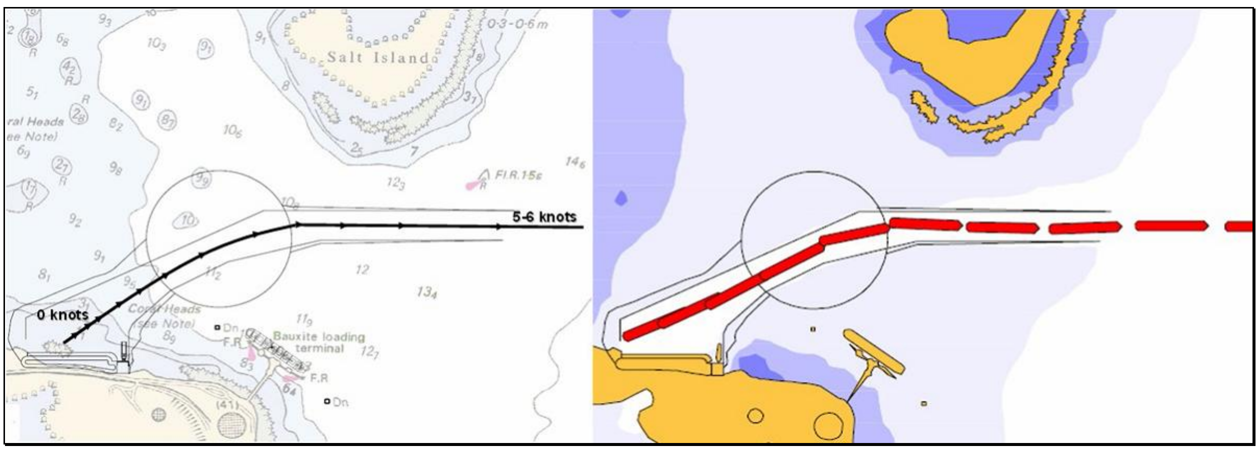


Figure 2-31: SHIPMA Vessel Track Configuration for Outbound Manoeuvre

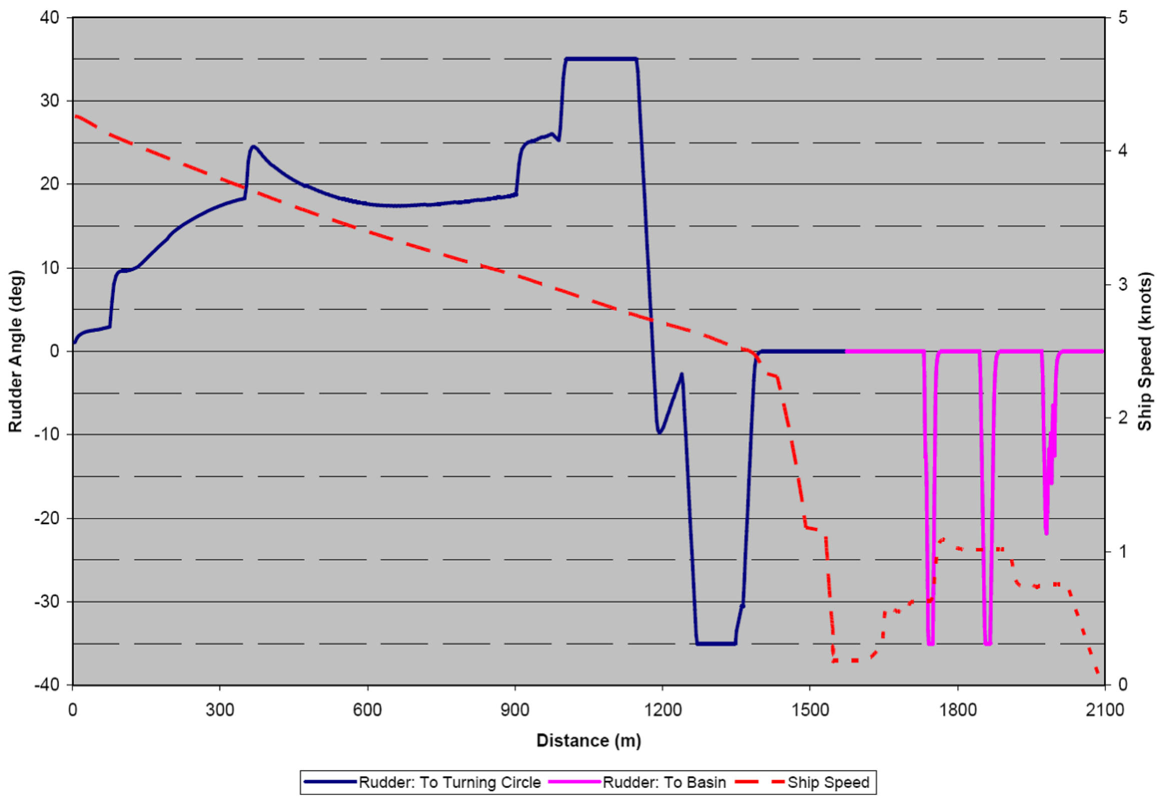


Figure 2-32: Example Rudder Angle and Ship Speed for Inbound Transit

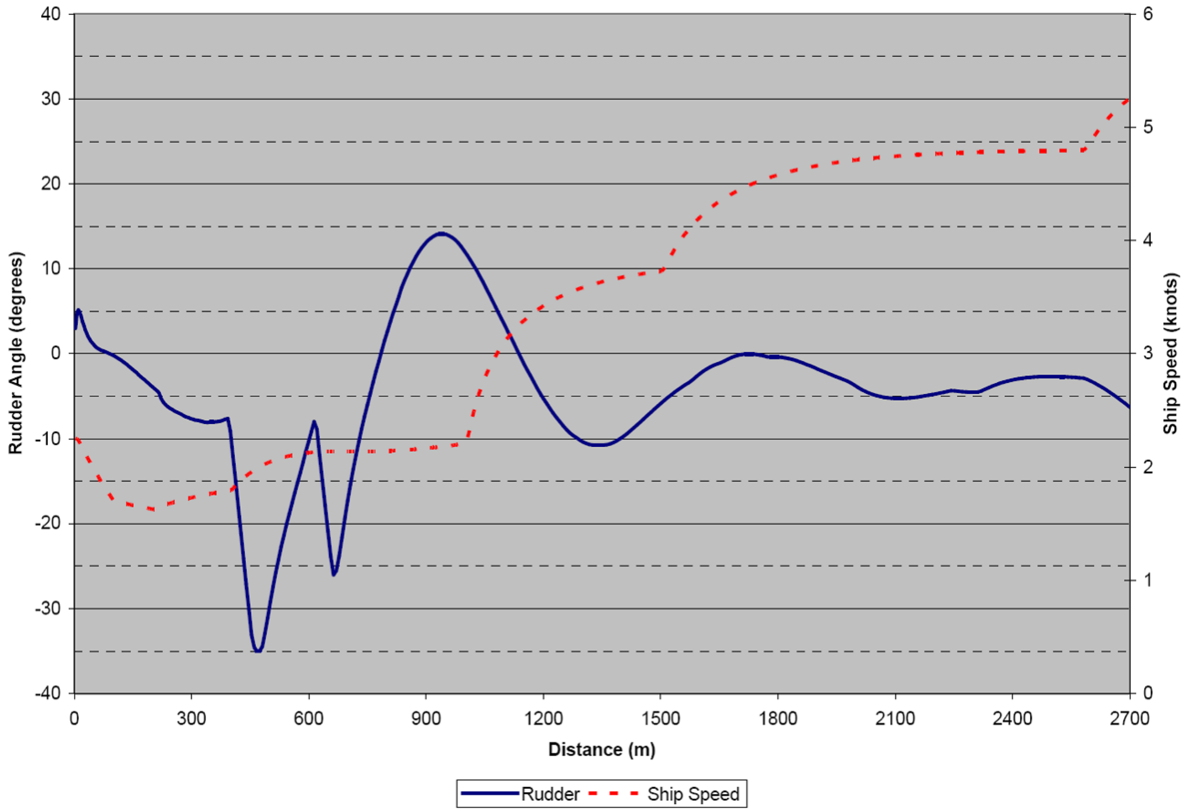


Figure 2-33: Example Rudder Angle and Ship Speed for Outbound Transit

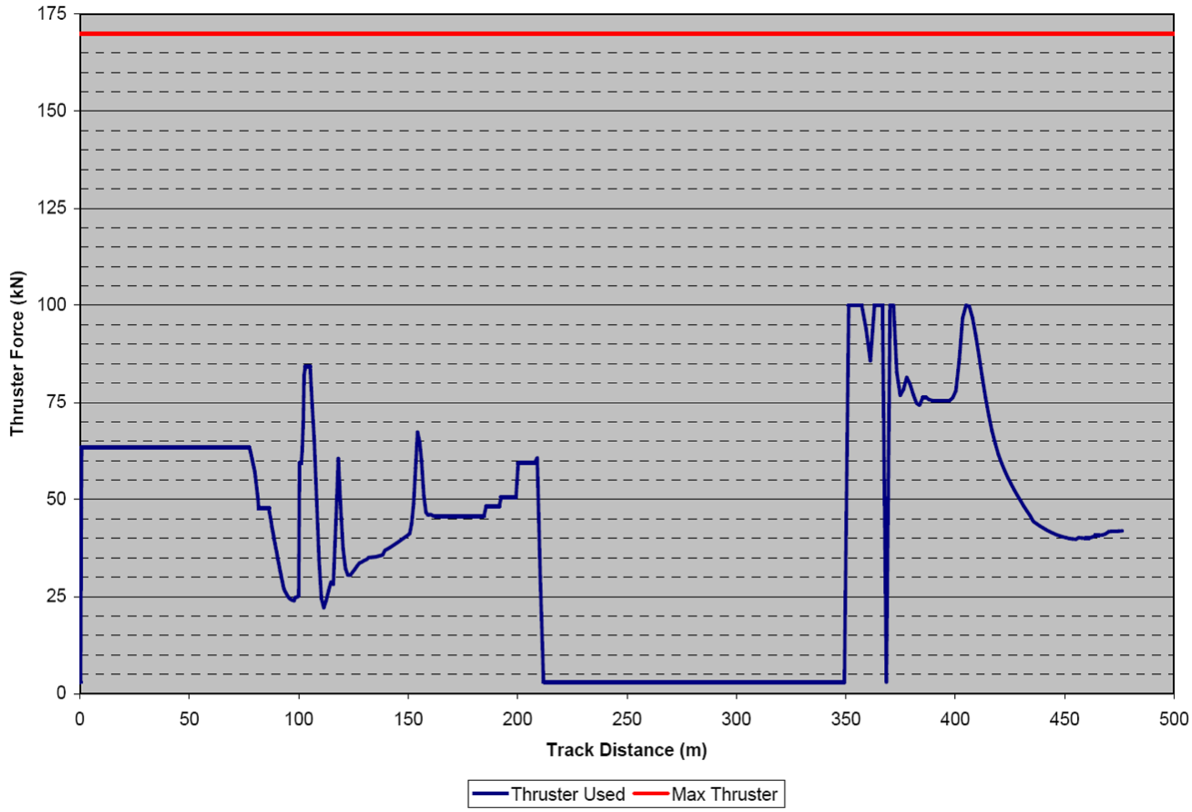


Figure 2-34: Example Bow Thruster Force (From Turning Circle to Berth)

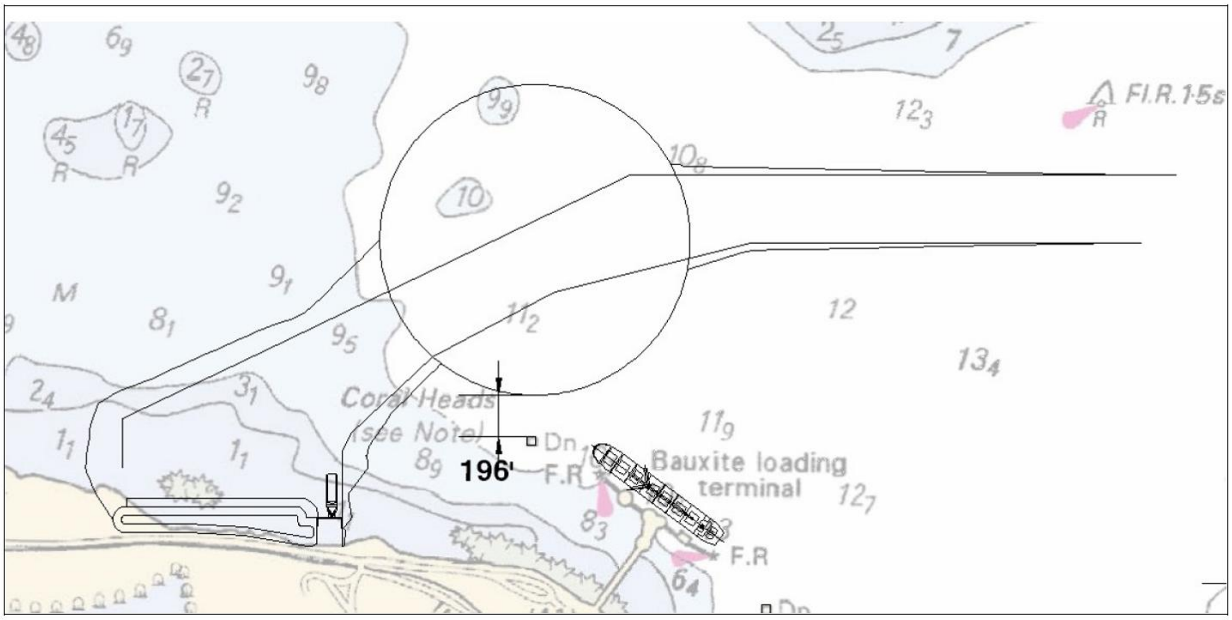


Figure 2-35: Distances from Edge of Channel to JAMALCO Bauxite Loading Terminal

Table 2-6 below shows that the simulated manoeuvres were possible without tugs for wind speeds less than 20 knots. Modelling of the carrier at the ballasted draft of 7 meters increases frontal and lateral wind area and provides a large sail for wind forces above 20 knots. For increased wind speed, winds above 20 knots, tugs are required to maintain course. An additional manoeuvre was performed which simulated the loss of the ships engine and rudder and proved successful with the use of the tugs.

Table 2-6: SHIPMA results table

Manoeuvre Direction	Wind Speed (knots)	Wind Direction (degrees)	Wave (height, period)	Draft Condition	Bow Thruster (Y/N)	No. of Tugs	Tug Power (horsepower)	Results
Inbound	20	North	3.5m, 8sec	Ballast	Y	0	-	Successful*
Inbound	30	North	3.5m, 8sec	Ballast	N	2	2 x 3,000	Successful
Inbound	20	East	3.5m, 8sec	Ballast	Y	0	-	Successful*
Inbound	30	East	3.5m, 8sec	Ballast	N	2	2 x 3,000	Successful
Inbound	20	South	3.5m, 8sec	Ballast	Y	0	-	Successful*
Inbound	30	South	3.5m, 8sec	Ballast	N	2	2 x 3,000	Successful
Inbound	20	ESE	3.5m, 8sec	Ballast	Y	0	-	Successful*
Inbound	30	ESE	3.5m, 8sec	Ballast	N	2	2 x 3,000	Successful
Inbound: Loss of Engine/Rudder	30	East	3.5m, 8sec	Ballast	N	2	2 x 3,000	Successful
Outbound: Loss of Engine	30	ESE	3.5m, 8sec	Loaded	N	2	2 x 3,000	Successful
Outbound	30	North	3.5m, 8sec	Loaded	Y	0	-	Successful
Outbound	30	East	3.5m, 8sec	Loaded	Y	0	-	Successful
Outbound	30	South	3.5m, 8sec	Loaded	Y	0	-	Successful
Outbound	30	ESE	3.5m, 8sec	Loaded	Y	0	-	Successful

* Note: at the 20 knot wind speed, the vessel did not directly follow the specified track; however the manoeuvre was still completed within the channel; is it assumed that an experienced pilot will be able to anticipate the effects of the wind and correct his manoeuvre accordingly.

To present a sample of the simulation manoeuvre findings, the following transits are examined in greater detail:

- ***Inbound: 20 knots without tugs:*** This manoeuvre was performed without the aid of tugs. The ship s bow thruster was used when needed to complete the manoeuvre. These conditions included a 20 knot wind from the north, east, south and east-south-east concomitant with transformed near-shore waves, resulting from an offshore wave height of 3.5m and an 8 second wave period.
- ***Inbound: 30 knots with tugs:*** This manoeuvre is performed with the aid of tugs under the worst assumed design operational environmental conditions. These conditions included a 30 knot wind from the north, east, south and east-south-east concomitant with transformed near-shore waves, resulting from an offshore wave height of 3.5m and an 8 second wave period.
- ***Inbound - Casualty: 30 knots with tugs:*** This manoeuvre assumes a failure of ships engine and rudder as soon as the vessel enters the channel. The rudder is assumed locked at midships along with no engine RPM. This condition included a 30 knot wind from the east with transformed near-shore waves, resulting from an offshore wave height of 3.5m and an 8 second wave period.
- ***Outbound Casualty: 30 knots with tugs:*** This manoeuvre assumes engine failure just as the outbound vessel is exiting the turning basin. There is no engine RPM, however it is assumed that the ship is being guided by the two tugs whose characteristics are found in **Section 2.5.2.1.2**. This condition includes a 30 knot wind from the ESE concomitant with transformed near-shore waves, resulting from an offshore wave height of 3.5m and an 8 second wave period.
- ***Outbound: 30 knots without tugs:*** This manoeuvre is performed without the aid of tugs under the most severe design operational conditions modelled. These conditions include a 30 knot wind from the north, east, south and east-south-east with transformed near-shore waves, resulting from an offshore wave height of 3.5m and an 8 second wave period.

2.5.2.3 Model Results

2.5.2.3.1 Inbound Transit 20 knots wind speed, with waves, no tug assistance

The following discussion and associated figures describe a simulation carried out by the navigation model from beginning to end, examining the transit in two basic segments. The case was examined for a 20 knot wind from the north, east, ESE, and south directions with the wave field described in **Section 2.5.2.1.4** and **5.2.1.3.2**. Each plot presents the track path of the vessel overlaid on the bathymetry of the waterway.

With 20 knots of wind speed, the carrier is able to successfully manoeuvre into the proposed channel and turning basin, and back up towards the berth. The manoeuvre was stopped with the ship lying approximately parallel with the terminal. It is assumed that with the ships propeller and bow thruster that the ship will be able to be safely berthed.

It should be noted that in order to make the manoeuvre successful for all 20-knot wind conditions, the user-defined track path had to be offset from the actual path transited by the carrier throughout the simulation. Wind direction dictates the direction of track offset; **Figure 2-36** presents the track path for a 20-knot wind coming from the north and corresponding track path set to the north of the centreline of the channel. Sustained wind speeds and large wind sail area on the ballasted carrier act to push the carrier away from the track path and towards the boundaries of the channel. As a result, it is recommended to widen the channel at the southern edge of the channel as it connects to the turning basin (see **Figure 2-36**). However, an experienced pilot should be able to anticipate the heavy winds which push the carrier away from its intended track and correct for these conditions. **Figure 2-37** presents plots for all wind directions examined.

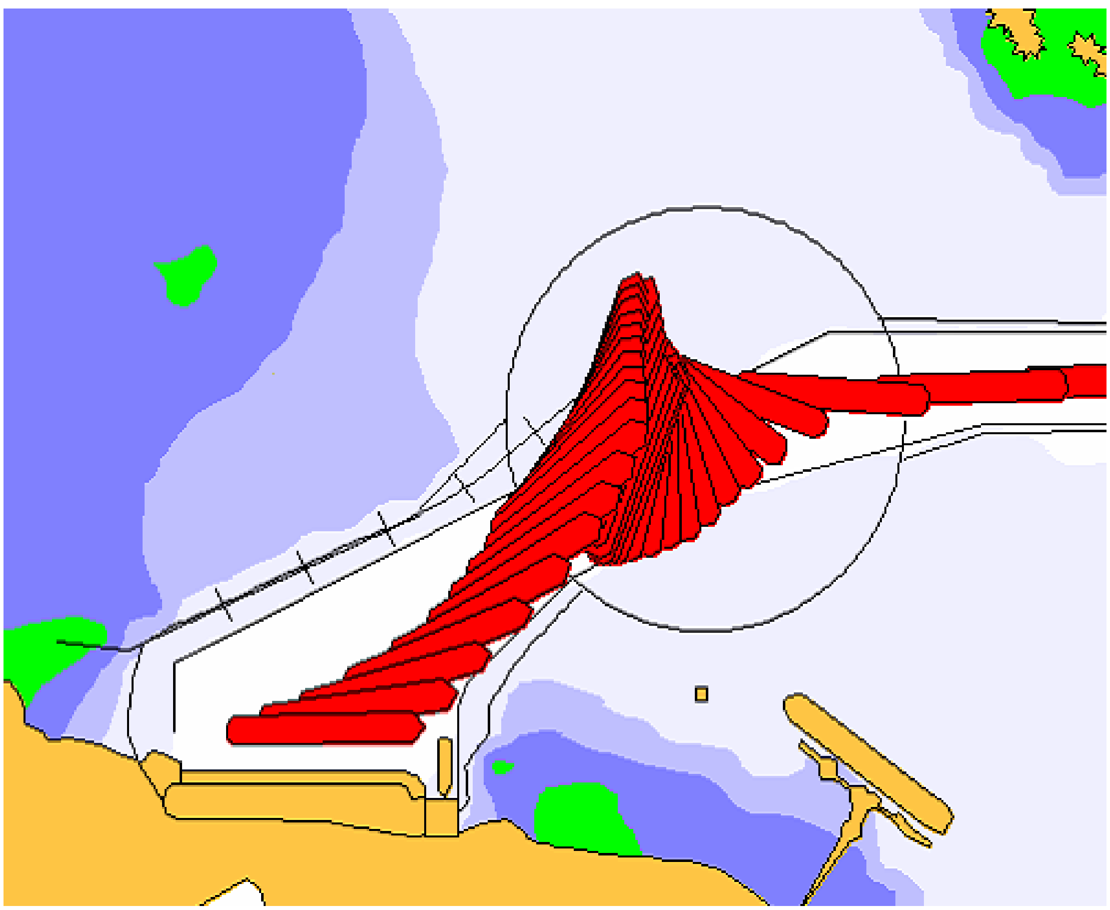


Figure 2-36: Inbound Manoeuvre 20 knots from North. Track Path to extreme North of Channel.

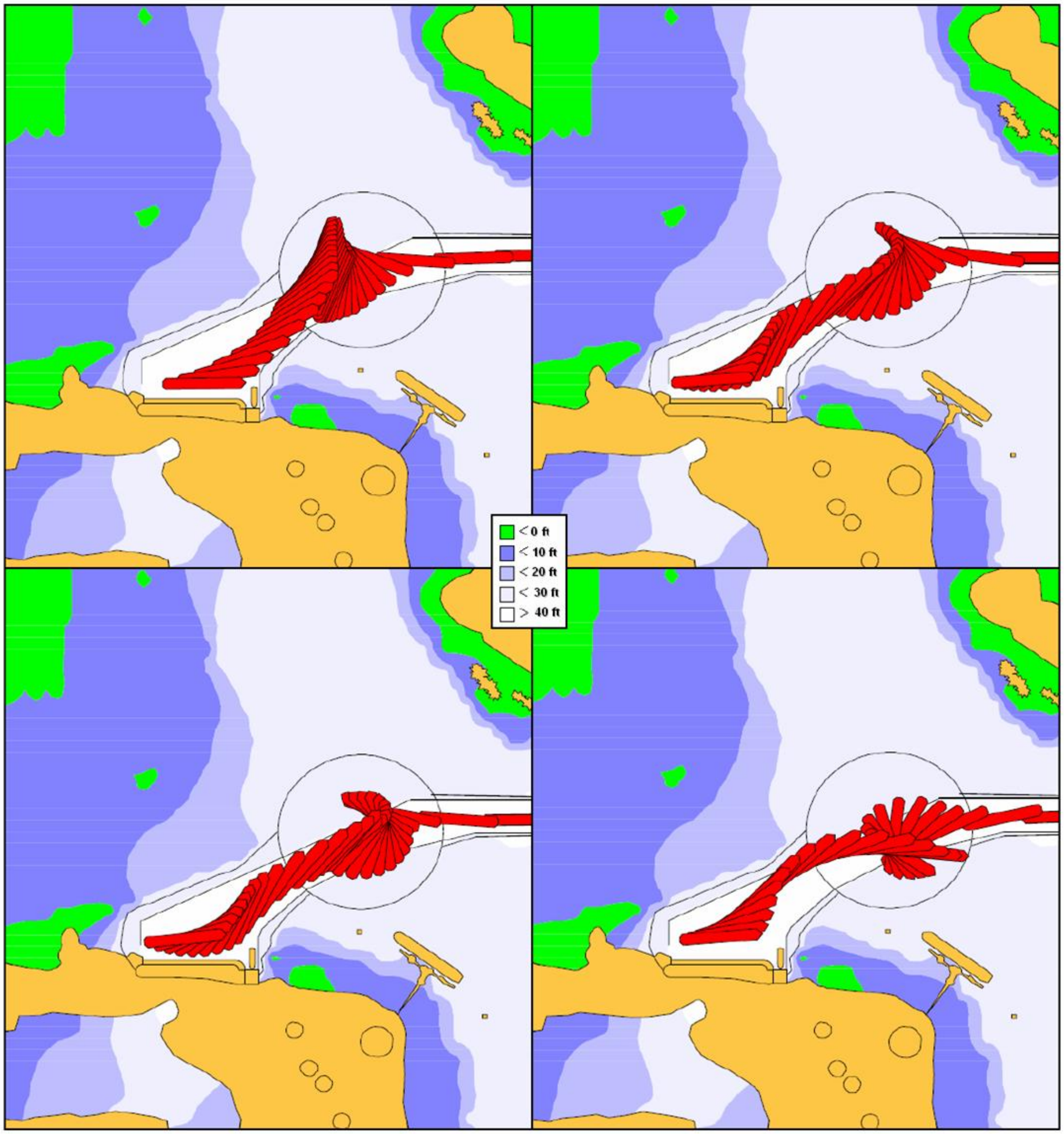


Figure 2-37: Inbound Manoeuvre 20 knots with no tug assistance. Clockwise from Top-Left: North, East-southeast

2.5.2.3.2 Inbound Transit - 30 knots wind speed, with waves, with tug assistance.

The following discussion and associated figures describe a simulation carried out by the navigation model from beginning to end. The case was examined for an assumed maximum operational condition 30 knot wind from the north, east, ESE, and south directions with the aforementioned wave field and tug assistance provided by two 3,000 hp conventional tugs. The efficiency of the tugs was reduced in the model to simulate a loss of effectiveness due to waves.

Each plot presents the track path of the vessel overlaid on the bathymetry of the waterway. **Figure 2-38** presents a sample of the basic manoeuvre. The bulk carrier enters the channel and transits under its own power to the turning basin. Tugs are attached at the entrance of the channel, however not used until the turning basin and then for the remainder of the manoeuvre.

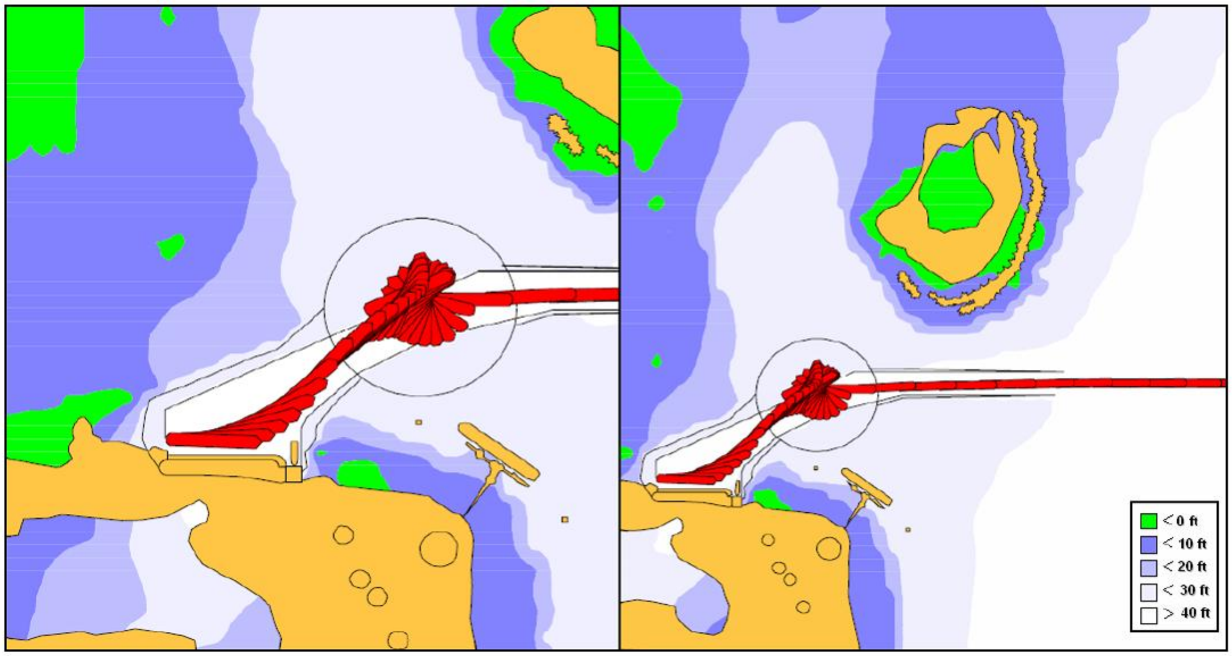


Figure 2-38: Inbound Manoeuvre - 30 knots wind speed; Left: Close up of Berth - Right: Overall Transit

With 30 knots of wind speed, the carrier is able to transit the channel and come to a stop within the turning circle. Using the ships propeller and tug assistance, the carrier is able to transit back towards the berth while maintaining proper course and direction. The run was terminated with the carrier parallel to the berth, where the tugs will be able to push the carrier onto the berth. Tug power assures greater precision while turning and berthing the carrier under wind conditions up to 30 knots, allowing the carrier to follow the track path which is set approximately in the centre of the channel. As entering the channel posses no difficulties for manoeuvring, only plots of final portion of the manoeuvre are presented in **Figure 2-39**.

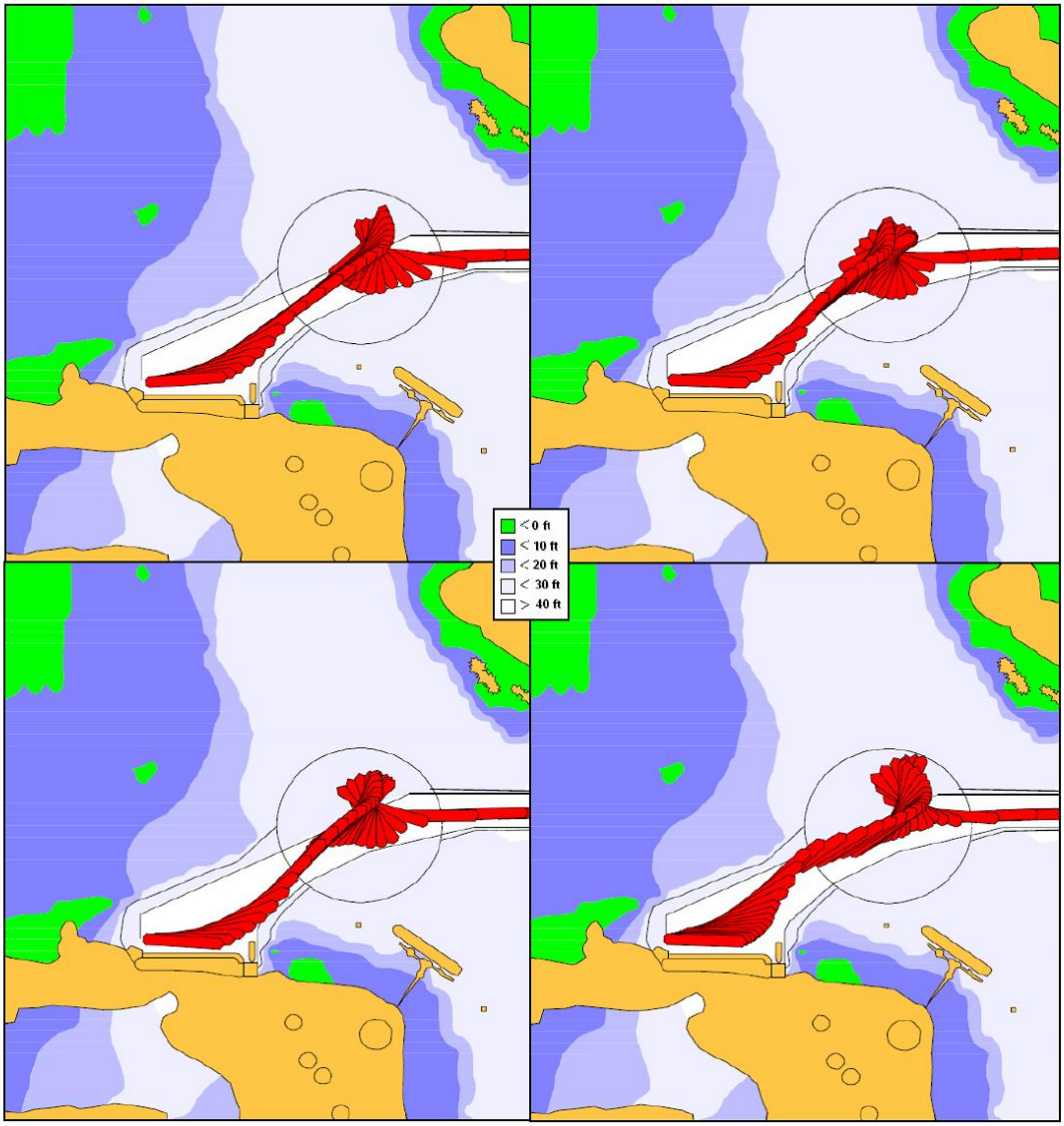


Figure 2-39: Inbound Manoeuvre 30 knots with tug assistance. Clockwise from Top-Left: North, East, South, East-Southeast

2.5.2.3.3 Inbound Casualty Transit 30 knots wind speed, with waves, with tug assistance.

The case was examined for an assumed maximum operational condition 30 knot wind from the east, with the aforementioned wave field and tug assistance provided by two 3,000 hp conventional tugs. The bulk carrier experiences a loss of the ships engine as well as use of the rudder approximately 100 m outside of the proposed channel. The ships rudder is locked at midships and engine RPMs are reduced to zero; the two tug boats are attached, one at the bow and the other at the stern, before the vessel enters the channel.

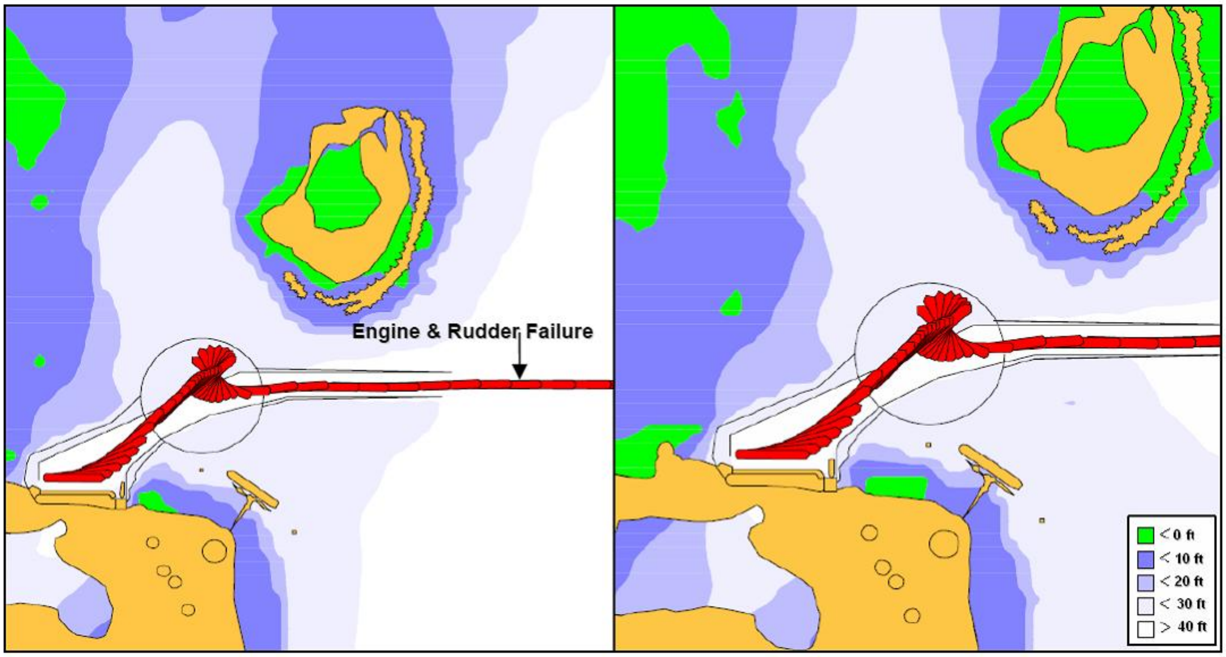


Figure 2-40: Inbound Manoeuvre 30 knots wind speed; Left: Overall Transit - Right: Close up of Berth

Despite the 30 knot wind speed, the carrier is able to maintain course in the channel with the aid of tug power. The tugs are able to slow the carrier to a near stop within the turning basin and then manoeuvre the carrier to the berth. Success of the manoeuvre is attributed to immediate tug response as soon as the bulk carrier experiences failures. The major concern of the manoeuvre is slowing the carrier to a near stop within the turning basin. Once the carrier has come to a stop, the manoeuvre towards the berth varies little from the same manoeuvre performed with the use of the carrier's engine and rudder. The run was terminated with the carrier parallel to the berth, where the tugs will be able to push the carrier onto the berth. While this case provides an example of possible ship casualty, further and more detailed instances should be examined using a real-time, full mission bridge simulator with a pilot in the loop.

2.5.2.3.4 Outbound Casualty Transit 30 knots wind speed, with waves, with tug assistance.

The case was examined for an assumed maximum operational condition 30 knot wind from the ESE, with the aforementioned wave field and tug assistance provided by two 3,000 hp conventional tugs. The bulk carrier experiences a loss of the ships engine approximately 100 m outside of the proposed channel. The ship's rudder is still in use and engine RPMs are reduced to zero; the two tug boats are attached, one at the bow and the other at the stern.

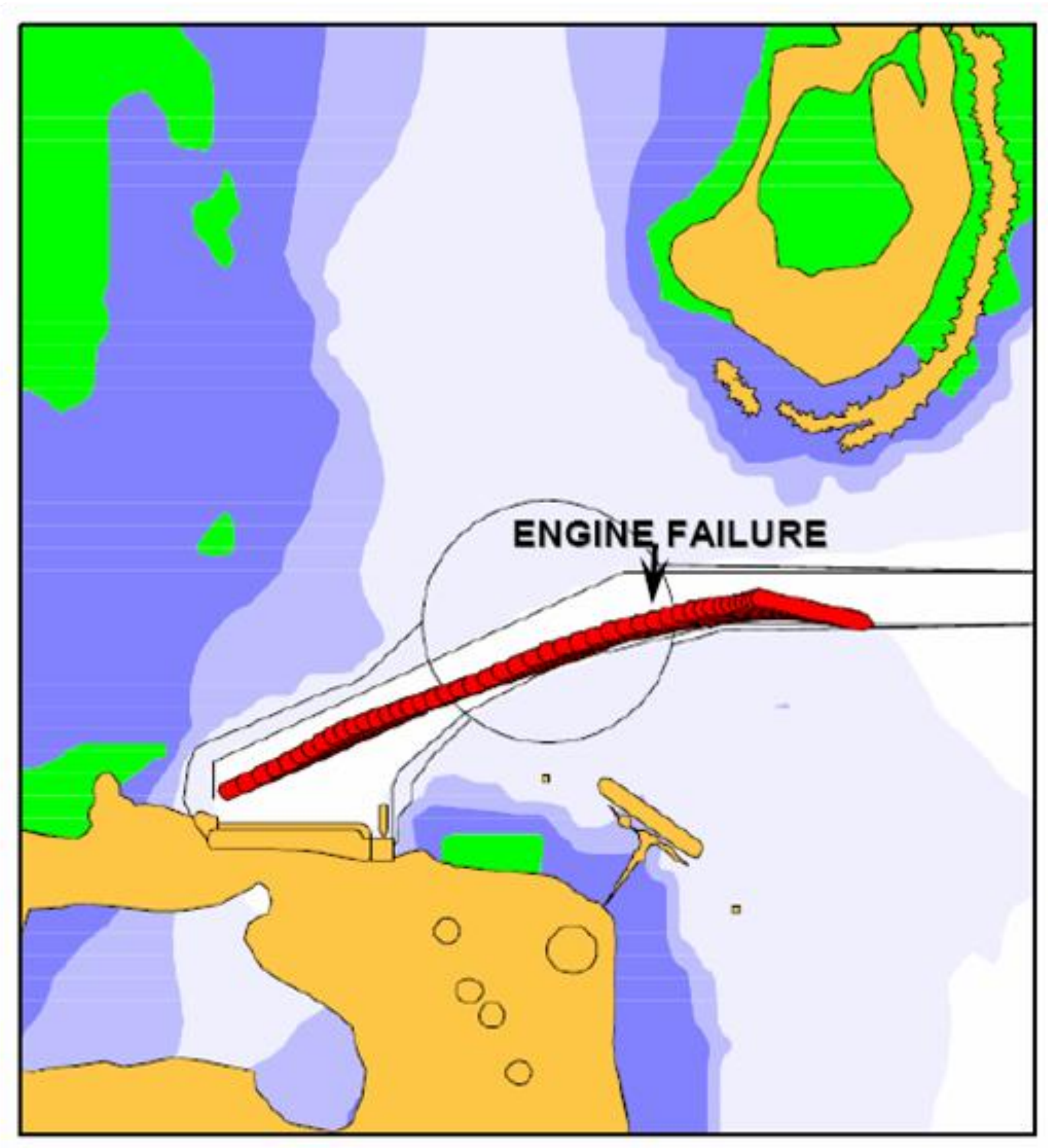


Figure 2-41: Outbound Manoeuvre without tug assistance (30 knots wind speed)

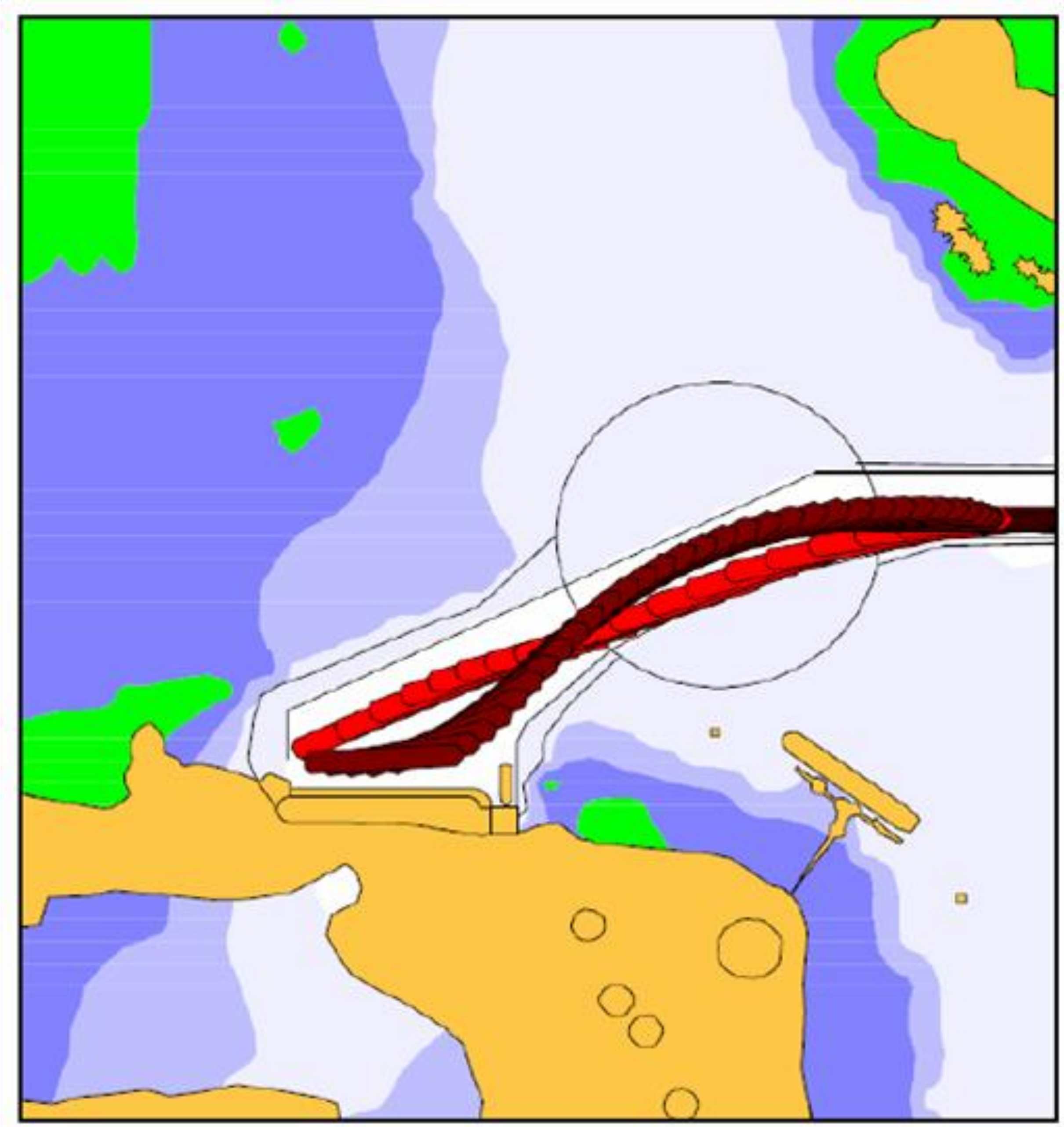


Figure 2-42: Outbound Manoeuvre when tugs are used (30 knot wind speed)

If no tugs are used for the manoeuvre, and the bulk carrier loses its engine within the turning circle, then wind catches the area on the deck house of the carrier and creates a moment about the ship, causing the bow to travel outside of the channel boundary as seen in **Figure 2-41**.

If tugs are attached to the carrier, then as soon as the ship looses engine power, the tugs become effective and are able to slow the vessel down. Once the vessel is under control, the tugs are able to reverse the loaded carrier back towards the berth (**Figure 2-42**). The run was terminated with the carrier parallel to the berth, where the tugs will be able to push the carrier onto the berth.

For clarity, the figures have a reduced time step to show the vessel's progress every 30 seconds throughout its transit. While this case provides an example of possible ship casualty, further and more detailed instances should be examined using a real-time, full mission bridge simulator with a pilot in the loop.

2.5.2.3.5 Outbound Transit 30-knot wind speed, with waves, no tug assistance.

The following discussion and associated figures describe a simulation carried out by the navigation model from the proposed RINKER berth to a distance offshore where inbound manoeuvres were started. The case was examined for 30-knot winds from varying directions, with the aforementioned wave field and no tug assistance. Each plot presents the track path of the vessel overlaid on the bathymetry of the waterway.

It is assumed the carrier will use its bow thruster to gradually move the bow away from the berth. From there, the ships main engine is engaged as it begins its transit towards the channel and away from the berth. The ship continues to pick up speed up to approximately 5 knots at the end of the channel, where the manoeuvre is terminated. This outbound transit is more easily accomplished, as its loaded draft provides stability and reduced wind area. The vessel also increases its speed, which provides water over the rudder and allows for better manoeuvrability.

Figure 2-43 presents plots for outbound manoeuvres for each wind condition examined.

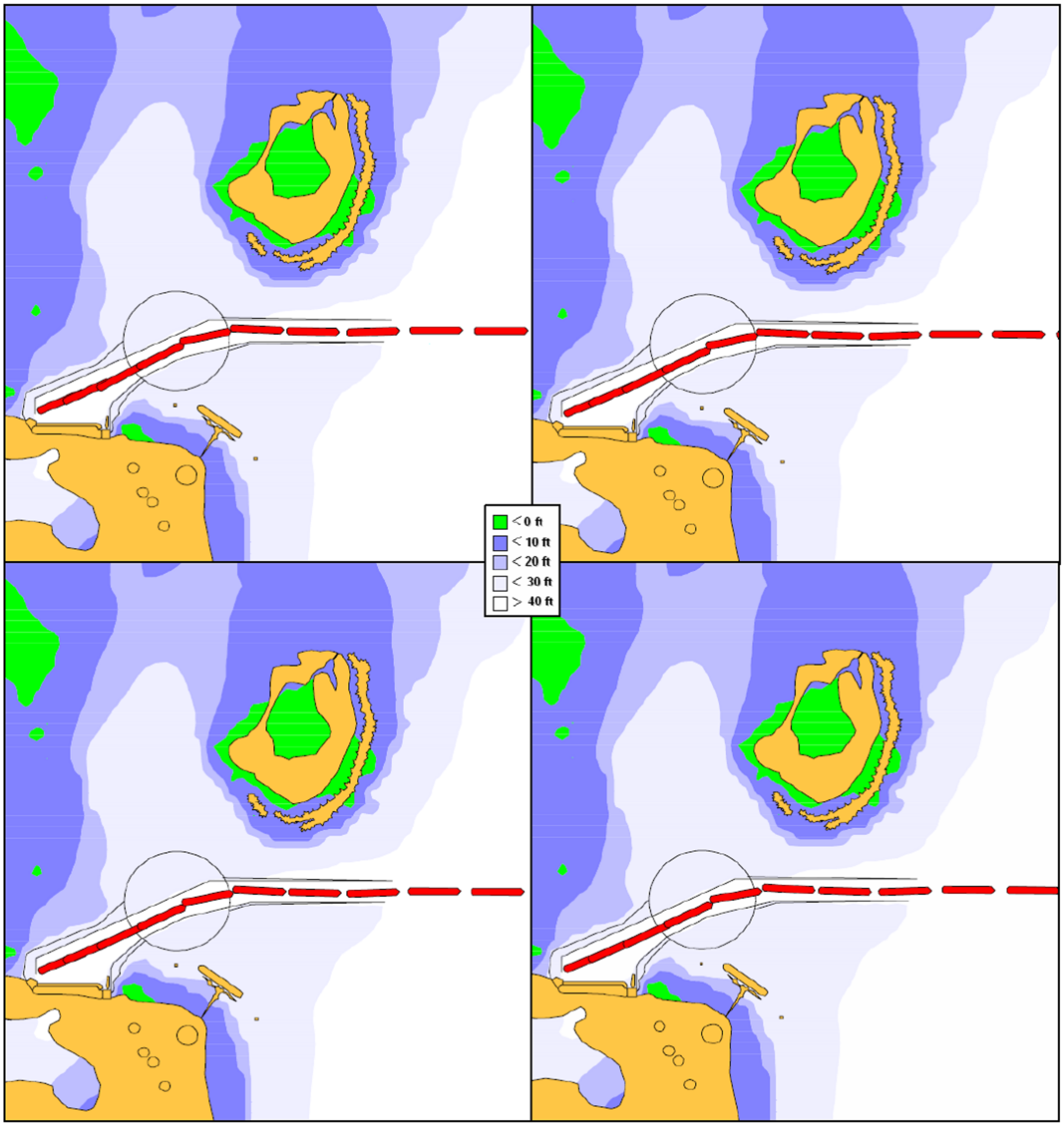


Figure 2-43: Outbound Manoeuvre 30 knots with no tug assistance. Clockwise from Top-Left: North, East, South, East-Southeast

2.5.2.4 Potential Passing Vessel Impacts

A passing vessel causes both a wake, and a drawdown of the water s surface. The magnitude of these vessel induced waves depends on the geometry of the channel, shape of the vessel hull, draft, and speed of passing. The greater the confinement or blockage, that is, amount of cross-sectional area of the channel occupied by the vessel displacement, the more pronounced the drawdown effect. These passing vessel induced waves decay with distance from the vessel but have the potential to impart undesired forces and motions on nearby moored vessels that can break mooring lines. The bulk carrier transiting to the proposed RINKER terminal will pass the existing JAMALCO facility. The channel is approximately 1300 feet from the JAMALCO mooring dolphin.

The PASS-MOOR model of the US Naval Facilities Engineering Service Center (Seelig, 2005) was used to estimate the force due to the passing bulk carrier on a similar sized moored vessel at the JAMALCO berth. The approximate lateral loads imparted were calculated at approximately 5 kips and 1 kip longitudinally for a 5-knot passing vessel speed. **Figure 2-44** illustrates the calculated applied force time history from the PASS-MOOR model.

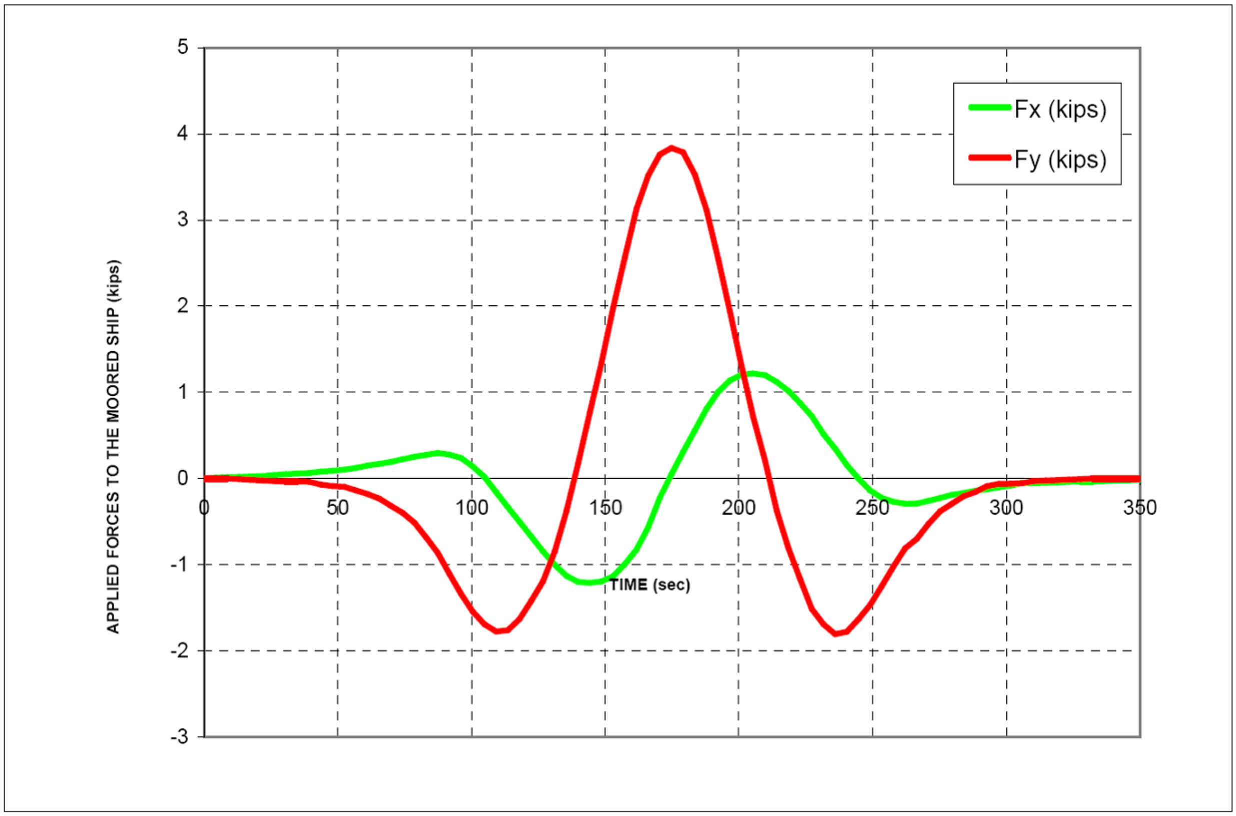


Figure 2-44: Modelled Applied Force Time History

These loads are considerably less than anticipated wind loads (which are at least an order of magnitude greater) and typical mooring line strengths. Therefore, the passing vessel should have minimal impact on the moored vessel.

2.5.2.5 Conclusions and Recommendations

Moffatt & Nichol (M&N) was contracted by RINKER Materials to perform an analysis of the manoeuvrability of a bulk carrier through a proposed channel and turning basin towards a berth at Rocky Point, Jamaica. The manoeuvres were preformed without tugs for wind speeds of 20 knots; higher, 30 knot, wind speeds were also examined with the use of tugs. A casualty manoeuvre was also performed to provide an initial assessment of the outcome when engine and rudder failure are experienced.

A vessel manoeuvre simulation case is determined to be a success when the vessel navigates its course with little or no deviation from its intended track. A case is considered unsuccessful if the vessel drifts off course dramatically or runs aground, or outside the channel boundaries.

The result of various cases simulated leads to the conclusion that tug assistance will be required to complete the manoeuvre under wind conditions greater than 20 knots. For wind speeds less than or equal to 20 knots, the manoeuvre can be performed using the ship s power, rudder and bow thrusters. The bow thruster was used throughout the turning manoeuvre to aid in directing the vessel. Widening the southern edge of the channel which connects the turning basin could reduce the risk of grounding, while the carrier transits from the turning basin to the proposed berth.

A few basic casualty manoeuvres indicate that berthing can occur when the carrier experiences loss of engine and rudder outside of the proposed channel as long as adequate tug power is provided. The bulk carrier can also be towed back to the terminal when it attempts an outbound manoeuvre and experiences loss of engine in the turning basin. These basic allision manoeuvres provide some insight into emergency manoeuvres, however, real-time simulations with a pilot in the loop are recommended.

Vessel departure was also modelled, and indicates that manoeuvres can be completed with winds up to 30 knots without the use of tugs for outbound transits.

In the cases simulated, both the outbound and inbound transiting and berthing vessel remain within the channel boundaries and do not interfere with JAMALCO marine facilities.

Calculated passing vessel loads are considerably less than anticipated wind loads and typical mooring line strengths. Therefore, the passing vessel should have minimal impact on the moored vessel.

2.6 Personnel Requirements

The proposed operations will require a range of specialised and professional skills and labour at all stages of project development. These skills are required at various locations which make up the chain of activities that characterises raw material procurement – mining, processing and distribution to overseas markets. This phase of development will employ approximately 380 persons at peak construction, and approximately 90-150 at peak operation (Port, Conveyor & Quarry) with the required skills inclusive of:

- Management and administration
- Engineering and technical services
- Equipment operations
- Port management
- Technicians and artisans among others

All employees will require training prior to start-up of the operation. The skills are readily available in Jamaica which has been engaged in relatively high technology operations for over 50 years as a result of its bauxite-alumina, sugar, petroleum refining, power generation and various manufacturing and minerals extraction industries.

In addition, the internal policy of RINKER facilities worldwide is to provide training for all its employees inclusive of safety and operations training. **Figure 2-45** below shows a graphical representation of estimated peak labour requirements.

The proposed area for implementation of this project has been supporting large scale industry for many years, as major sugar factories and bauxite-alumina operations are located there. All employees regardless of background will undergo training prior to start-up. The employee pool is expected to comprise individuals from the immediate area as much as possible.

The skill-set anticipated for this phase as well as the quarry expansion is outlined below:

ADMINISTRATION	PLANT	SERVICES	LOADOUT
General Manager	General Superintendent	Kitchen Personnel	Loadout Foreman
Accounting Manager	Pit Foreman	Electrical	Loadout Maintenance Foreman
IT Manager	Pit Maintenance Foreman	Infirmary Personnel	Dock Foreman
Safety Manager	Plant Foreman	QC Personnel	Loadout Labours
Plant Manager	Plant Maintenance Foreman	Warehouse Personnel	Loadout Mechanic
Loadout Manager	Mobile Mechanic	Landscaping	
Maintenance Manager (Plant)	Plant Mechanic	Security	
Maintenance Manager (Mobile)	Electrical	Perimeter Security	
QC Manager	Production	Clerical	
Purchasing Manager	Clerical		
HR Manager	Welders		
Kitchen Manager	Tire Labour		
Housing Manager	Loader Driver		
Electrical Manager	Truck Driver		
Warehouse Manager	Drivers		
Security Manger	Drillers Blasters		
Clerical	Stripping		
	Load		
	Secondary breaking		
	Crush primary		
	Crush secondary		
	Crush tertiary		
	Plant Tunnel		
	Sand production		
	Labours/Clean-up		

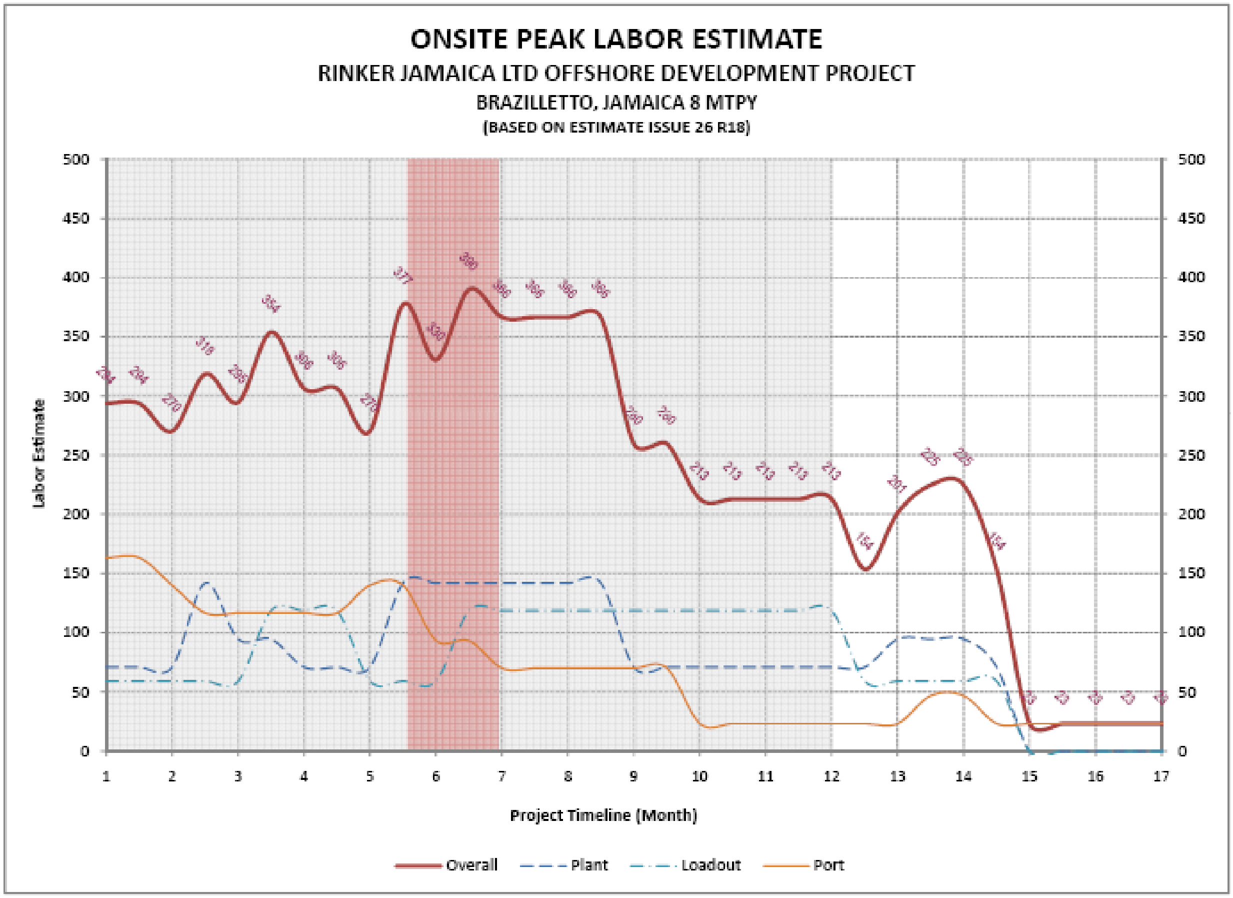


Figure 2-45: Onsite Peak Labour Estimate - Construction

2.7 Solid Waste Management

Solid waste will be generated during the pre-construction, construction, and operation of the temporary barge unloading facility. During pre-construction solid waste will be generated from land clearance and soil movement. During construction activities, solid waste will be generated primarily from packaging and containers related to materials, supplies and equipment brought in for the construction phase of the project. RINKER will place garbage skips at the proposed Port to effectively manage this anticipated increase, also the frequency of collection will be matched to the amount of waste being generated to avoid pile-up or spilling of contents. Collected solid waste will be transported by an approved solid waste haulage contractor for disposal at an approved landfill.

2.8 Sewage Handling

Temporary portable chemical toilets will be used during the construction of the port and aggregate stockpiling facility. These toilets are widely used throughout construction operations, as well as within the operations of industrial entities island-wide.

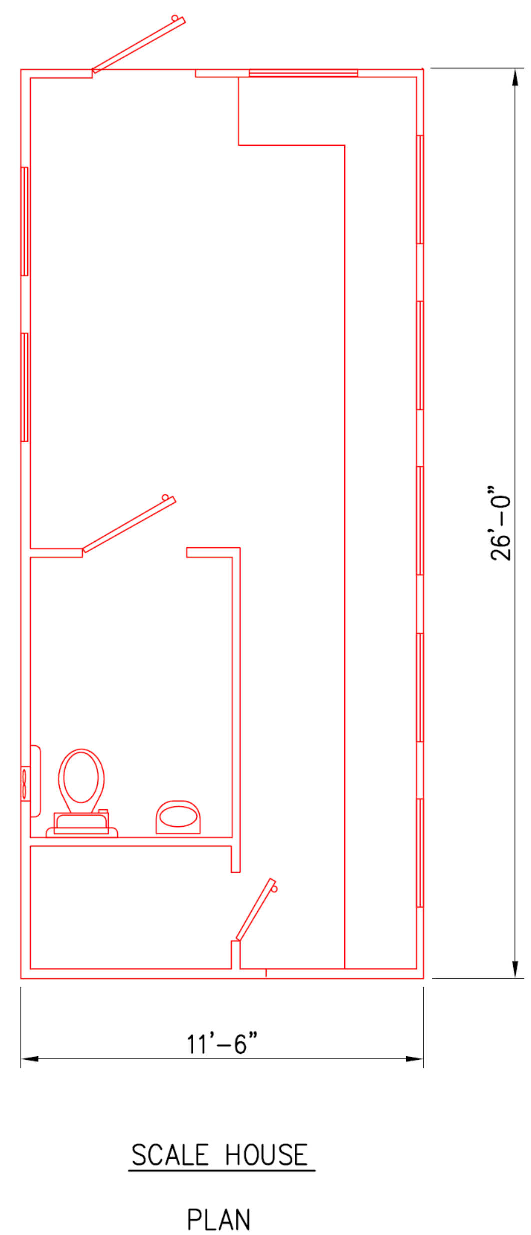
A private contracted firm will maintain, remove and dispose of the sewage and provide manifesting to RINKER regarding the point of final disposal.

During the operational phase, a small septic system is being proposed for the port development. A pre-cast building with an enclosed septic tank that can be pumped out once per month is being proposed. Rinker has utilised this system at other ports in the US to great effect. A representation of this system is shown below along with a write-up/brochure in the **Appendix IX**.

The design also allows for the building to be used as a small office at the port. **Figure 2-46** below shows a typical plan of the proposed wastewater package plant.

A tertiary treatment facility will be built at the proposed plant site to facilitate treatment of the wastewater generated. This move is to ensure the hydrological regime is not impacted negatively by this aspect of the operations and that health, sanitation and safety standards are met.

Under circumstances of reasonable usage, sewage can be anticipated to be generated at a rate of 12.5 litres per individual per shift.



Scale House

11'-6" x 26' Concrete or Block Building, shall include the following:

Structural Specifications:

- Concrete: Steel-reinforced, polypropylene fiber reinforced, 4000 PSI minimum 28-day compressive strength, air-entrained (ASTM C260).
- Reinforcing Steel: ASTM A615, grade 60 unless otherwise indicated.
- Reinforcing Fiber: Polypropylene fiber, Fibermesh @ 1.5 pounds per cubic yard.
- Caulking: All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be SIKAFLEX-1A elastic sealant or equal.
- Panel Connections: All panels shall be securely welded together with 1/4" thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A283, Grade C. Cast-in anchors used for panel connections to be Dayton-Superior #F-63, or equal.
- Walls & Roof: 2-Hour Fire Rated.
- Walls 3", Floor 6", Roof 4" @ edge; 5" @ center; giving 1" slope from center to edge.
- Loadings: Wind 120 MPH, Roof 60 PSF, Floor 250 PSF.

Features to be provided:

Layout:
- 8' x 5' restroom (ADA Compliant) with 4' x 5' utility chase/storage area, 10,000 gallon vault, fluorescent lighting, china toilet & sink, mirror, 8" ventilation fan, stainless steel paper towel and toilet paper holders.
- Main room with countertops, windows and door.

Structural:
- 8' Interior Height.

Electrical:
- 125 amp breaker panel
- EMT surface mounted conduit
- (6) 4' dual bulb fluorescent light fixtures with switch
- (1) fluorescent light fixture in restroom with switch
- (1) incandescent light fixture in chase with switch(6) 120v 20 amp duplex receptacles
- Exterior 70W HPS light fixture with photocell and switch (mounted over door)

Environmental:
- 2.5 ton wall mounted HVAC unite with heat and thermostat
- R-18 insulation with FRP laminated 3/4" wheatboard walls and ceiling, white
- Floor smooth finished concrete with non-slip floor coating

Accessibility:
- Two (2) 3'-0" x 7'-0" 3-hour fire rated 18 gauge steel door with 16 gauge cast-in-place frame, drip edge, NRP hinges, mortise lockset, hydraulic door closer, aluminum threshold, galvanized, primed & painted.
- 3'-0" x 6'-8" restroom door, painted wood.
- 3'-0" x 6'-8" chase door, painted wood.

Exterior Texture:
- Exposed aggregate or smooth painted exterior finish

Miscellaneous:
- 32' foot countertop (under windows)
- Eight (8) 3' x 4' windows (270° view)
- Opaque Lexan sidelight in restroom
- Hurricane tie-down package (150+ MPH wind resistance)
- All required Florida approvals

REVISIONS

REV.	DATE	BY	DESCRIPTION
A	05-25-07	RGB	RELEASED FOR PRICING

REFERENCE DRAWINGS:

JAXPORT JACKSONVILLE PORT AUTHORITY

Rinker MATERIALS

Rinker Materials
Jaxport Terminal
DAMES POINT
Jacksonville, FL

GENERAL ARRANGEMENT
SCALE HOUSE
PLAN VIEW
DESCRIPTION

SCALE: 1"=1'–0"
DRAWN: JEK
DATE: 12/12/06
CHECK:
DATE:

BROOKS SYSTEMS PROJECT NUMBER: 26909

Registered Engineer
FLA. REG. NO.

DRAWING NUMBER: A–SH1–1060 REV. A

Figure 2-46: Pre-Engineered Wastewater Package Plant (Prefabricated Modular Concrete Structure)

ANALYSIS OF ALTERNATIVES

3 Analysis of Alternatives

3.1 Introduction

In considering the development options, the following alternatives were analysed. These are:

1) No Action
2) The Proposed Development
3) Alternative Location (Port & Conveyor)
4) Alternative Technology (Conveyor)

3.2 No-Action Alternative

With the "No Action" Alternative, the dry limestone forest and mangrove areas would remain the same. The mangroves would experience continued disruption through charcoal burning, land clearance for housing and bee-hive as well as continued dumping. The limestone forest with the reserves in place would not be utilised beyond the existing rate of quarrying being done by Chemical Lime Company.

The potential investment to this relatively poor community would not be realised. The unemployment rate would remain high. The existing lack of social amenities would also remain the same.

The size and scale of the proposed development along with the level of proposed investment and potential positive spin-offs for the surrounding communities, especially in terms of jobs, makes the No Action Alternative unacceptable.

3.3 The Proposed Development

The proposed project seeks to develop a Port and Conveyor Corridor adjacent to the existing JAMALCO Port facility along with dredging of the sea floor to allow for access of vessels up to PANAMAX size, equipment and supplies. The proposed alternative (preferred alternative) has taken into account various discussions with stakeholder groups (government, non-government and residents of surrounding communities) over the past four (4) years in the final designs.

Initially, a large-scale port-side stockpiling was proposed. This alternative was debated with various entities and the extent of the negative social and environmental implications allowed for a revision of designs. This proposed development is the outcome of these discussions.

The proposed port is designed further out in deeper waters to reduce the footprint on sensitive and important natural reserves such as mangrove, seagrass and corals. The northward limit of the port is defined by the compromises acceptable with the prevailing setting (wind, waves, water depth etc.). The potential impact from storm surges associated with tropical storms and hurricanes limit the maximum distance from shore for the port. The stockpiling area also represents a compromise on impact to sensitive and important natural reserves such as mangrove, seagrass and corals. The footprint of the proposed stockpiling is reduced from previous designs to maintain the lowest possible impact to these resources. As outlined in the Project Description, the proposed port will affect 1.2 hectare of seagrass down from 7.5 hectares in previous designs. No corals will be lost with this design, similar to previous designs.

The conveyor corridor associated with the proposed port will be elevated on piles to ensure limited seagrass impact nearshore. The impact to mangroves is regulated by the stipulation of a 15 m setback from the existing JPS transmission corridor. In this area pilings will also be constructed to reduce the impact to tidal flats, as well as storm surge inland. In other areas on more consolidated land there will be a filled footprint for the conveyor corridor. The impact zone in this area is approximately 5.6 hectares and represents impact to mangrove and other nearshore vegetation and tidal flats/Salinas.

A comprehensive impact assessment was undertaken for actual footprint impacts on seagrass and mangroves (See Section 6 of this report). This section also provides specific mitigation measures for impacts to these resources.

The proposed project, despite having some environmental implications, presents the best practical, socio-cultural and economic option. The proposed project as designed will allow for the retention and protection of a significant stand of mangroves and seagrass in an area with the largest single intact mangroves along Jamaica's coastline. It reduces the access points to the mangroves from hunters, charcoal preparers and also from illegal solid waste disposal and drug trafficking. RINKER/CEMEX has a rich history of sustainable development and as part of its operations in Jamaica will ensure its continued viability into the future for Jamaica's future generations to enjoy, while providing the necessary jobs for a community considered one of the poorest in the country, while contributing to the national income.

This proposed project is in line with current developments in the area. RINKER proposes to use a conveyor corridor from the transport of aggregate material from the quarry to the port in similar practice to the rail used by JAMALCO in the same vicinity. This will significantly reduce the likelihood of many negative impacts which have been experienced in the past. These negative impacts include severe traffic congestion, the need to modify roadways, the removal of utilities and the cutting down of trees to facilitate movement of material and equipment. This is the preferred alternative.

3.4 Location

3.4.1 *Aggregate and Port Alternatives*

Based on the location of suitable aggregate reserves and port, a number of sites were identified and evaluated islandwide for aggregate supply and port options. The table below outlines the analysis for the selected location. There were several locations that could be considered suitable but the proposed location was evaluated as most feasible, as it relates to the economic, social and environmental considerations. The suitability of a location was referenced against the following nine (9) parameters:

1. Resource / reserves
2. Access to site
3. General development of surrounding area
4. Water / electricity
5. Port facilities
6. Transportation modes to port
7. Availability of labour in area
8. Land ownership
9. Environmental sensitivity

The areas included in this assessment covered at least seven (7) parishes: the following table outlines the assessment as it relates to Brazilletto Mountains and Rocky Point in Clarendon.

Table 3-1: Summary/Ranking of Aggregate Reserves and Port Possibilities in Jamaica

Characteristics	Brazilletto Mountains - Clarendon
Resource / reserves	Prime areas already under control by Chemical Lime. Operations of both quarry and port are brown sites.
Access to site	Partly paved quarry road leading off main road from Old Harbour – Salt River
General development of surrounding area	Fishing village located at Welcome Beach and Guest House and Spa at Milk River. Protected area with mixed-use zoning – Industrial and mining zone included
Water / electricity	Electricity available, water marginal upgrading required
Port facilities	Nearest port is the JAMALCO Rocky Point port less than 3 miles from quarry site. Draft limitation – approx. 35-37 ft (Handymax vessels)
Transportation modes to port	Area located along coast. Overland conveyor system to port with area for stockpiling portside possible
Availability of labour in area	Labour pool availability. Retraining required
Land ownership	Government and private
Environmental	Although this is under the control of Chemical Lime, the following should be noted: • Brazilletto is in a protected area. A permit was issued for a quarry, lime plant and port. The Brazilletto Mountain area was under stress from charcoal burning activities. There is severe unemployment in the area. The level of poverty is reportedly the highest in Jamaica. • A permit was obtained for establishing a port at Salt River (separate and apart from that mentioned above). This is close to the Port Esquivel and JAMALCO Rocky Point Ship Channels. **Conclusion**: Perhaps a closer look, in terms of feasibility, should be taken of the Salt River possibility. **Recommendation**: The Salt River Port possibility should be analyzed. Overland transportation from Salt River is the main challenge. A permit has been obtained for a port at Salt River. A permit could be obtained for the overall project. Salt River – Rocky Point of high priority.

3.4.2 *Port and Conveyor Corridor*

3.4.2.1 Port

The nearest established ports are JAMALCO's Rocky Point Port and Windalco's Port Esquivel which houses alumina shipping operations. These ports have limited wharf capabilities and the potential delays and congestion that would occur at the port could render the operations infeasible and potentially hazardous. This option will not accommodate either entities potential expansion plans. Outside Clarendon, the other potential ports of entry would be port locations within Kingston Harbour to the east (Kingston) and Port Kaiser to the west (St. Elizabeth). This alternative would be economically disadvantageous to RINKER. Similarly, it would be socially and to a lesser extent environmentally disadvantageous to the job creation in the South Clarendon area.

In the event that a deal could be brokered with another wharfage facility, RINKER would have to transport the aggregate material via significant distances by road, through communities that would prove disruptive, negatively impact the natural and built environments and result in significant cost to RINKER as well as upgrades to the routes and possible compensation for disruptions.

These options present a high economic cost to RINKER and inherent dangers in transporting equipment via roadways to these ports with the exception of JAMALCO's Rocky Point.

Additionally, the Brazilletto Quarry had received a permit to build a port in the location of Salt Island, a nearshore cay. This option, though possible, presents significant obstructions to the boating and recreational amenities of residents in the region. The ecological damage would also be greater since various aspects of creating a new port such as dredging would be conducted in a fairly less disturbed region.

3.4.2.2 Stockpile Area

The quarry is located in the foothills of the Brazilleto Mountain to the north. The current Chemical Lime Quarry has been assessed as having material that is too soft in nature with regards to the final intended product. Material that will satisfy the intended project has been found in the western end of mining lease 129. This will necessitate the opening of the western face of the mountain to quarrying. This presents significant positive implication in comparison to quarrying from the current quarry location.

1. The southern face of the mountain designated as a buffer zone will remain intact. That is, no conveyor corridor will be required to exit the foothills via the Salt River community.

2. The routing of conveyor and its associated noise and vibrations will be routed further away from the Salt River and Brazilletto Settlement communities.

In order to ensure enough material is available to load a ship when in port, a small reserve stockpile must be maintained. The ability of a port to service a ship has direct cost constraints. The proposed plan entails the stockpiling of approximately 90,000 tons of washed and sized aggregate at the port, sufficient to fill 1.5 ships (assuming PANAMAX vessels of capacity 60,000 tons).

The alternatives evaluated included: the proposed port with reserve stockpile of 1.5 ships volume, a large-scale stockpile adjacent the proposed port, and stockpiling within the quarry confines. Each alternative evaluated had their own constraints and the proposed project (the preferred alternative) was chosen based on various parameters, chief among which were:

- Engineering constraints,
- Project Economic costs
    - Distance to port from quarry
    - Length of conveyor required
    - Operating schedule
    - Suitability of aggregate raw material
- Socio-economic implications on nearby communities and commercial infrastructure, and
- Environmental implications within a declared protected area.

Stockpiling at the port presents a major advantage to other options due to the significant economic options particularly as it relates to cost associated with loading ships beyond the usual loading timeframe. However, this option presents significant environmental implications, particularly as it relates to the loss and/or modification of the biological resources in the area, namely: seagrass, mangrove and coral reefs. The social implications of port side stockpiling are limited to reduced aesthetic appeal.

The preferred alternative requires reserve stockpiling at the port to fill 1.5 ships at any given moment. This proposed port would impact approximately 1.2 hectares of seagrass and 5.6 hectares of mangrove habitat (mangroves and other essential habitat requirements). This represents a compromise between stockpiling at the quarry and large-scale stockpiling adjacent the port.

Large-scale port-side stockpiling will result in a loss of at approximately 7.5 hectares of seagrass and 5 hectares of mangrove. Impacts to coral reefs in the area due to direct loss are negligible. The corals in the area are currently subjected to significant stress from reduced water quality and other impacts such as recent natural hazards, particularly hurricanes. **Plate 3-1** below outlines the conveyor route with port-side large-scale stockpiling

Stockpiling at the quarry similarly has economic, social and environmental implications. Stockpiling within the quarry will result in continuous conveyor operation when ships are in port. This will exacerbate the ambient noise and vibration within the region of the community that the conveyor passes through. The conveyor will require a direct 7 km line to service ship loading activities which presents a significant economic cost as well as increase potential for negative occurrences.

3.4.2.3 Conveyor Corridor Route

Four alternative conveyor route options to the proposed were analyzed for the transfer of aggregate from the process plant to the ship loading facility. **Plate 3-1** shows the conveyor running south from the Quarry bisecting the Brazilletto Mountain foothills through the Salt River community. Stockpiling for aggregates would take place on the plains.

The second alternative has the same general route as alternative 1 with the exception of stockpiling adjacent the proposed port (**Plate 3-2**). The third conveyor route passes through the mangroves with port-side stockpiling (**Plate 3-3**). The last option shown in **Plate 3-4** has the conveyor going over water to Salt Island. Of the 5 options, **Plate 2-1** in the project description shows the preferred route with the least environmental impact and incidentally, the lowest cost alternative. The conveyor proposed will be a completed hooded throughout.

Alternative 1 will result in habitat fragmentation of the proposed buffer zone (foothills of Brazilletto Mountains. This alternative will result in significant noise and vibration effects to residents in close proximity to the corridor. Alternative 2 includes the potential impacts of Alternative 1 as well as significant loss of seagrass in coastal waters (approximately 7.5 hectares). This represents an excess of 6.25 times the proposed impact area for seagrass with even less scope for successful mitigation. Though all attempts would be directed to ensuring the conveyor meet and exceed, where possible, existing regulations and standards, the impact to residents would be greater than the preferred alternative. The biodiversity and aesthetic loss would also be greater in the region where the conveyor splits the mountain side. The operation would also require a longer period of operation per day than the current preferred alternative. The hazards faced by the motoring and pedestrian public, though small, would also be greater than the preferred alternative.

Alternative 3 has the same impacts outlined in alternative 2 along with significant loss of mangrove. This option does not represent a possibility in light of the major ecological function of the mangroves in this area. It would also significantly impact on the critical endangered species to a greater extent, particularly the crocodile and migrant bird populations. Alternative 4 though vastly different to the others also presents major engineering and ecological setbacks. It would present impacts to the traffic patterns of local fishermen, use of the public bathing beach (Welcome Beach) and use of Slat Island to the public.

Alternatives 3 and 4 presents significant negative implications though social, environmental and economic concerns. The routing of the conveyor through the mangrove forest south of the community of Salt River would result in severe degradation to the extent of the mangroves as well as the habitat for various fauna, particularly the protected crocodile and West Indian Whistling Duck. There would be need for a maintenance roadway as well as the filling of sections of the area to provide a stable footprint for the conveyor. The mangrove community in this area is also slated for development as a nature tour and preservation site by C-CAM. It is Rinker's intention to ensure the viability of the natural resources in this area through singular or cooperative arrangements within the region. Alternative 4 would bring the footprint closer to Salt Island, a relatively unaffected area. There would also be significant negative impacts to boat traffic accessing the Salt River area. There are possible negative implications to the use of the Welcome Beach utilised by the surrounding communities for recreational needs. These alternatives are not the preferred alternatives.

The preferred alternative allows the conveyor to be routed in two segments; one from the proposed quarry to the proposed plant on the plains south and east of the community of Salt River and Brazilletto Settlement, and the second from the proposed plant east towards the port alongside the Peninsula road. This allows for the best possible option of routing the conveyor as far away from residential and ecological receptors as environmentally and economically practicable.

The necessity of Alternative 1 is in regards to the availability of lands held by the Sugar Company of Jamaica. This option therefore outlines what route would be taken should lands not be available on the plains for the Proposed Limestone Plant. It is further detailed in **Appendix X**.

Plate 3-1: Conveyor Corridor & Proposed Port with Stockpile on the Plains – Alternative 1

Plate 3-2: Conveyor Corridor & Aggregate Stockpile at Port – Alternative 2

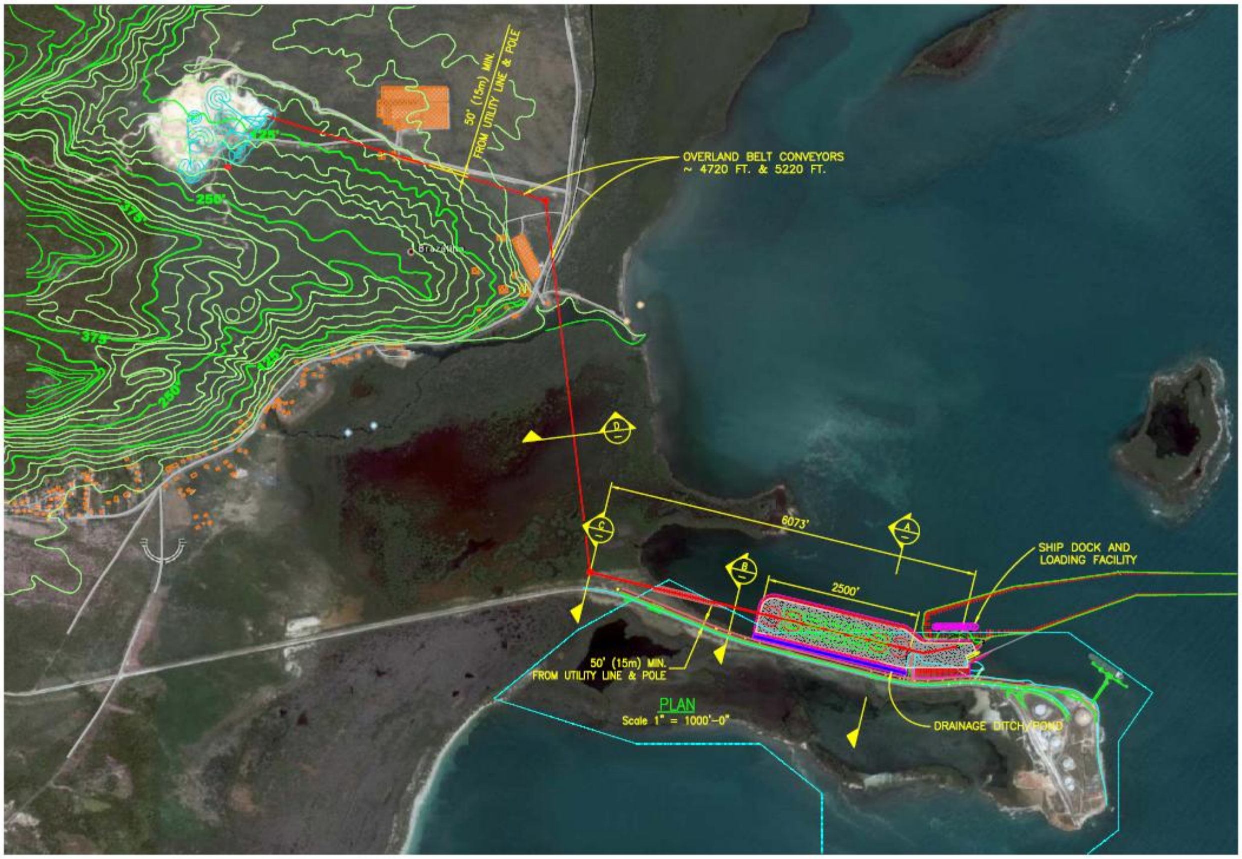


Plate 3-3: Conveyor through Mangroves & Stockpile adjacent Port- Alternative 3

Plate 3-4: Port at Salt Island, Conveyor Corridor & Stockpile at Quarry - Alternative 4

3.5 Technology

3.5.1 *Conveyor*

Four conveyor styles were analyzed for the transfer of aggregate from the process plant to the ship loading facility. **Table 3-2** summarizes the comparison of the different conveying technologies. The preferred conveyor is outlined in the first column – the troughed belt conveyor.

A conventional troughed conveyor was chosen as the preferred alternative due primarily reduced noise, runtime, and potential dust creation. Dust covers (hood) on a conventional conveyor reduce potential of dust creation while maintaining easy access for maintenance. Fewer mechanical components on this style conveyor has a lower running mechanical noise creation as well as decreased maintenance time, thus further lowering noise creation.

Globally[3] a comparison of the various conveyor systems versus haul truck inputs, shows an economic advantage using conveyors rather than haul trucks to move and stockpile material. Based upon certain parameters, savings may be as high as US$0.46 per ton, or US$700,000 annually (**Figure 3-1**).

In addition to economics, there are other advantages to the use of conveyors. Conveyors are environmentally friendly, while individual trucks or loaders emit and stir pollutants along the entire transfer path. Furthermore, trucks are limited to level applications, and are highly compromised when operated on grades exceeding a 6 percent incline.

The use of equipment such as automated telescoping radial stackers, portable jump conveyors, tripper conveyors, mobile stackable units, stationary overland systems further support the justification for conveyors, based upon the following key benefits:

- **Improved product quality:** Conveyors eliminate the multiple handling of material, while preventing the compaction and contamination typically caused by trucks and/or loaders. Importantly, telescoping conveyors eliminate segregation and material degradation.
- **Lower operating expense:** Conveyors cut labour and training costs. They are not reliant upon humans. They require no breaks or shift changes, and will operate at maximum efficiency during every hour of operation, conveying at capacities ranging from a mere

[3] Jarrod Felton, Comparison: conveyor vs. haul truck, Pit & Quarry, http://www.pitandquarry.com/pitandquarry/Material+Handling/Cost-cutting-conveying/ArticleStandard/Article/detail/410967?contextCategoryId=683&searchString=Comparison:%20conveyor%20vs.%20haul%20truck

trickle to 30,000 tph (on major overland systems). By contrast, trucks and loaders require operators and intensive, costly day-to-day maintenance. (**Figure 3-2**)

- **A limited inflationary effect:** Rising fuel and energy prices have little effect on conveyor operating costs. Conveyors are not sensitive to fuel shortages. Consider that electricity costs are fairly stable compared to diesel prices — and conveyors can move material during off-peak energy intervals.

With a lifespan of more than 20 years, their high-capacity performance and low-cost operation provide benefits over an extensive life cycle. In addition, flexibility in conveyor design allows customization to limitless applications.

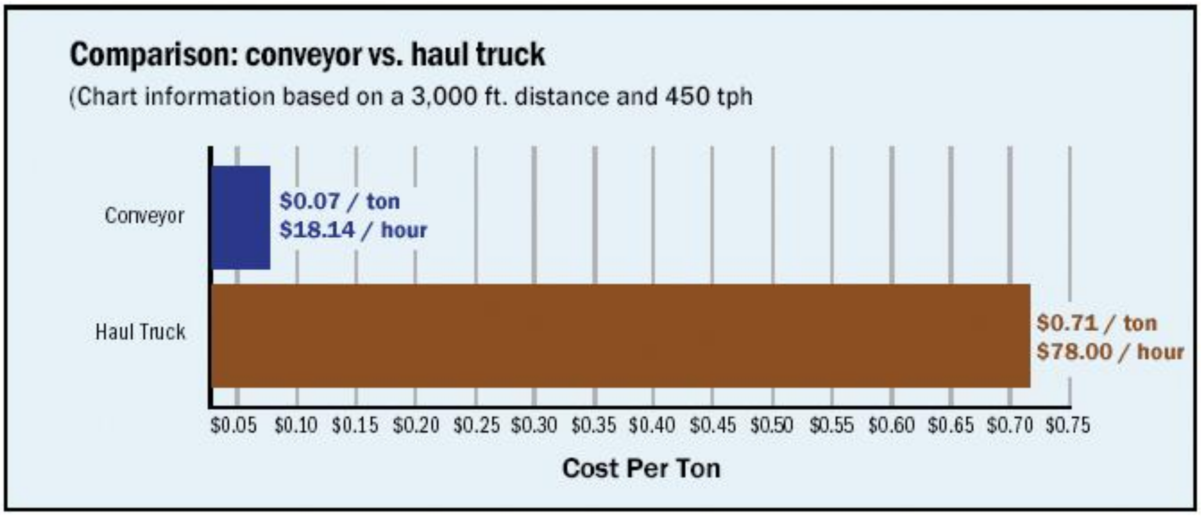


Figure 3-1: Comparison of Conveyor Systems vs. Haul Truck

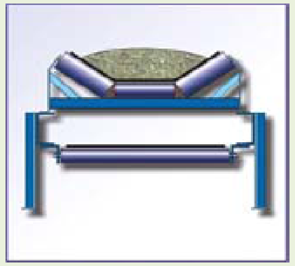
Operation cost of equipment

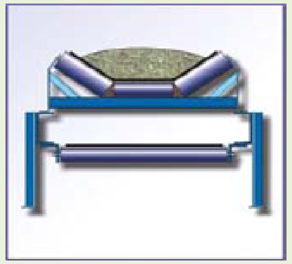
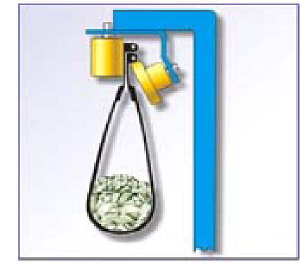
Based on 2,500 hours per year, 500,000 tons per year

Equipment	Model	Operating $/hour	Annual Cost	Cost/Ton
TeleStacker Conveyer	TS150	$5	$12,500	$0.03
Articulated Truck	D30D	$28	$70,000	$0.14
Mine Truck	775B	$48	$120,000	$0.24
Wheel Loader	988B	$59	$147,500	$0.30
Dozer	D9	$62	$155,000	$0.31

Figure 3-2: Estimated Operation Cost of Equipment

Table 3-2: Conveyor Technology Evaluation

Conveyor Types	Troughed Belt Conveyor	Pipe Conveyor	Cable Conveyor	Enclosed Belt Conveyor
Configuration				
Capacity	4000 stph	4000 stph	4000 stph	4000 stph
Belt Width	54"	80" (24" dia.)	72"	55" Belts (6 required)
Belt Speed	700 fpm	700 fpm	700 fpm	540 fpm
Ave. Unit Cost	$1200/ft.-$3000/ft.	$3000/ft.-$5000/ft.	$2500/ft.-$4000/ft.	$3500/ft.-$5000/ft.
Ave. Support Steel Required	40-48 lb/ft.	75-90 lb/ft.	40-48 lb/ft.	90-105 lb/ft.
Idlers Spacing	4-5 ft.	7-8 ft.	4-5 ft.	4-5 ft.
Spare Parts	Standard Availability	Partial Standard Availability	Partial Standard Availability	Partial Standard Availability
Curvability	Linear	Min. Radius = 1200 ft.	Min. Radius = 1500 ft.	Min. Radius = 5-15 ft.
Dust Control	Conveyor Enclosure	N/A	Conveyor Enclosure	N/A
Summary	Advantages: - Least expensive - Standard parts - Reliable - Less Maintenance Disadvantages: - Linear curvability	Advantages: - Self enclosed to reduce dust - Moderate curvability Disadvantages: - More maintenance due to more moving parts - More expensive due to more moving parts and wider belt - More noise due to more moving parts	Advantages: - Moderate curvability Disadvantages: - More expensive due to belt materials and wider belt - Parts not as standard	Advantages: - Self enclosed to reduce dust - High curvability Disadvantages: - More expensive due to more belt sets required - More power and maintenance required due to increased number of belts - More noise due to more belts

Conveyor Types	Troughed Belt Conveyor	Pipe Conveyor	Cable Conveyor	Enclosed Belt Conveyor
Configuration				
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Idlers Spacing	4-5 ft.	7-8 ft.	4-5 ft.	4-5 ft.
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Curvability	Linear	Min. Radius = 1200 ft.	Min. Radius = 1500 ft.	Min. Radius = 5-15 ft.
Dust Control	Conveyor Enclosure	N/A	Conveyor Enclosure	N/A
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LEGISLATIVE AND REGULATORY FRAMEWORK

4 Legislative and Regulatory Framework

4.1 Introduction

International and national policies, legislation, regulations and environmental standards pertaining to this project were researched and analysed. The objective was to ensure that the project complies with all policy, legal and regulatory requirements. The study examined those policies, legislation and regulations governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, site selection and land use control at the regional, national and local levels that relate to or should be considered in the framework of the project.

The proposed project falls within the Portland Bight Protected Area (PBPA). It is managed by the Caribbean Coastal Area Management (CCAM) Foundation in conjunction with the Natural Resources Conservation Authority. The Ministerial Order creating the Portland Bight Protected Area under Section 5 of the Natural Resources Conservation Act was signed on Earth Day (April 22) 1999.

The PBPA is approximately 1,876 sq. km (724 sq. mile) of integrated terrestrial and marine protected area. The 520 sq. km (200 sq. mile) terrestrial area is 4.7% of Jamaica's land mass, and the 1,356 sq. km (524 sq. mile) of marine space is 47.6% of her shallow shelf. The PBPA contains 210 sq. km (81 sq. mile) of dry limestone forest, 82 sq. km (32 sq. mile) of wetlands, and an as yet undetermined area of seagrass beds and coral reefs. It is habitat for birds, iguanas, crocodiles, manatees, marine turtles, fish and human beings.

4.2 CEMEX/RINKER Policies & Practices

CEMEX has a target of zero injuries and does not accept unsafe working practices. Accident prevention, safeguarding employee health and environmental protection are an integral part of CEMEX's business philosophy. It is company policy that all operations are safe for personnel, communities and the environment.

CEMEX has a global policy for health and safety that provides a framework, which is aligned to Government standards in operating countries. All employees must comply with the CEMEX Operations Health and Safety Policy, which sets out employees' responsibilities. It is used to ensure health and safety arrangements are clear, implemented and constantly reviewed. CEMEX expects documented plans to be developed throughout the business detailing health and safety targets, which are formally monitored, to ensure they deliver continuous improvements.

To maintain high standards, the CEMEX Health and Safety Management system, which is based on the following 14 elements, is being implemented throughout CEMEX operations:

1. Leadership and management participation
2. Regulations, audits and inspections
3. Safe operative practices
4. Accident investigation and tracking
5. Behavioural safety
6. Health and safety training
7. Emergency preparation and fire prevention
8. Contractors safety
9. Risk analysis, job safety analysis and PPE
10. Hazardous works and maintenance control
11. Safety promotion
12. Health risk
13. Facilities and work environment
14. Driving safety

To improve safety further, CEMEX is also strengthening its driver safety programmes and expects all employees to comply with the Safety Essentials 12 fundamental rules around safe behaviour.

- **RINKER Safety, Health & Environment Policy**

Providing safe healthy workplaces and respecting the environment are core values of Rinker Group. We are committed to:

- the elimination of all recordable injuries, occupational illnesses, preventable vehicular incidents and environmental incidents (***Zero4Life***)
- complying with all legal requirements relating to safety, health and environment;

- ensuring we do not manufacture or market any product or service unless it can be done safely and with care for the environment;
- using resources efficiently and respecting the interests of the community

4.3 Applicable National Legislation, Standards and Policies

The following represents descriptions of applicable legislative requirements with which activities of this proposed upgrade must comply:

- Agenda 21
- Natural Resources Conservation Authority (NRCA) Act, 1991
- Ramsar Convention, 1971
- Wildlife Protection Act, 1945
- Watershed Protection Act, 1963
- Mining Act, 1975
- Minerals (Vesting) Act, 1947
- Quarries Act, 1983
- Town & Country Planning Act, 1987
- Forestry Act, 1937
- Water Resources Act, 1995
- Underground Water Control Act, 1959
- Jamaica National Heritage Trust Act, 1985
- Public Health Act, 1985
- Disaster Preparedness & Emergency Management Act, 1993
- National Solid Waste Management Authority Act, 2001
- Occupational Safety & Health Act, 2003 (Draft)
- Clarendon Parish Provisional Development Order, 1982

4.3.1 *The NRCA Act, 1991*

The Act is the overriding legislation governing environmental management in the country. It also designates National Parks, Marine Parks, and Protected Areas and regulates the control of pollution as well as the way land is used in protected areas.

This Act requires among other things, that all new projects or expansion of existing projects which fall within a prescribed description or category must be subjected to an Environmental Impact Assessment (EIA).

The regulations require that fourteen (14) copies of the EIA Study Report must be submitted to the Authority for review. There is a preliminary review period of ten days to determine whether additional information is needed. After the initial review the process can take up to ninety days for approval. If on review and evaluation of the EIA the required criteria are met, a permit is granted.

Specifically, the relevant section(s) under the Act which addresses the proposed project activities are:

s.10:(1) Subject to the provisions of this section, the Authority may by notice in writing require an applicant for a permit of the person responsible for undertaking in a prescribed area, any enterprise, construction or development of a prescribed description or category-

(a) to furnish the Authority such documents or information as the Authority thinks fit; or

(b) where it is of the opinion that activities of such enterprise, construction or development are having or are likely to have an adverse effect on the environment, to submit to the Authority in respect of the enterprise, construction or development, an EIA containing such information as may be prescribed, and the applicant or, as the case may be, the person responsible shall comply with the requirement.

s.12: Licenses for the discharge of effluents etc.

s.17: Information on pollution control facility

s.18: Enforcement of Controls – threat to public health or natural resources

s.32-33: Ministerial Orders to protect the environment

s.38: Regulations

All the necessary applications have been submitted and found acceptable to the Agency. This EIA document satisfies the penultimate review process, mandatory public meeting next, before the required licences and permits can be issued. An application for a Permit and License was completed and submitted to NEPA as well as a Project Information Form (PIF) and Terms of Reference (ToR). The approved ToR for this EIA is included in the appendix of this document (**Appendix I**)

4.3.1.1 The Natural Resources Conservation Authority (Air Quality) Regulations, 2006

These regulations were gazetted on July 12, 2006. This regulation speaks to the quality of the airshed within which an industrial entity is discharging emissions (gases or particulate matter). Discharge license requirements are outlined in Part I of this Act, and Part II speaks to the stack emission targets, standards and guidelines.

The environmental impact from any air emissions (gasses or particulate matter) will be influenced by the ambient meteorological conditions within the area, such as wind (speed and direction), and rain.

Table 4-1 below outlines the ambient air quality standards as issued by NEPA.

Table 4-1: Air Quality Standards for Jamaica (NEPA)

Pollutant	Averaging Time	Standard (maximum concentration in µg/m3)
Total Suspended Particulates Matter (TSP)	Annual	60
	24 hour	150
PM10	Annual	50
	24 hour	150
Lead	Calendar Quarter	2
Sulphur Dioxide	Annual	80 primary, 60 secondary
	24 hour	365 primary, 280 secondary
	1 hour	700
Photochemical oxidants (ozone)	1 hour	235
Carbon monoxide	8 hour	10,000
	1 hour	40,000
Nitrogen Dioxide	Annual	100

The proposed Port and conveyor corridor have the potential to impact on the surrounding residential communities, particularly in the Salt River area. The design specifications for the port and conveyor corridor utilise modern technology currently in use globally, and meet international standards in the industry. All the necessary technical mitigations in design will be addressed by the equipment selected and geared towards the existing local setting. RINKER has established programmes and policies to monitor air quality at all its facilities worldwide. This type of monitoring will be extended to all RINKER proposed developments in Jamaica, as applicable.

4.3.1.2 Trade Effluent Standards

The Trade Effluent Standards have existed in draft format since 1996. These standards regulate the quality of effluent discharged from any entity into public drains/sewers and all surface and water bodies such as ponds, sea or lake. Similar to the Air Quality regulations, a discharge license is required to release any trade effluent and guidelines set forth for acceptable water quality standards including sewage effluent.

A new tertiary effluent treatment plant is proposed for this project but will be evaluated as part of the Brazilletto Expansion EIA document. The treatment plant is designed to meet and exceed all applicable effluent treatment standards. Workers at the port will utilise portable chemical toilets.

4.3.1.3 Noise Standards

Noise Standards for Jamaica have been proposed by NEPA based on the World Bank standards. The guideline for daytime perimeter noise is 75 decibels and 70 decibels for night-time noise.

RINKER has policies in place to monitor noise in its operations internationally; these will be incorporated into their new Jamaican operations at the Brazilletto Quarry. Blasting and quarrying noise is currently monitored at the Brazilletto Quarry. New protocols will be developed to include the Port and conveyor corridor to be built. Additionally, the Port, conveyor corridor and associated mechanical equipment that may generate noise will be fitted with manufacturer specified silencers and other devices to ensure noise levels do not exceed standards.

The Port, Conveyor Corridor and Aggregate Stockpile will conform to the applicable regulations and standards of Jamaica.

4.3.2 *The Mining Act 1975;*

The Mining Act regulates the activities of the mining sector including the various intricacies involved in the granting of licenses, prospecting rights and regulations, compensation payments and the utilization of special lands under a mining lease.

This Act is of special importance to the proposed mining activities and would be administered by the Commissioner of Mines.

RINKER has an exclusive operating contract with Chemical Lime Company Limited, the holders of the mining licence, to operate the Brazilletto Quarry. This quarry has been in operation for approximately 10 years.

4.3.3 *The Minerals (Vesting) Act, 1947*

The Minerals (Vesting) Act, through the Minister, has the power to declare that all minerals being in, on or under any land or water, whether territorial waters, rivers, or inland sea, are vested in and are subject to the control of the Crown. As such this Act governs the extent to which royalties are payable to landowners.

RINKER has an exclusive operating contract with Chemical Lime Company Limited, the holders of the mining licence, to operate the Brazilletto Quarry. This quarry has been in operation for approximately 10 years.

4.3.4 *Quarries Control Act, 1983*

The Quarries Control Act of 1983 designates the establishment of quarry zones, and controls licensing and operations of all quarries. A Quarries Advisory Committee is mandated under the act to regulate this industry. The Committee advises the Minister with responsibility for quarries (Minister of Energy, Mining and Telecommunications) on the general policies that relates to quarries.

A license is required for establishing or operating a quarry under Section 5 of the Quarries Act. The Application procedures are outlined in Section 8. RINKER has an exclusive operating contract with Chemical Lime Company Limited, the holders of the mining licence, to operate the Brazilletto Quarry.

4.3.5 *The Watershed Protection Act, 1963*

This Act governs the activities operating within the island's watersheds, as well as, protects these areas. The watershed designated under this Act, in which this project lies, is the Rio Minho watershed area.

Determinations will be made to identify any potential impacts that this project may have on the watershed and will propose mitigative actions where impacts are identified.

Much of the land contained in the quarry licence is under vegetative growth and will continue to be so until existing quarry faces have been exhausted. RINKER has no intention of stripping the entire conveyor corridor. Once built, a vegetative buffer zone will be maintained around the conveyor corridor.

4.3.6 *The Wildlife Protection Act, 1945*

This act involves the declaration of game sanctuaries and reserves, game wardens, control of fishing in rivers, protection of specified rare or endemic species. The Act also provides for the protection of animals and makes it an offence to harm or kill a species which is protected. It stipulates that, having in one's possession "whole or any part of a protected animal living or dead is illegal.

This Act has to be considered for the proposed project, ecological assessments will determine if rare or endangered species will be impacted. 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 are protected under this Act.

Though threatened and/or rare wildlife species were discovered during the ecological survey, the proposed project is not expected to have any significant impact on these reserves in the area. RINKER has no intention to harm any threatened and/or rare wildlife reserves.

4.3.7 *The Forestry Act, 1937*

This Act provides for the management and the declaration of Forest Reserves on Crown Lands and regulates activities in Forest Reserves. This Act will be reviewed to determine if the upgrade activities (particularly mining) will impact on Forest Reserves and to what extent.

The Brazilletto Quarry is not found within any designated Forest Reserves. However, the area can be considered a good example of a typical dry limestone forest with pockets considered as examples of potential primary forest. The area is zoned under the theme – Extractive Industry. Ten (10) endemic plant species were discovered; however, none is classified as rare or threatened or regionally sensitive. RINKER intends to protect, as much as possible, the dry limestone forest of the Brazilletto Hills, particularly in the form of buffer zones during the construction and operation of the Port and conveyor corridor.

4.3.8 *Water Resources Act, 1995; Underground Water Control Act, 1959*

The Underground Water Control Act of 1959 is the legal instrument and is enforced by the Water Resources Authority (WRA). The Water Resources Act is expected to provide for the management, protection, controlled allocation and use of water resources of Jamaica. Thus the water quality control for both surface and ground water are regulated by this Act.

If the proposed facility intends to utilize any existing ground water, permission would be needed, in the form of an issued license for this activity. Under this Act exploratory activities such as the boring/drilling of wells for the purpose of searching for underground water without the written consent would be a violation.

In addition, any activity which negatively influences the quality of existing water, whether ground or surface, would be relevant to this Act.

The proposed project will not impact on groundwater reserves. Water is supplied from the Brazilletto Quarry production wells and is used in various areas of operation. At the quarry, water usage is mainly for the amenity block (toilets and showers), and for washing of limestone. Additionally, wash water will be recycled into operations where it can be facilitated. Water for the Port operations will be sourced from the wells drilled by RINKER.

4.3.9 *The Clean Air Act, 1964*

The Clean Air Act speaks to entities such as the Stockpiles, conveyors and ship loading, which are industrial operations. This facility has the potential to discharge particulate matter to the atmosphere. This Act makes reference to the use of inspectors to inspect any premises, carry out tests, and take samples of any substance that he/she considers necessary or proper for the performance of duties.

This project will be regulated by this Act in accordance with the NRCA (Air Quality) Regulations. RINKER intends to abide by all regulations regarding air quality and intends to put in place best management practices used in other operations globally at this site.

4.3.10 *The Town and Country Planning Act, 1987*

This Act governs the development and use of land. Under this law the Town Planning Department is the agency responsible for the review of any plans involving industrial development. The law allows for specific conditions to be stipulated and imposed on any approved plans. This planning decision is based upon several factors, these include;

- the location of the development
- the nature of the industrial process to be carried out
- the land use and zoning
- the effect of the proposal on amenities, traffic, etc.

This Act is applicable to the proposed activities. The new port and conveyor corridor will be accompanied by increased quarrying. All conditions regarding the nature of the proposed industrial activity will be adhered to under this law, all necessary permits and licences will be applied for.

4.3.11 *The Jamaica National Heritage Trust Act, 1985*

The Act is administered by the Jamaica National Heritage Trust (JNHT), formerly the Jamaica National Trust. This Act provides for the protection of important areas, including the numerous monuments, forts, statues, and buildings of historic and architectural importance in Jamaica.

During this project, an Archaeological and Heritage Retrieval Plan may be implemented to protect any historical or archaeologically significant item encountered. RINKER will utilise the services of the JNHT should any archaeological remains be found during the construction activities for the port and conveyor corridor.

4.3.12 *The Public Health Act, 1974*

This Act controls and monitors pollution from point sources. Any breaches of this Act would be sent through the Central Health Committee which takes action through the Ministry of Health, Environmental Health Unit (EHU). The EHU has no direct legislative jurisdiction, but works through the Public Health Act to monitor and control pollution from point sources. Action against any breaches of this Act would be administered by the Central Health Committee. The functions of the department include:

- The monitoring of waste water quality, including regular water quality analysis, using water standards published by NEPA;
- Monitoring of occupational health as it relates to industrial hygiene of potentially hazardous working environments;
- Monitoring of air pollutants through its laboratory facilities.

In addition, there are various sections of this legislative instrument which governs and protects the health of the public. Relevant sections under the Public Health Act of 1985, are Sections 7.- (1) *A Local Board may from time to time, and shall if directed by the Minister to do so, make regulations relating to (0) nuisances* and 14.- (1) *The Minister may make regulations generally for carrying out the provisions and purposes of this Act, and in particular, subject to section 7, but without prejudice to the generality of the foregoing, may make regulations in relation to (d) air, soil and water pollution.*

Aspects of the project related to odour have been considered since odour is a part of the Air Emissions regulations to be promulgated in 2004. RINKER will install or subcontract services for conducting ambient air quality monitoring in the project area during pre-construction, construction, and operation phases.

4.3.13 *Disaster Preparedness and Emergency Management Act, 1993*

The principal objective of the Act is to advance disaster preparedness and emergency management measures in Jamaica by facilitating and coordinating the development and implementation of integrated disaster management systems. RINKER will establish procedures and guidance documents in respect of disaster preparedness and emergency management as done at other production facilities globally. These measures will be tailored, as necessary, to the Jamaican situation with assistance from various agencies.

4.3.14 *The Factories Act, 1968*

The Factories Act regulates factories and makes conditions for their inspection. The major points under this act that may affect this project are:

- The safe means of approach or access to, and exit from, any factory, or machinery
- The fencing and covering of all dangerous places or machines;
- Life-saving and first aid appliances;
- Securing safety in connection with all operations carried on in a factory
- Securing safety in connection with the use of cranes, winches, pulley-blocks and of all engines, machinery, mechanical gear, and contrivances generally
- The periodic inspection, testing and classification, according to age, type or condition, of boilers
- The duties and responsibilities assignable to any person generally, and in particular to employers, owners, and managers in charge of factories, in connection with any one or more of such regulations;
- The proper ventilation of any factory, having regard to the nature of the process carried on therein;
- The sanitation, including the provision of lavatory accommodation (having regard to the number of workers employed) at any factory

4.3.15 *National Solid Waste Management Authority Act, 2001*

The National Solid Waste Management Authority (NSWMA) under this Act has the responsibility to manage and regulate the solid waste sector. It includes requirements for licences for operators and owners of solid waste disposal facilities (in addition to permit requirements of NEPA).

RINKER will implement the necessary arrangements for solid waste management and disposal for all solid waste generated from this proposed project. RINKER will recycle, as much as possible, the materials used within its operation.

4.3.16 *Occupational Safety & Health Act, 2003 (Draft)*

This Act oversees the prevention of injury and illness resulting from conditions at the workplace, the protection of the safety and health of workers and the promotion of safe and healthy workplaces.

Sampling of sections from the Draft Act that are relevant to this project, include:

4. (1) This Act applies to all branches of economic activity and to all owners, employers and workers in all such branches.

5. (1) The owner of every industrial establishment or mine which carries on business on or after the appointed day shall, subject to subsection (8), apply to the Director in the prescribed form to be registered under this Act.

18. (1) Provides a description of the duties of employers, outlining the need for quality work areas and work environments, procedures and guidelines that will result in safe and healthy workplaces.

19. (1) discusses the duties of employers at construction sites in terms of employee safety and health during work activities.

25. (1) an employer shall make or cause to be made and shall maintain an inventory of all hazardous chemicals and hazardous physical agents that are present in the workplace.

26. (1) this section provides guidelines and procedures for employers to follow in terms of identification of hazardous chemicals. This includes labelling and identification protocols.

30. (1) Basically, this section of the Act requires an employer to provide training of its employees with a potential for exposure to hazardous chemicals or physical agents.

It is expected that this Draft Act will be Gazetted in the near future. RINKER has an understanding and appreciation for the contents of this policy. RINKER also has its own occupational, safety and health policies that it regulates and reports on, this policy will be extended to the proposed project.

4.3.17 *Clarendon Parish Provisional Development Order, 1982*

This document provides the development plan for the Parish of Clarendon. It clarifies the role and responsibility of the local planning authority and provides guidance on how development of the parish should proceed. All activities in this RINKER proposed port and conveyor corridor that requires local planning authority approval will be properly identified and the appropriate permits and licenses will be secured.

4.4 Local Policy

All development applications are submitted for approval to the Town Country Planning Authority, through the local Parish Council and then forwarded to the relevant authorities including NEPA and the Environmental Control Division (ECD) of the Ministry of Health. NEPA, the governing environmental agency, may require an environmental impact assessment (EIA) to be considered along with the development plan for the Authority's approval. The ECD imposes guidelines for air, water and soil standards to be maintained after construction.

4.4.1 *The Portland Bight Protected Area*

The Portland Bight Protected Area (PBPA) was created on April 22, 1999 (Natural Resources Conservation Authority Act, The Natural Resources Conservation (Portland Bight Protected Area) Order 1999. The PBPA is 250 km2 (200 mile2) of land and 1,356 km2 (524 mile2) of marine space with a total of 1,876 km2 (724 mile2) (see **Figure 4**).

The complex ecosystem of the PBPA provides habitat for a wide variety of Jamaican wildlife. On the coastline is the largest remaining mangrove system in Jamaica, which together with the extensive seagrass beds provides the largest nursery area for marine fish, molluscs and crustaceans in the island's territorial waters. Beaches on the mainland and on the inshore coral cays are major nesting sites for sea turtles. Manatees are now rare, but many crocodiles inhabit the rivers and wetlands.

Overlooking Portland Bight are four tropical dry limestone forests, the most intact left in Central America and the Caribbean: the Hellshire Hills, Brazilletto Mountain, Portland Ridge and Kemps Hill. Over 50 rare and endemic plants are to be found there, as well as many endemic animals.

Over 50,000 people reside within the boundaries of the PBPA in over 40 communities.

Co-management (or stakeholder management) of natural resources is the approach where representatives of all the stakeholders in a natural resource – including the government –

participate in the planning, execution and enforcement of the regulations and strategy for the proper management of that resource.

This is predicated on the notion that civil society participation in local decision-making is critical in implementing and enforcing decisions concerning the resources they use as stated in Principle 10 of Agenda 21.

The National Environment and Planning Agency, the government agency with legal responsibility for managing parks and protected areas, is preparing a legal instrument by which the management responsibility for the PBPA will be delegated to the Caribbean Coastal Area Management Foundation (C-CAM).

The Portland Bight Wetlands and Cays were given Ramsar designation on 2nd February, 2006. Below is a synopsis of the Portland Bight Wetlands and Cays and their importance as outlined by the Ramsar Convention Secretariat, as taken from their website[4].

Portland Bight Wetlands and Cays. *02/02/06*; St. Catherine, Clarendon; 24,542 ha; 17º49'N 077º04'W. Protected Area. Located on the south coast of the island, just west of Kingston, Portland Bight (or bay) includes some 8,000 ha of coastal mangroves, among the largest contiguous mangrove stands remaining in Jamaica, as well as a salt marsh, several rivers, offshore cays, coral reefs, seagrass beds, and open water. The area constitutes a critical feeding and breeding location as well as a general habitat for internationally threatened species such as the cave frog (*Eleutherodactylus cavernicola*), the Jamaican boa (*Epicrates subflavus*), the endemic hutia or coney (*Geocapromys brownii*), and the West Indian manatee (*Trichechus manatus manatus*). An endemic cactus (*Opuntia jamaicensis*) is also considered endangered under CITES. More than 3,000 fisher families make their livelihoods in the Bight, harvesting mostly finfish but also lobster, shrimp, oysters, and conch, and there are important sugar plantations in the surrounding area. Threats are feared from over-hunting and -fishing, pollution from sugar wastes, mangrove destruction for aquaculture, and invasive species. Ramsar site No. 1597.

A comprehensive impact assessment was undertaken for actual footprint impacts on seagrass and mangroves (See Section 6 of this report). This section also provides specific mitigation measures for impacts to these resources.

[4] Ramsar Convention on Wetlands http://www.ramsar.org/profile/profiles_jamaica.htm Posted 26 January 2000, updated 10 February 2006

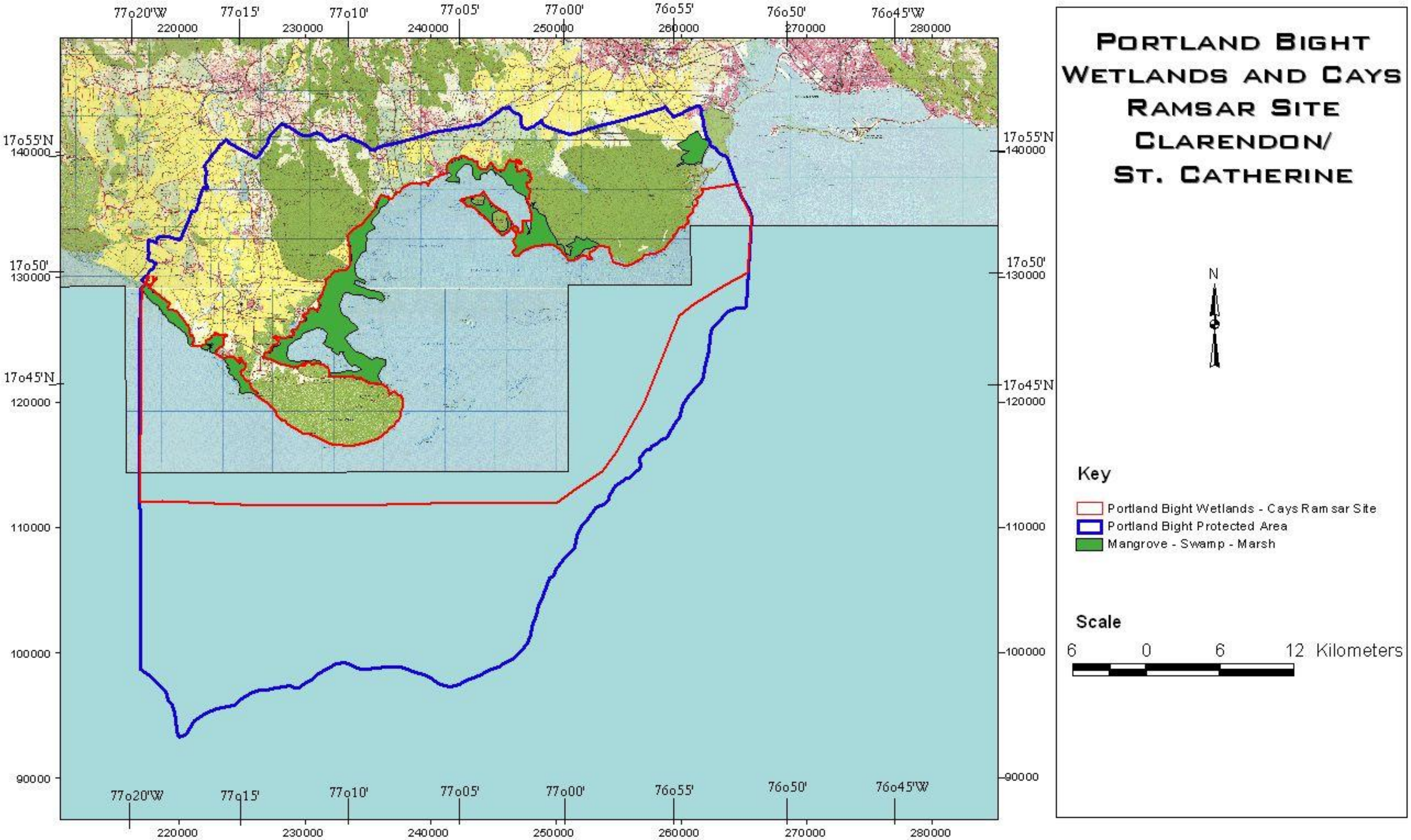


Plate 4-1: Portland Bight Wetlands & Cays

4.5 International Policy

4.5.1 *Agenda 21*

In June 1992, Jamaica participated in the United Nations Conference for Environment and Development (UNCED) in Rio de Janeiro, Brazil. One of the main outputs of the conference was a plan of global action, titled Agenda 21, which is a "comprehensive blueprint for the global actions to affect the transition to sustainable development" (Maurice Strong). Jamaica is a signatory to this Convention. Twenty seven (27) environmental principles were outlined in the Agenda 21 document. Those most relevant to this project, which Jamaica is obligated to follow are outlined below:

- Principle 1: Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.
- Principle 2: States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies.
- Principle 4: In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.
- Principle 8: To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.
- Principle 10: Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes.
- Principle 15: In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
- Principle 16: National authorities should endeavour to promote the internationalisation of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.

- Principle 17: Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.

RINKER, as part of an international organisation, is cognisant of and abides by international treaties and protocols. The principles of Agenda 21 that relate to this project will be applied throughout the project lifespan as necessary.

4.5.2 *Convention on Wetlands (Ramsar, 1971)*

The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 158 Contracting Parties to the Convention, with 1713 wetland sites, totalling 153 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance.

Jamaica became a signatory to this convention on February 07, 1998. There are three designated Ramsar Sites totalling 37,765 hectares, and are as follows:

1. Black River Lower Morass (Ramsar site No. 919)
2. Palisadoes – Port Royal Wetlands (Ramsar site No. 1454)
3. Portland Bight Wetlands and Cays (Ramsar site No. 1597)

The last is found within the immediate geographic sphere of influence of the proposed development, and totals approximately 24,542 ha.

The treaty outlines guidelines for contracting parties (Governments) in the following areas:

1. Guidelines for the management of groundwater to maintain wetland ecological character (Resolution IX.1 Annex C ii)
2. Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM) (Resolution VIII.4)
3. Guidelines for international cooperation under the Ramsar Convention Implementing Article 5 of the Convention [adopted as an annex to Resolution VII.19 (1999)
4. New Guidelines for management planning for Ramsar sites and other wetlands (Resolution VIII.14)
5. Guidelines for developing and implementing National Wetland Policies (adopted by Ramsar Resolution VII.6)

6. Guidelines for establishing and strengthening local communities' and indigenous people's participation in the management of wetlands [Adopted as an annex to Resolution VII.8 (1999)]
7. Guidance for the consideration of the deletion or restriction of the boundaries of a listed Ramsar site (adopted by Resolution IX.6)
8. Principles and guidelines for wetland restoration (Resolution VIII.16)
9. A Conceptual Framework for the wise use of wetlands and the maintenance of their ecological character (Resolution IX.1 Annex A)

4.5.3 *Convention on Biological Diversity (Rio de Janeiro, 1992)*

Signed by 150 government leaders at the 1992 Rio Earth Summit, the Convention on Biological Diversity is dedicated to promoting sustainable development. Conceived as a practical tool for translating the principles of Agenda 21 into reality, the Convention recognizes that biological diversity is about more than plants, animals and micro organisms and their ecosystems – it is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live.

Jamaica signed to the convention on June 11, 1992 and ratified it on January 6, 1995. Under this treaty, Jamaica is ranked fifth among islands of the world in terms of endemic plants. The country also enjoys a high level of endemism for animal species, as these examples illustrate: 98.2% of the 514 indigenous species of land snails and 100% of the 22 indigenous species of amphibians are endemic to Jamaica. Nearly 30.1% of this mountainous country is covered with forests. Jamaica's highest point, the Blue Mountain Peak, reaches a maximum height of 2,256m. There are 10 hydrological basins containing over 100 streams and rivers, in addition to several subterranean waterways, ponds, springs, and blue holes. The country's rich marine species diversity include species of fish, sea anemones, black and stony corals, mollusks, turtles, whales, dolphin, and manatee.

The activities undertaken by Jamaica derive from seven goals, which are:

- to conserve Jamaica's biodiversity;
- to promote sustainable use of biological resources;
- to facilitate access to biological resources (to promote biotechnology and ensure benefit sharing);
- to ensure safe transfer, handling and use of Living Modified Organisms (LMOs);
- to enhance resource management capacity;
- to promote public awareness, education, and public empowerment; and
- to promote regional and international cooperation and collaboration

The action plan comprises specific projects that have been elaborated with regards to these goals. Those most relevant aspects of this convention to this project, which Jamaica is obligated to follow are outlined below:

- Article 6. General Measures for Conservation and Sustainable Use
- Article 7. Identification and Monitoring
- Article 8. In-situ Conservation
- Article 9. Ex-situ Conservation
- Article 10. Sustainable Use of Components of Biological Diversity
- Article 13. Public Education and Awareness
- Article 14. Impact Assessment and Minimizing Adverse Impacts

DESCRIPTION OF THE BASELINE ENVIRONMENT

5 Description of the Baseline Environment

5.1 Introduction

The project site is located in a coastal zone encompassing the areas of Salt River (southern boundary of Brazilletto Mountain) and the coastal peninsula of Rocky Point, Clarendon (in close proximity to the existing permanent JAMALCO Port facility).

It is found within the Portland Bight protected Area (PBPA) which recently was designated as a Wetland of International Importance on 2^{nd} February 2006 (RAMSAR designation). The coastal peninsula is a flat and narrow strip of land bordered primarily by mangroves and seagrass beds. The mangroves in the area show damage from past storm events such as Ivan (2004), Dennis (2005) and Dean (2007), and human intrusion. Immediately opposite the proposed site is an extensive mangrove stand which also shows significant damage from the past storm events. The terrestrial, riparian and aquatic habitats within the PBPA are home to a wide range of native and migrant wildlife. Some of the native wildlife is endemic to Jamaica. The foothills of the Brazilletto Mountain, along which a part of the conveyor corridor will pass, is primarily a dry limestone forest

A transportation corridor (secondary road and railroad) runs parallel to the coast in this area and provides access to the existing JAMALCO Rocky Point Port. A JPS transmission corridor is present along the transportation corridor.

5.2 Physical Environment

5.2.1 *Meteorology*

Meteorological data for the area was sourced from the National Meteorological Service and supplemented with secondary information from in-house databases. These databases include information from close collection points such as the Monymusk Sugar Estate.

5.2.1.1 Climate

Mean annual average rainfall is 2,032 mm (80 inches) per year. The historical pattern has light rains in May, a summer dry season marked by brief but torrential thunderstorms, a main rainy season from September to November and a marked dry season from November to April. However, both annual totals and daily rainfall patterns are highly variable. The stationary weather system over central Jamaica in June and July 2002 produced two-thirds of the parish's annual rainfall in 15 days.

Annual rainfall gradients decrease from north to south and west to east. The northern mountains have the highest volumes, often in the form of heavy fog.

5.2.1.2 Rainfall

Rainfall is the most variable of the climatic parameters exhibiting a bimodal nature. The thirty (30) year (1951-1980) average monthly rainfall values, highlight the typical rainfall pattern for the region (**Figure 5-1**). The driest period runs from December to March and is associated with cold fronts migrating from North America. There are two distinct wet seasons, May to June and September to November occurring as regular yearly cycles.

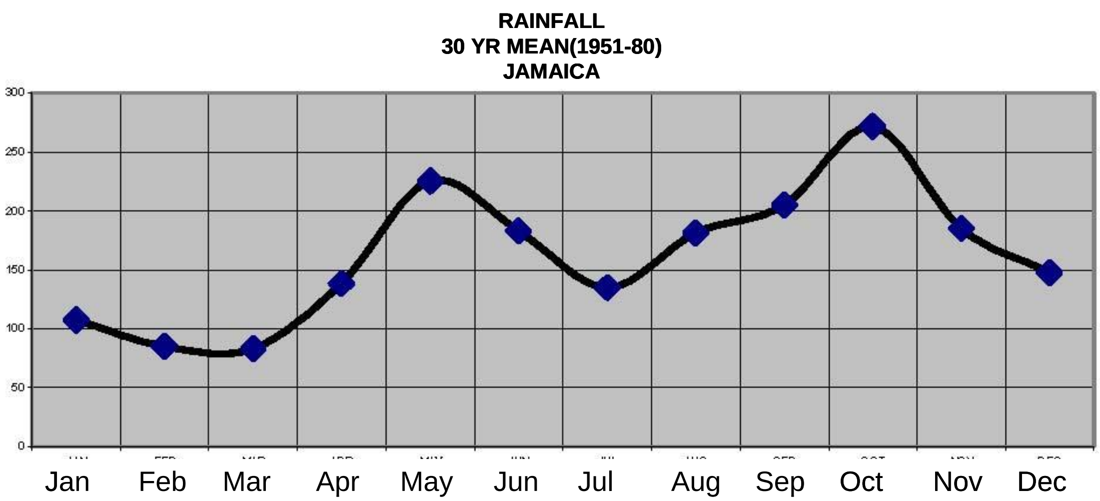


Figure 5-1: Jamaica 30 Year Rainfall Mean (1951-1980)

Of the weather parameters, rainfall is the most variable. Islandwide, during the period 1951 to 1980, annual rainfall ranged from a maximum of 2593 mm (102.09 in) in 1963 to a minimum of 1324 mm (52.13 in) in 1976, with an average of 1940 mm (76.38 in) annually. The hundred-year (1881-1990) mean annual rainfall is 1895 mm (74.61 in). Historically, the wettest year on record was 1933 with an annual rainfall of 2690 mm (116.54 in) whilst the driest year was 1920 with an annual rainfall of 1299 mm (51.14 in). **Figure 5-2** shows the mean long-term mean rainfall for the parish of Clarendon for 1951-1980.

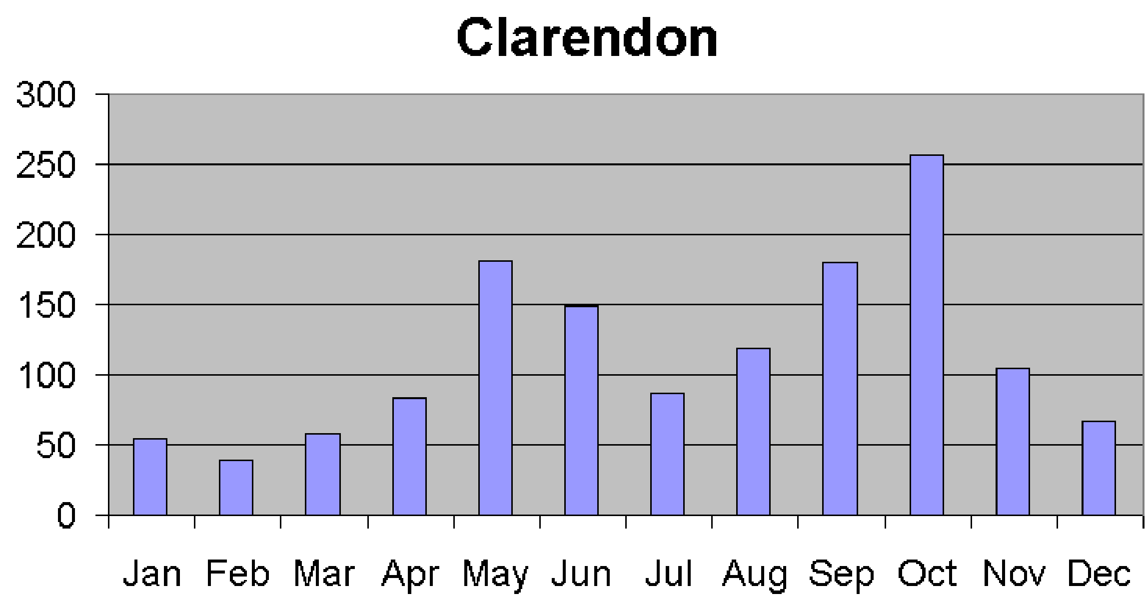


Figure 5-2: Clarendon Long-Term Mean Rainfall (mm) 1957-1980[5]

Whether during the dry or rainy season, however, other rain-producing systems are influenced by the sea breeze and orographic effects which tend to produce short-duration showers, mainly during mid-afternoon.

The parish of Clarendon receives an annual average of 1378 mm of rainfall per year mainly during the rainy period, between the months of May and November. The driest period occurs from January through March, with less than 58 mm per month. **Figure 5-3** shows the average yearly rainfall for Monymusk while **Figure 5-4** shows annual rainfall for Salt River, the closest available rainfall monitoring sites.

[5] Jamaica Meteorological Service, Climatological Data

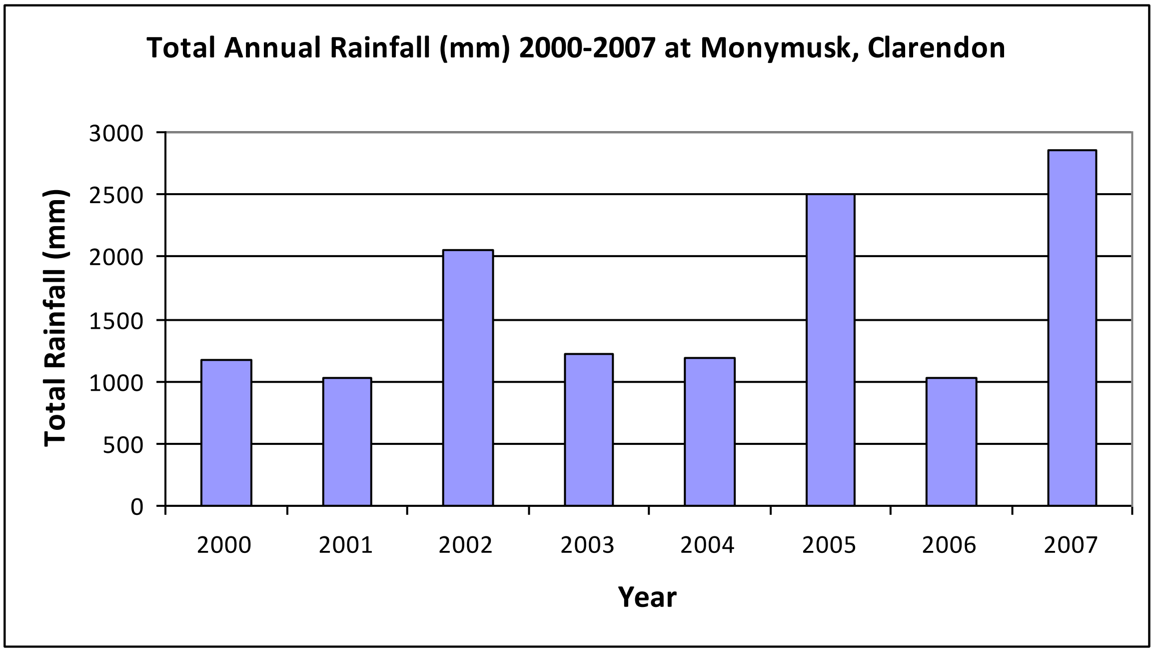


Figure 5-3: Annual Precipitation (mm) at Monymusk, Clarendon for the Period 2000-2007[6]

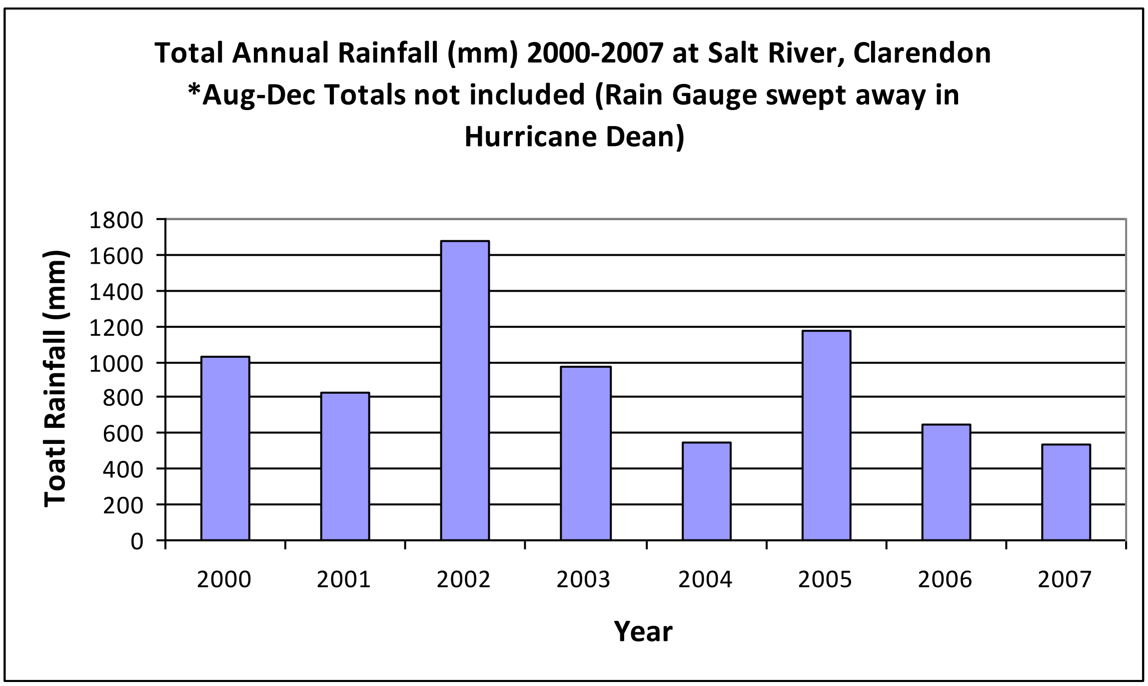


Figure 5-4: Annual Precipitation (mm) at Salt River, Clarendon for the Period 2000-2007

[6] Jamaica Meteorological Service, Climatological Data

5.2.1.3 Wind & Waves

5.2.1.3.1 Wind

Rocky Point and Brazilletto Mountain experiences the traditional north easterly trade winds that affect the island. Hurricanes are a serious seasonal threat from June to November; since 1886, 21 hurricanes have made landfall in Jamaica, while over 100 have passed within 240 km (150 miles) of the island. The paragraphs below outline the current patterns that affect the area and were re-verified in October-December 2007 and January-February 2008 and found to be consistent with data presented in the JAMALCO Temporary Barge Docking Facility EIA (2006) and the JAMALCO 2.8 Metric Ton per year Efficiency Upgrade EIA (2004) prepared by Conrad Douglas and Associates Ltd.

During the morning period, the prevailing winds are from the north. These winds are land driven and are reversed in the evenings. The plate below represents an aerial photograph of the area taken on an early morning in 1991. The area has remained consistent in size and topography as represented, and the conditions are quite similar as verified through ground truthing. The currents affecting the area are influenced by these winds.

Figure 5-5 presents the wind rose for the Norman Manley International Airport, Jamaica from 1976 - 2005. The climate reported in the figure illustrates predominant winds from the east through southeast. Fairly constant wind conditions are shown with winds exceeding 20 knots approximately 10% of the time, and 30 knot wind speeds are exceeded only 0.26% (**Figure 5-6**).

Based on calculation done, it can be concluded that:

- Wind speeds less than 20 knots successful with no tug assistance required
- Wind speeds between 20-30 knots successful with tug assistance
- Vessels remain a minimum of 350 ft from the center of the Jamalco berth

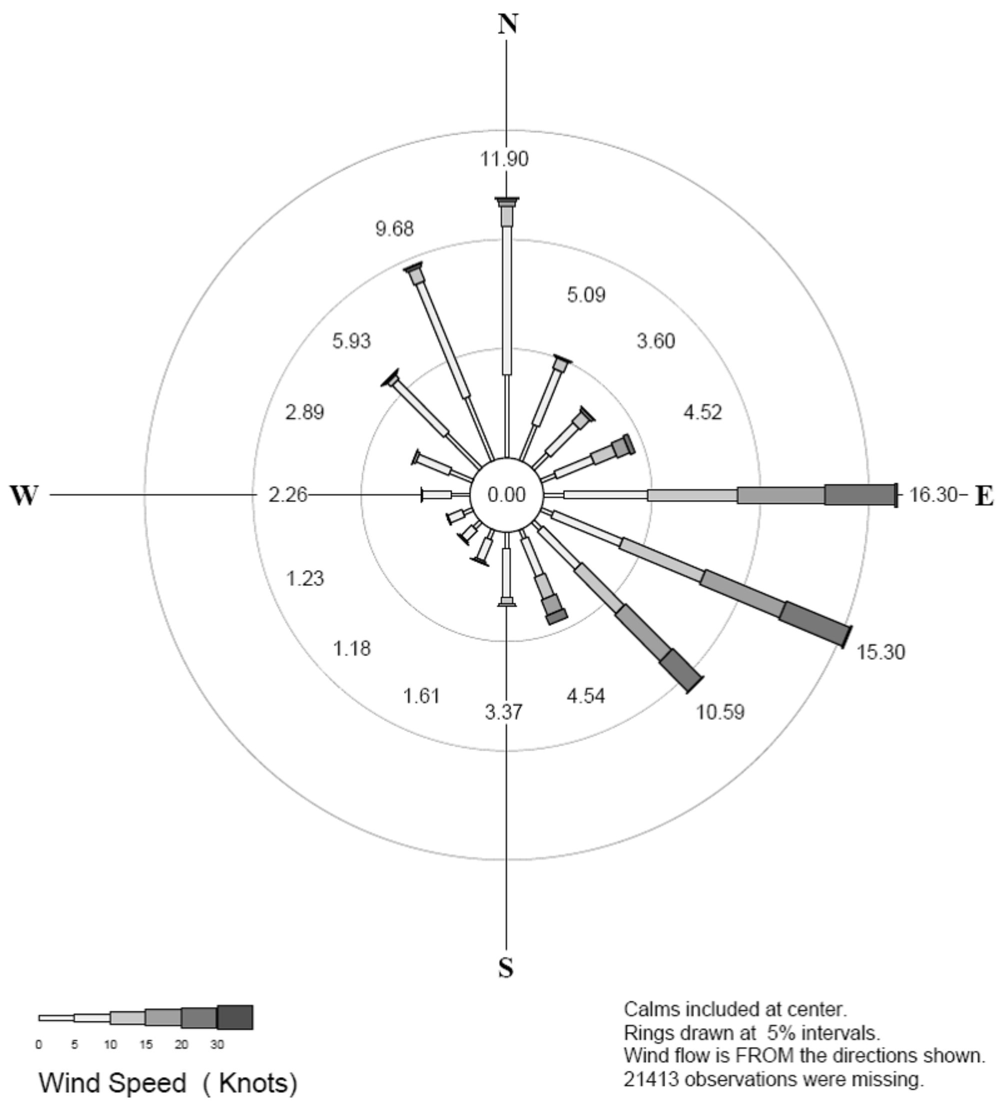


Figure 5-5: Wind Rose for Norman Manley International Airport, Jamaica (1976-2005)[7]

[7] Moffat & Nichol International, **RINKER Materials Vessel Manoeuvring, 2006**

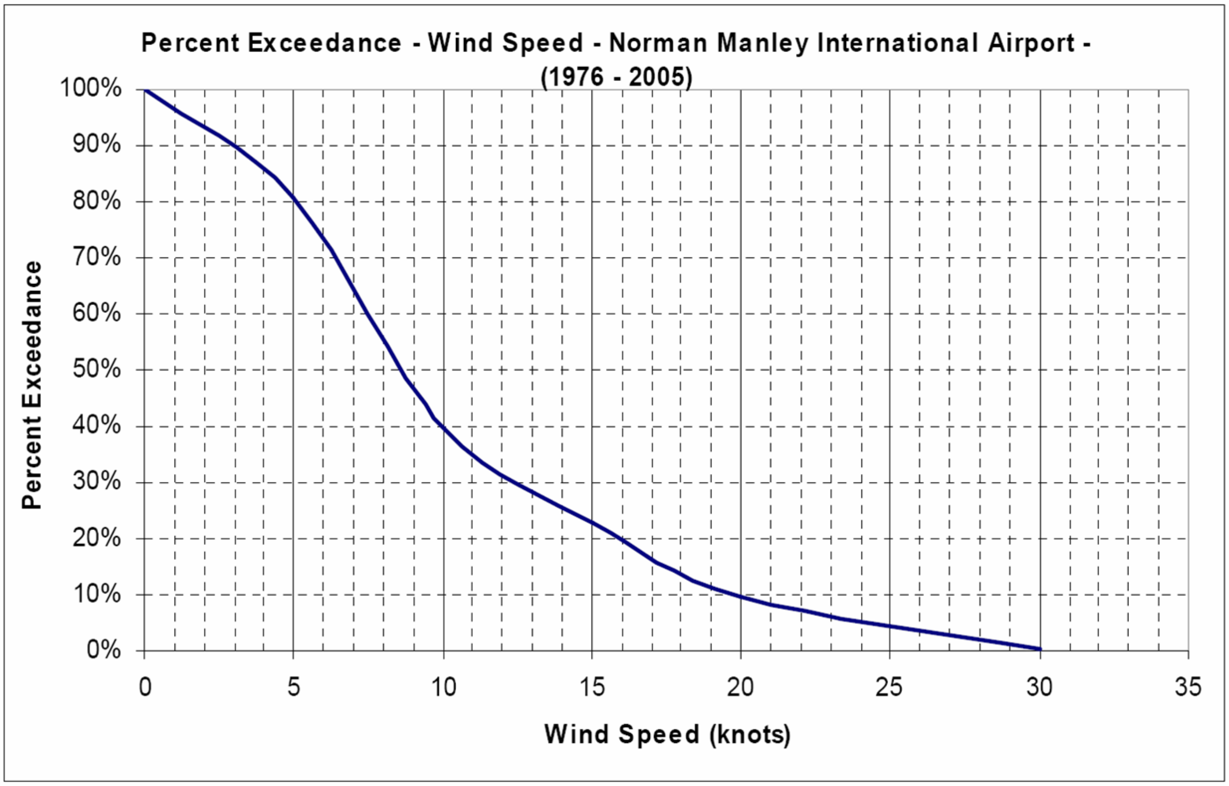
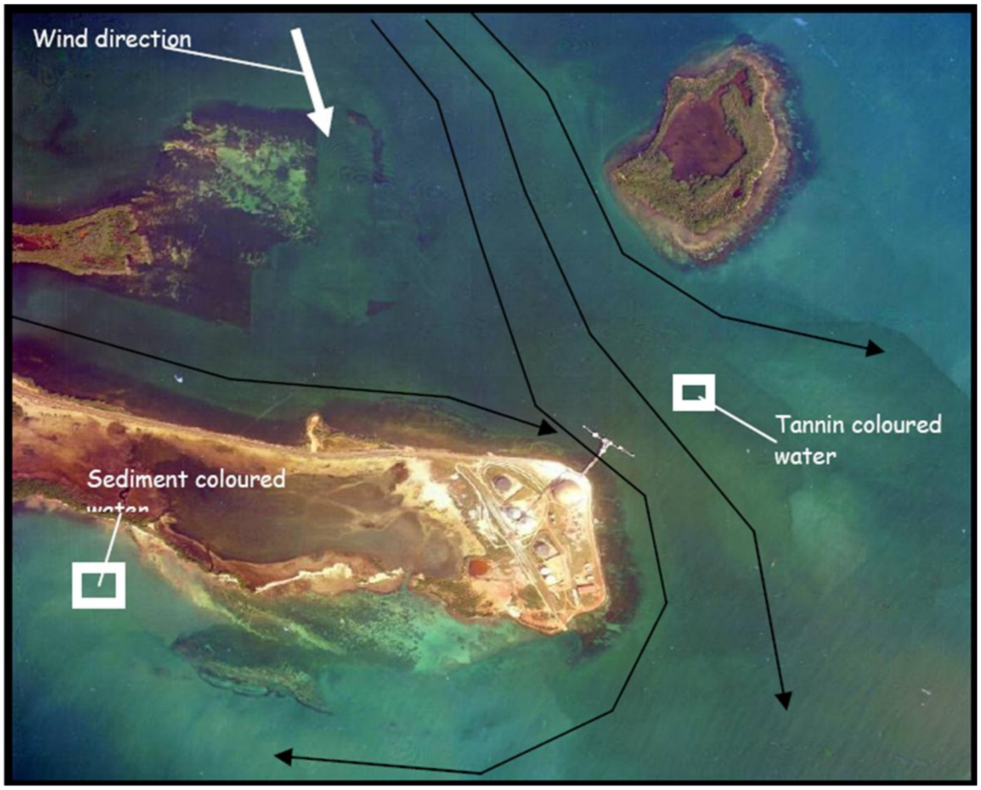


Figure 5-6: Percent Exceedance - Wind Speed - Norman Manley International Airport (1976-2005)

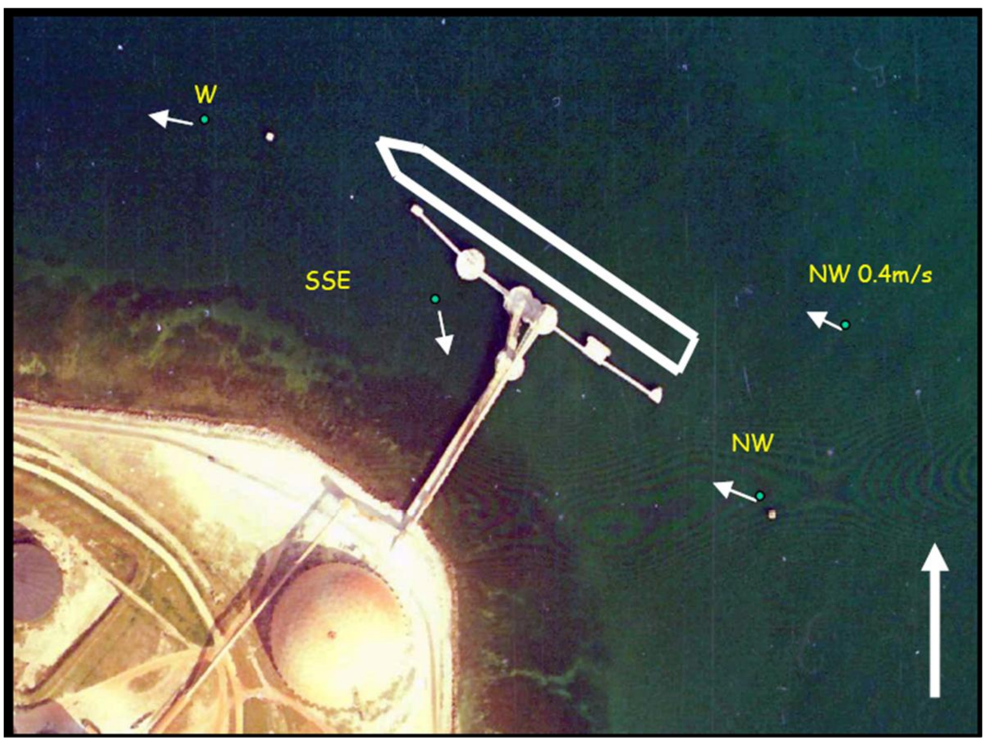
5.2.1.3.2 Waves

Discharges of fresh water from the Salt River affect the proposed area from the mangroves to the north-west of the proposed project site. The discharges tend to be dark brown in colour, a reflection of the tannins that are leached from mangrove tree roots, particularly red mangrove within the Portland Bight Area.

Plate 4-1 below suggests that water movement indicators were being influenced by the prevailing wind at the time. Contributing to the direction of movement would be the effect that the seafloor has on currents, through a process called wave refraction (The process by which a wave approaching the shore changes direction due to slowing of those parts of the wave that enter shallow water first).



A. Water Current Movement Influenced by Daytime Winds [IMAGE OBTAINED FROM CD&A 2004 STUDY]



B. Water Current Movement Influenced by Daytime Winds [IMAGE OBTAINED FROM CD&A 2004 STUDY]

Plate 5-1: General Current Movement in the Vicinity of the Proposed Site

CEAC Solutions Company Limited (Ja.) investigated wave and tide action at Rocky Point using a Workhorse Sentinel (600 KHz) located in 10.5 m water depth. A summary of their findings is outlined below. The instrument was deployed on May 10, 2007 and retrieved on July12, 2007. The instrument was redeployed on July 13, 2007 with the following recording parameter settings:

- Number of pings per ensemble = 50
- Magnetic Variation = 6 degrees West
- Duration of ensemble = 10 minutes
- Interval between ensembles = 1 hour

Inspection of the wave data revealed that the waves (Hs) range in height from 0.24 to 0.89 m at the ADCP location. The corresponding Peak wave periods range from 2.0 seconds to 9.4 seconds (**Table 5-1**). As expected the dominate direction was approximately 104 degree relative to North.

Table 5-1: Wave climate summary for the period May 25th to July 12th, 2007

	Significant wave height **(Hs)**	Peak Period **(Tp)**	**Direction**	**Tide**
Minimum	0.24	2.00	0.00	10.16
Maximum	0.89	9.40	359.00	10.68
Average	0.56	3.31	104.59	10.44
Range				0.53
Hs – Significant wave height, **Tp** – Peak Period, Dp - Direction				

Wave height data for the period of measurement indicates the diurnal peaking of the wave period to 7 and 9 seconds. It is possible that there may be some correlation between wind speeds in deep waters and the arrival of these long period waves on such a regular basis (**Figure 5-7 - Figure 5-8**). Inspection of the tide elevation data revealed that the location experienced three spring and three neap tides with a range of 0.53 metres (or +/- 0.265 metres). This range is larger than expected (**Figure 5-9**).

Another deployment during the period October 17-31, 2007 revealed:

- The operational wave heights for the period appear to be 0.3 to 0.4 meters with a period of 2.5 and 3.0 seconds on average, with a maximum wave height of 0.61 meters.
- The majority of the waves are coming from ENE to E.

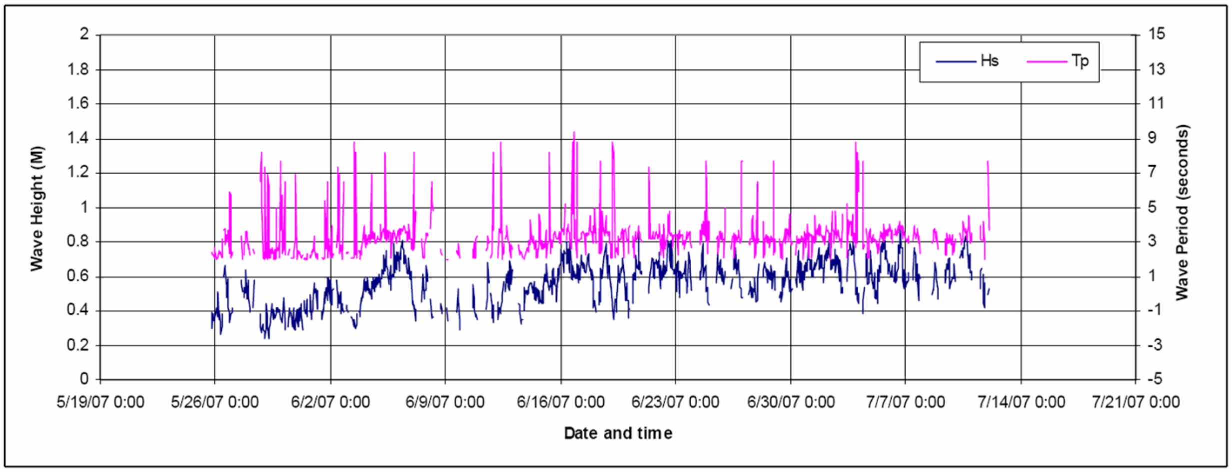


Figure 5-7: Significant Wave Heights (m) – Hp & Tp

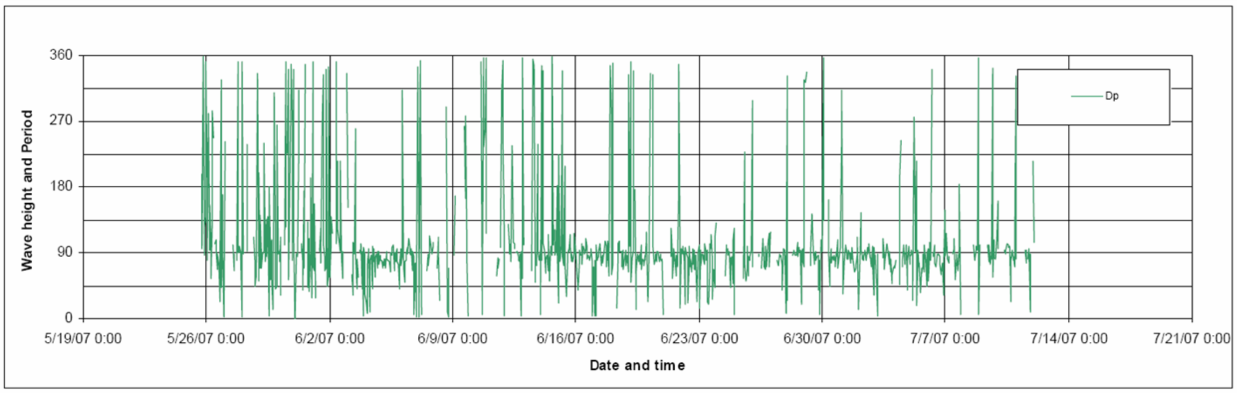


Figure 5-8: Significant Wave Heights (m) – Dp

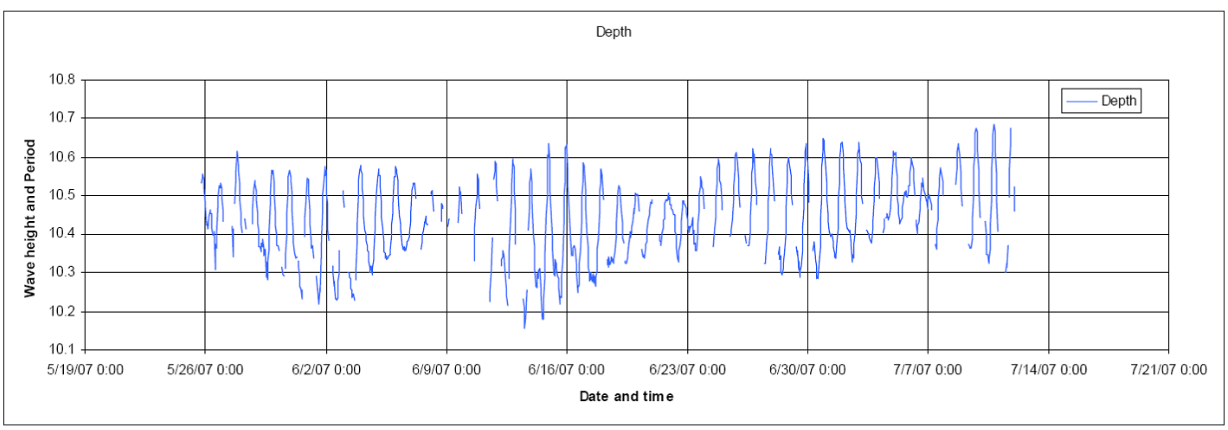


Figure 5-9: Tide ranges

Below is information based on a M&N study that utilized the fast-time, autopilot simulation software SHIPMA developed by MARIN (Maritime Research Institute Netherlands) to perform a detailed computer-based simulation of the manoeuvres required for the design vessel to safely transit the proposed channel and turning basin.

The offshore waves are presented in the wave rose below and present direction to which waves propagate. **Figure 5-10** presents a wave rose calculated from a wave-hindcast model based on fully developed waves from winds in section 4.2.1.3.1. For the SHIPMA simulation, waves were transformed from offshore wave heights using a previously developed model (see **Figure 5-11**).

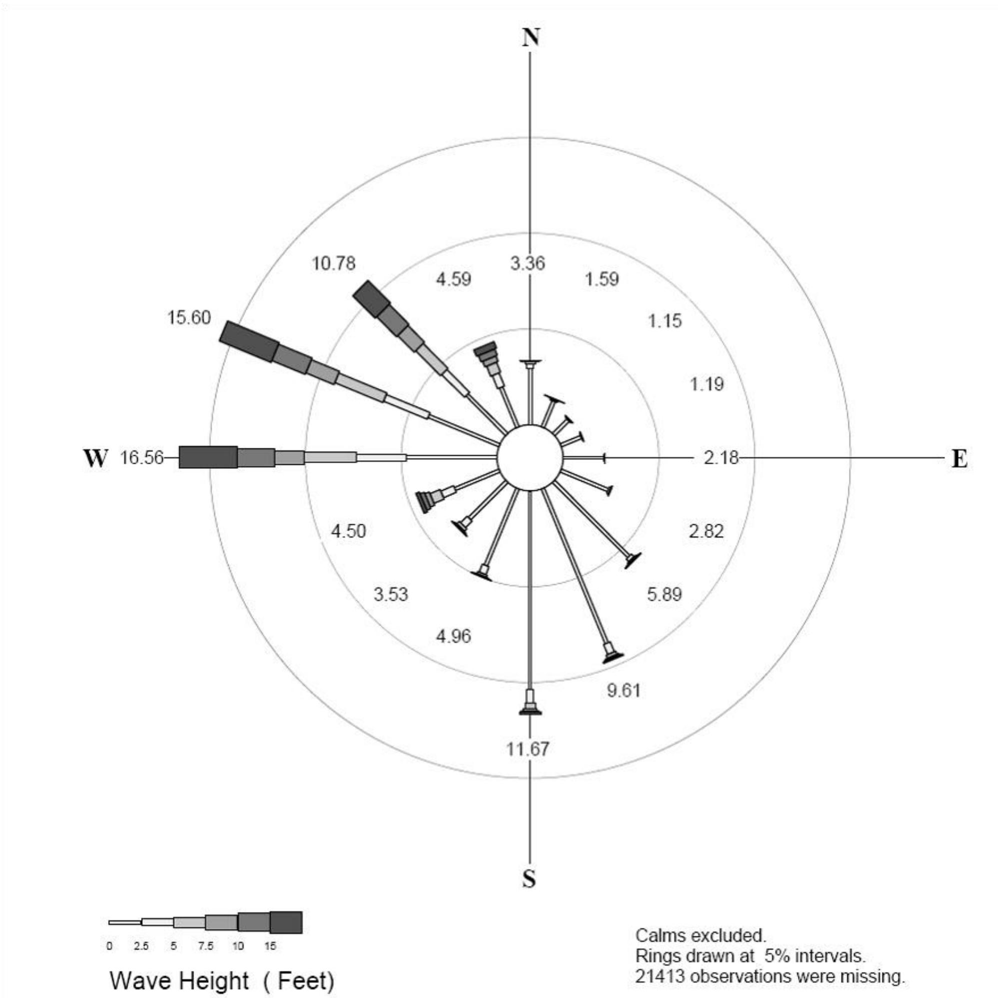


Figure 5-10: Percent Occurrence of Wave Height and Direction from Deep Water Wave Hindcasting (1976-2005) - Direction indicates where the waves are propagating towards [8]

[8] M&N, RINKER Materials Vessel Manoeuvring, 2006

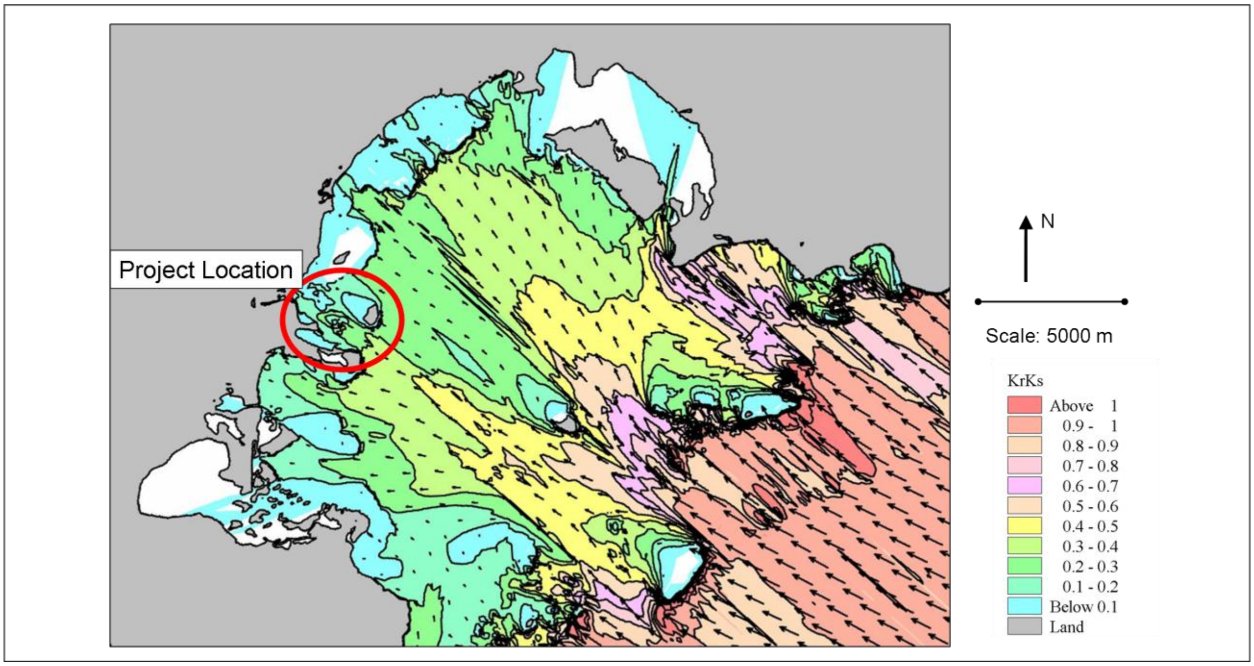


Figure 5-11: Near-shore Wave Transformations into Portland Bight[9]

5.2.1.4 Temperature and Relative Humidity

Apart from rapid fluctuations associated with afternoon showers and/or the passage of frontal systems, the island's temperatures remain fairly constant throughout the year under the moderating influence of the warm waters of the Caribbean Sea.

The warmest months are June to August and the coolest December to February. Night-time values range from 18.9 ºC to 25.6 ºC (66 to 78.1 ºF) in coastal areas with inland temperatures cooler. The diurnal range of temperature is much greater than the annual range and exceeds 11.0 ºC or 20 ºF in mountainous areas of the interior.

At elevations above 610 metres (2000 feet), minimum temperature of the order of 10 ºC (50 ºF) have been reported occasionally when active cold fronts reach the island. The project location is within the coastal zone at elevations within the range 0 - 230 m (0 – 750 ft.).

Variations of sunshine from month to month in any area are usually small, approximately one hour. Differences, however, are much greater between coastal and inland stations. Maximum day-length occurs in June when 13.2 hours of sunshine are possible and the minimum day-length

[9] Moffat & Nichol International, RINKER Materials Vessel Manoeuvring, 2006

occurs in December when 11.0 hours of sunshine are possible. However, the mean sunshine in mountainous areas is less than 6 hours per day, while in coastal areas it is near 8 hours per day. The shorter duration in the hilly areas is caused mainly by the persistence of clouds.

Relative humidity is a term used to describe the amount of water vapour that exists in a gaseous mixture of air and water, expressed as a percentage of the maximum amount of water vapour that could be present if the vapour were at its saturation conditions. Afternoon showers are the major cause of most daily variations in relative humidity. Highest values recorded during the cooler morning hours near dawn, followed by a decrease until the early afternoon when temperatures are highest.

The average monthly % relative humidity and temperature experienced on the south coast is given below (**Figure 5-12**). These values are tempered by the usual afternoon showers experienced in the hilly interiors. The average annual temperature for this period was 28.34 ºC.

Temperature and relative humidity are not expected to have any meaningful impact on the proposed port and conveyor corridor operation. **Figure 5-13** and **Figure 5-14** outline the temperature and pressure experienced in the area of the JAMALCO Port for a five (5) week period in 2007 (October 17 – November 21).

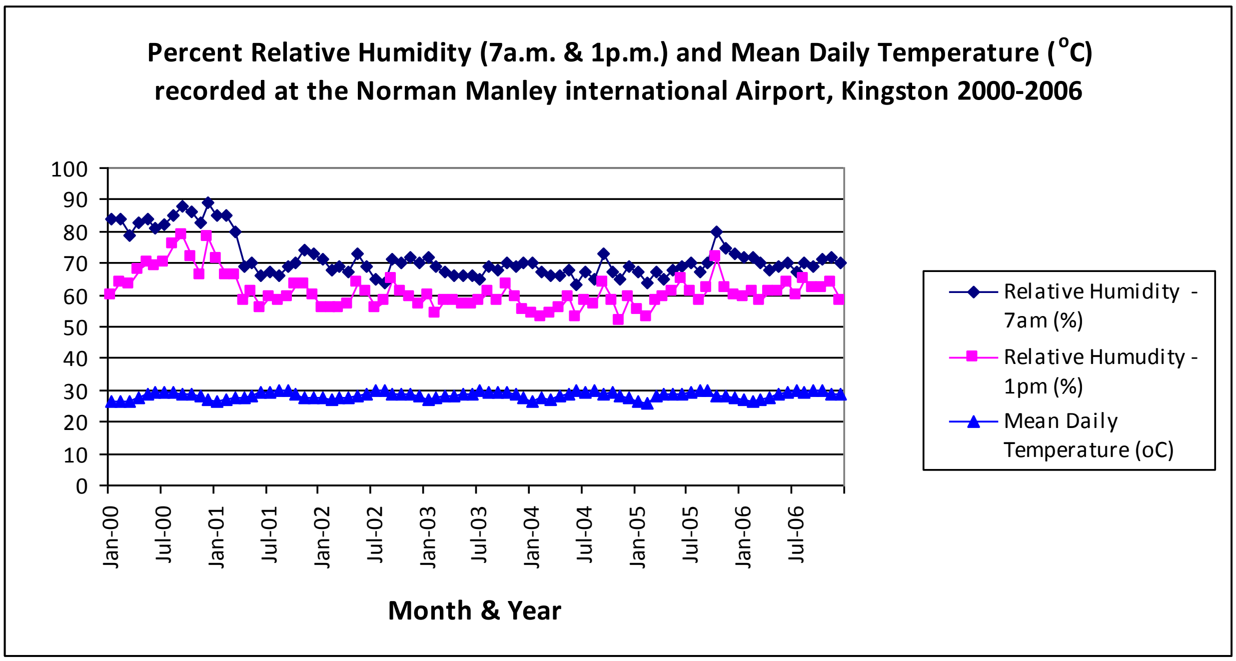


Figure 5-12: Percent Relative Humidity and mean daily temperature experienced at Norman Manley International Airport, Kingston 2000-2006

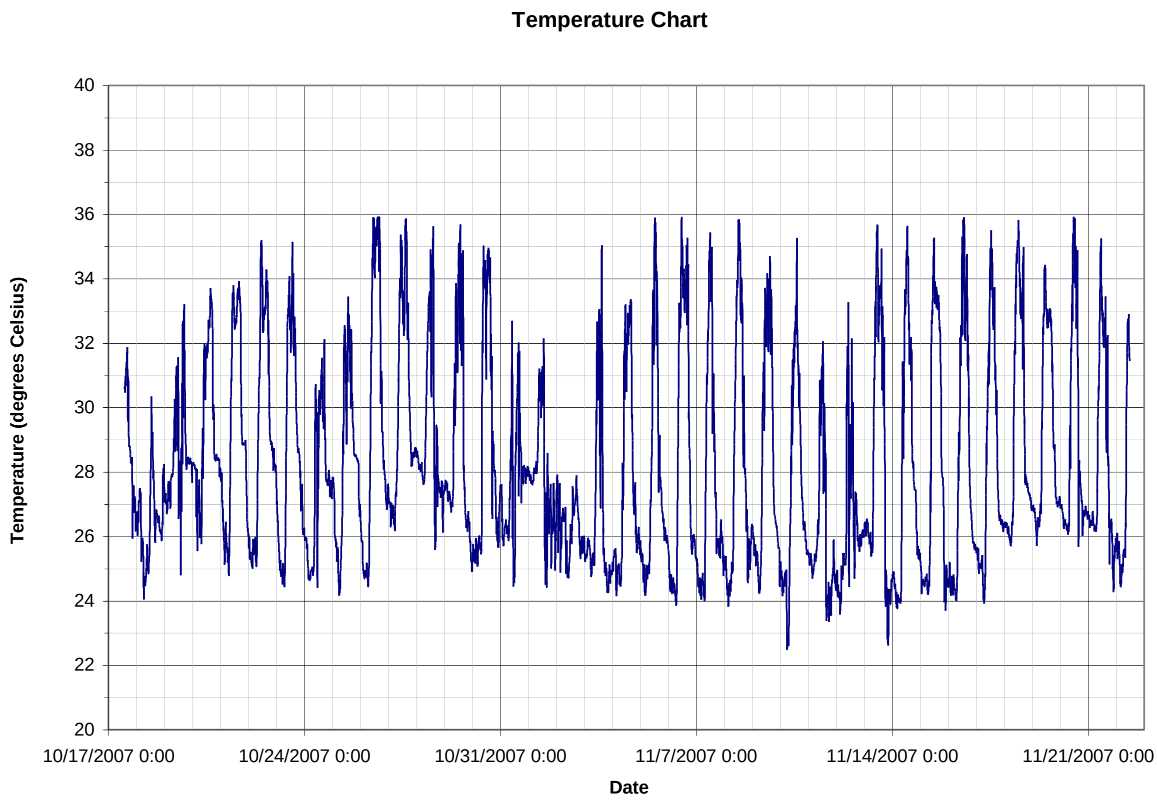


Figure 5-13: Temperature Chart outlining the temperature profile of the area for a 5 week period

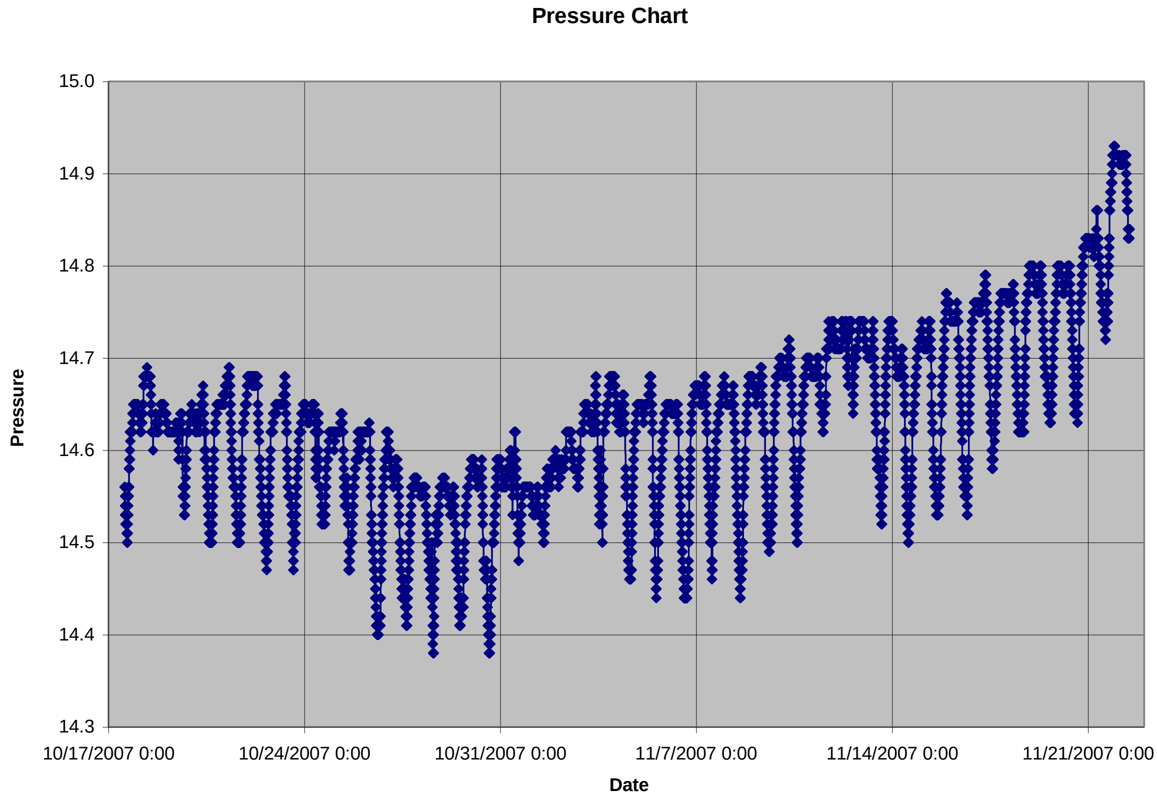


Figure 5-14: Pressure Chart outlining the Pressure Profile of the area for a 5-Week Period

5.2.2 *Audiometric Analysis (Noise)*

The community of Salt River is the closest community in proximity to the proposed development. Current commercial and industrial interest, aside from the Brazilletto Quarry, in the area are the existing JAMALCO Rocky Point Port, West Indies Sugar Company warehouse (currently being used by JAMALCO), and the Tarentum Coffee Factory.

The proposed port is located in a rural area with the nearest residential or commercial development approximately 3 km (2 mi) away of the proposed facilities. The only human noise receptors in the vicinity of the project area are employees of the JAMALCO port facility. The proposed conveyor connecting the proposed plant and port will be orientated in an east-west direction south of the communities of Salt River and Brazilletto Settlement. Current noise sources in the general project area is primarily associated with vehicle traffic along the Salt River – Tarentum main road, train traffic to and from JAMALCO Port, as well as firearm practice at the Gun, Rod & Tiller Club periodically. At the present time, sound transmission is limited due to ground absorption, as well as shielding by interposing topography and vegetation. An ambient noise in the general area is estimated to be near 50 dBA, mostly from traffic sources and from natural events including wind and animal sounds.

The audiometric survey was recorded in the following six (6) locations within the sphere of influence of the proposed project: The audiometric survey was conducted using calibrated hand-held digital audiometers (Norsonic 118). Noise levels were measured at the various locations selected because of their proximity to planned activities and residential areas closest to the proposed project.

The following table and plate outlines the locations for sample sites.

Table 5-2: Location and Coordinates of noise sample sites

Location	Coordinates	
Salt River (Intersection with Rocky Point peninsula Road)	17° 49' 39.67" N	77° 11' 6.15"W
Salt River (WISCO Warehouse)	17° 50' 13.59" N	77° 10' 4.57"W
Rocky Point (proximity to JAMALCO Port)	17° 49' 09.19" N	77° 08' 50.48"W
Tarentum (at the coffee factory)	17° 50' 34.99" N	77° 10' 27.02"W
Brazilletto Quarry (south)	17° 50' 24.15"N	77° 10' 57.75"W
Mitchell Town	17° 48' 38.37"N	77° 11' 41.80"W

Of the 6 locations sampled, the average noise level was highest at the Tarentum (38.56 dBA) and lowest at the Rocky Point port site location (12.34 dBA). These values were well below the residential noise standard of 70 dB. It should be noted that quarry related noise standard for blasting is a recommended 129 dBA. **Table 5-3** below shows the noise levels for the six locations within the regional sphere of the quarry outside blasting events.

All equipment specified for the Proposed Port and Conveyor operation will meet the requisite local requirement as set by NEPA. The primary source of noise nuisance will result from the long periods of continuous use of the conveyor. The conveyor will be fitted with sound deadening material where necessary to attenuate noise. Totally covered areas will be constructed near the most sensitive receptors (the Salt River community). Additional noise generating equipment will also be fitted with silencers, where possible.

The conveyor to be used will meet all local and international standards, as applicable, for such equipment, and the best technology guidelines will be used as it relates to the international Aggregate Industries.

Table 5-3 below shows the average, maximum and minimum audible decibel levels for the project site and surroundings. Maximum noise levels would have been generated by the rail services to the Port, marine traffic, and regular motoring traffic in the area which is intermittent.

Table 5-3 Average Sound Pressure levels for the Proposed Project

	Locations	Average (dB)	Maximum (dB)	Minimum (dB)	NEPA Standard (dB)
LAeq	Salt River (Intersection with Rocky Point peninsula Road)	25.46	52.9	21.2	**70**
	Salt River (WISCO Warehouse)	31.20	36.1	23.2	**70**
	Rocky Point (proximity to JAMALCO Port)	12.34	18.8	2.3	**70**
	Tarentum (at the coffee factory)	38.56	47.6	26.3	**70**
	Brazilletto Quarry (south)	14.88	25.6	7.8	**70**
	Mitchell Town	24.24	38.6	19.9	**70**

LAeq refers to the "equivalent" average sound pressure level measured using the A-weighting which is most sensitive to speech intelligibility frequencies of the human ear. The A-weighting curve is used in sound level meters for measuring environmental and industrial noise as it relates to the potential hearing damage (normal hearing range of 31.5Hz to 8kz) and other noise health effects at moderate to high intensity levels. As such it has widespread use in audio equipment measurement.

The following list outlines typical noise levels from various sources.

Common Noise Levels	
Source	dBA
Military jet, air raid siren	130
Amplified rock music	110
Jet takeoff at 500 meters (1,640 feet)	100
Train horn at 30 meters (100 feet)	90
Freight train at 30 meters (100 feet)	95
Heavy truck at 15 meters (50 feet)	90
Tractor or lawn mower at 15 meters (50 feet)	85
Busy city street, loud shout	80
Busy traffic intersection	80
Highway traffic at 15 meters (50 feet)	70
Predominantly industrial area	60
Background noise in an office	50

Common Noise Levels	
Source	dBA
Suburban areas with medium density transportation	50
Soft whisper at 5 meters (16 feet)	30
Threshold of hearing	0

Note: A 10 dBA increase in level appears to double the loudness, and a 10 dBA decreases loudness by about 50%.
Source: Egan, M. David 1988. City Environmental Quality Review Technical Manual.

Very few noises are constant; therefore, it is necessary to describe noise over periods of time. One way to describe the fluctuating noise heard, over a specific time period, is as if it had been a steady, unchanging sound. For this condition, a descriptor called the equivalent continuous sound level can be computed from measured data. This descriptor is the time-weighted average sound level that, in a given situation and time period (e.g., 10 hours per day), conveys the equivalent sound energy as the actual time-varying sound. This option was utilized here to describe the noise in the various communities surrounding the project sphere of influence (**Table 5-3**).

The primary noise generators resulting from implementation of the proposed project would be heavy materials handling equipment and the conveyance system. In the region closest to residences and the port, the conveyor will be housed within an enclosed system to reduce any potential noise. **Table 5-4** depicts estimated noise levels for these project elements at the noise source and at distances of 100, 500, and 1,000 meters.

Table 5-4: Noise Specifications for Aspects of Limestone Quarry & Conveyor Systems Elements

Sound Source	Sound Level (dBA)	Operating Time of Sound Source (hr/day)	Equivalent Continuous Sound Level (dBA)	Sound Level (dBA) at 100m	Sound Level (dBA) at 500m	Sound Level (dBA) at 1000m
Fixed Equipment						
Compressor for Dust Collectors	95 (-30)	10	61	21	7	1
Overland Belt Conveyor	75	10	71	31	17	11
Total Sound Level of Fixed Equipment:			**82**	**42**	**28**	**22**
Mobile Equipment						
Payloader (11 tons)	85	10	81	58	44	38
Haul Truck 1 (55 tons)	85	10	81	58	44	38
Water Truck (12 tons)	75	3	66	43	29	23
Total Sound Level of Mobile Equipment:			**86**	**63**	**49**	**42**
Drilling						
Drilling	90	5	83	43	29	23
Total Sound Level of Drilling:			**83**	**43**	**29**	**23**
Blasting						
Blasting	110	0.014	78	78	65	58
Total Sound Level of Blasting:			**78**	**78**	**65**	**58**

Notes: (-30) indicates estimated sound reduction as a result of equipment located within an enclosed building.
Source: Cement Engineers Handbook, originated by Otto Labahn, Fourth Edition by B. Kohlhass and 16 other authors, 1983.

Figure 5-15 below displays the noise trend for one (1) hour durations at selected locations. The complete audiometric report is included as **Appendix V**.

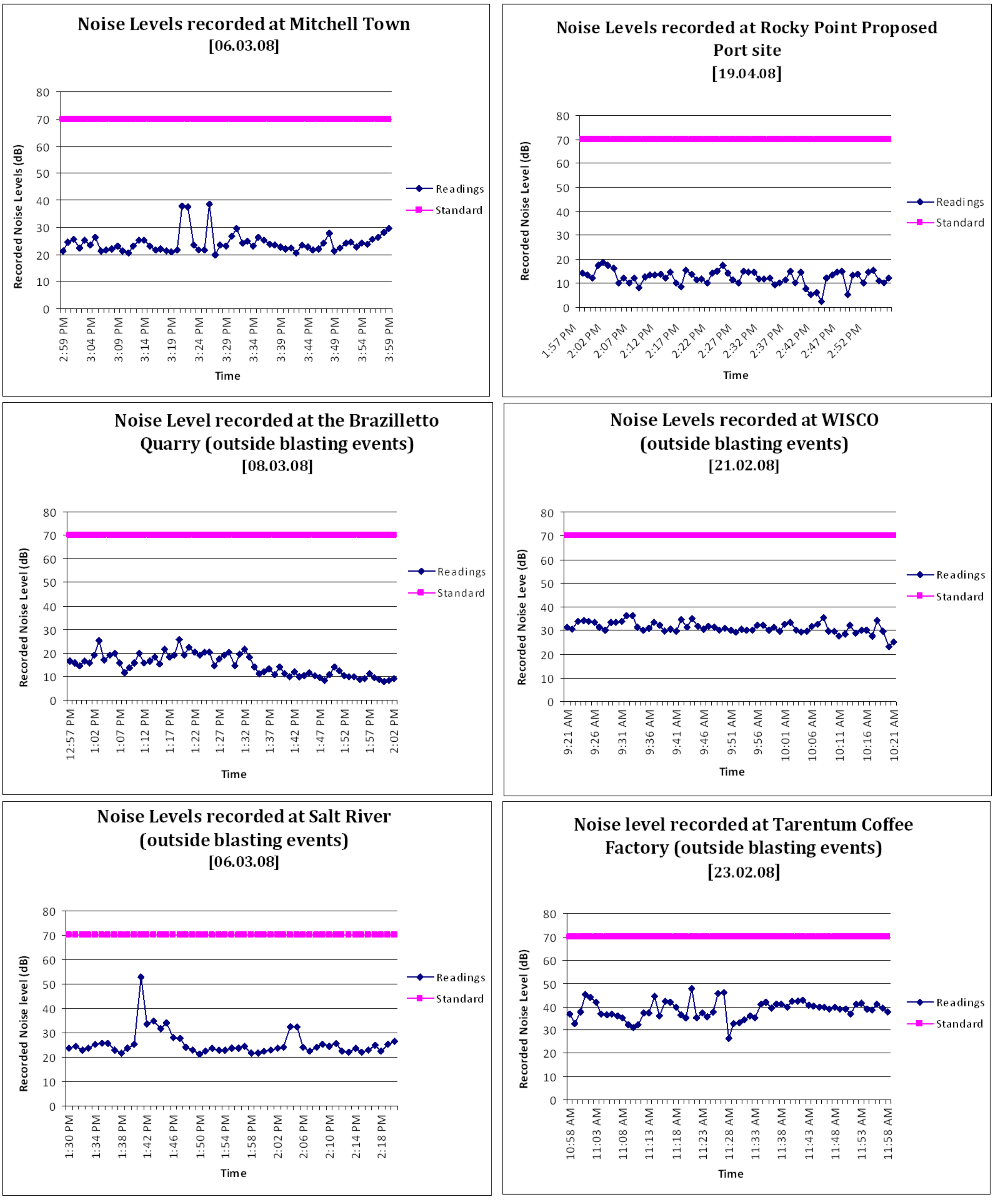


Figure 5-15: Noise Trend Charts for all 6 Sites Sampled

5.2.3 *Ambient Air Quality*

The primary emissions anticipated from the Proposed Port and Conveyor operations will come from equipment and machinery operating and limited wind-blown particulate matter from the reserve stockpile area. While not being deemed insignificant, it is not anticipated that any of these operations will generate significant amounts of air emissions that should be a cause for alarm or concern to the citizens of the area or any other potential receptor.

Emissions of particulates are intermittently released as a result of quarrying activities, windblown dust associated with bulk material handling, transportation and stockpiling of material. However, this does not directly impact on the proposed project but will be the subject of a separate EIA, though addressed in this document as a cumulative impact.

Ambient air quality assessment was recorded in six (6) locations within the sphere of influence of the proposed project during the period February 23 – March 9, 2008.

The result of the sampling showed the highest level of emissions at the Tarentum Coffee Factory (132.92 $\mu g/m^3$) while the lowest were at Rocky Point (18.28 $\mu g/m^3$) and Mitchell Town (28.44 $\mu g/m^3$). It should be noted that all recorded values were below the Standard for ambient air quality for a 24-hour sample – 150 $\mu g/m^3$. The following table shows the record of ambient air quality at the 6 sites.

Location	Coordinates		Recorded TSP reading ($\mu g/m^3$)
	North	West	
Salt River (Intersection with Rocky Point peninsula Road)	17° 49' 39.67"	77° 11' 6.15"	49.66
Salt River (WISCO Warehouse)	17° 50' 13.59"	77° 10' 4.57"	121.69
Rocky Point	17° 49' 09.19"	77° 08' 50.48"	18.28
Tarentum (at the coffee factory)	17° 50' 34.99"	77° 10' 27.02"	132.92
Brazilletto Quarry (south)	17° 50' 24.15"	77° 10' 57.75"	99.61
Mitchell Town	17° 48' 38.37"	77° 11' 41.80"	28.44

The prevailing winds at the proposed site are from the southeast. This wind direction would effectively reduce the potential for nuisance by taking any potential wind blown nuisance away from the general direction of neighbouring communities from the main impact site – Brazilletto Quarry. It is not anticipated that the works proposed for the construction of the Proposed Port and Conveyor corridor would result in the formation of fugitive dust or emissions of a quantity and composition that would cause a negative impact on the closest residents to the area or the surrounding environment.

Sample Analysis of Concentration of Total Suspended Particulate Matter (TSP) – Tarentum Coffee Factory (The additional analyses are attached as **Appendix V**).

LOCATION:	Tarentum Coffee Factory				
EQUIPMENT # :	07-0397				
FILTER # :	P5029447				
WEATHER CONDITIONS:	Sunny				
START DATE & TIME :	23-Feb-08	11:01 AM			
END DATE & TIME :	2/24/2008	11:02 AM			
Mass Concentration (MC) is given by	MC = (Wf -Wi) / V				
Where Wf = final mass of filter element					
Wi = initial mass of filter element					
V = corrected sample volume					
Now					
Wf =	0.1448	g	(=)	144800	µg
Wi =	0.1439	g	(=)	143900	µg
Wf - Wi =	900	µg			
Corrected Volume =	6771.2	L	(=)	6.7712	m^3
Mass Concentration (MC)			(=)	**132.92**	**µg/ m^3**
Run Time	1441	min			
Regulatory Standard for TSP is					
24 hr (average)	**150**	**µg/ m^3**			
Annual Average	60	µg/ m^3			

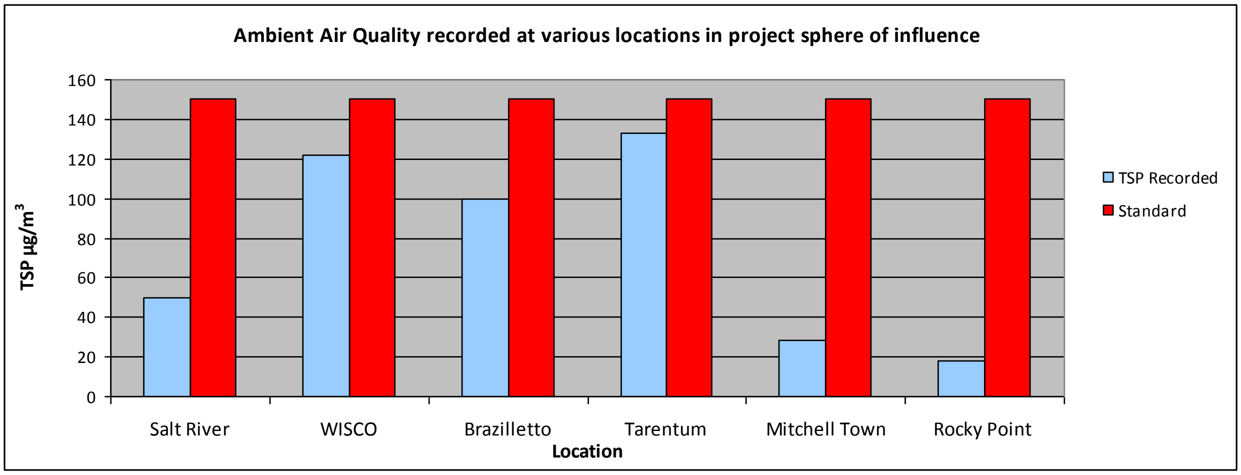


Figure 5-16: Comparison of Ambient TSP recorded against NEPA Standard

Proven particulate control and dust suppression strategies will be employed at the RINKER facilities to minimise particulate and fugitive dust emissions. These may include but are not limited to the use of hooded conveyors and sprinkler systems.

The implementation of dust minimising protocols and procedures will allow RINKER to effectively measure and report the impacts that the operations may have in terms of particulate air quality.

RINKER will implement a number of fugitive emission control measures (all proven methods adopted at industrial facilities in Jamaica) inclusive of the following:

- Vegetating bare areas with grass or other applicable plant material, where necessary.
- Watering of unpaved surfaces as often as necessary to minimize re-entrainment of fugitive particulate matter from these surfaces.
- Maintaining good housekeeping practices to minimize the accumulation of materials, which could become fugitive.
- Use of a covered conveyor belt with the associated protective features
- Dust generated from the loading and transportation of aggregate will be reduced through the use of telescopic ship loading chutes and the washing of the aggregate prior to loading on conveyor.

5.2.4 *Coastal Water Quality Assessment*

The following parameters were evaluated within the coastal waters surrounding the proposed Port development at Rocky Point, Clarendon:

- Total and Faecal coliform

- Total suspended solids
- Total Phosphates
- Total Nitrates
- Oil and Grease
- Dissolved Oxygen
- Temperature
- Salinity and Conductivity
- Biological Oxygen Demand (BOD_5)

Table 5-6 and **Table 5-6** below outline the findings of this assessment. The results as given by the Scientific Research Council (SRC) for BOD, phosphates, nitrates, oil and grease, total and faecal coliform, all fall within acceptable NEPA standards with few minimal exceptions as seen in the tables below. The value for total coliform and fats, oil and grease at one location each was considered slightly elevated.

It should be noted that when compared with NEPA's trade effluent standards and the National Ambient Water Quality Standard for marine waters, these values are all within limits and are very low. NEPA has no standard for marine water bodies along any of Jamaica's coast.

The normal pH of open ocean seawater is about 8.1, or slightly alkaline. The pH of seawater in typical estuaries and coastal waters routinely varies from pH 7.5 to 8.5 with occasional occurrences of pH greater than 9 or less than 7. The pH levels recorded fall within the range 7.72-8.31 which is in line with typical coastal waters[10]. Most animals that live in the water need oxygen, and, except for air-breathing animals like turtles and whales, most use oxygen dissolved in the water. Natural processes and human pollution can cause serious reductions in dissolved oxygen. Both anoxia (no oxygen) and hypoxia (very low oxygen - ≤2 ppm) are harmful to fish, shellfish and other marine animals[11]. The recorded dissolved oxygen levels are low (2 – 4 ppm) to adequate (more than 4 ppm) ranging from 2.75-6.95 ppm. In some shallow areas, high winds regularly cause enough vertical mixing to re-suspend the bottom sediments. In general, sea grass beds decrease the turbidity signal because they absorb light that could have reflected from the bright bottom and into the satellite's view[12].

The results of the water quality analysis indicate that water quality in the area at the time of the sampling event was in good condition. The following parameters were analysed for eleven

[10] URI Chemical Oceanographer Analyzes the Effects of pH on Coastal Marine Phytoplankton. Marine Ecology Progress Series. http://www.innovations-report.de/html/berichte/umwelt_naturschutz/bericht-16317.html

[11] http://www.heinzctr.org/ecosystems/coastal/depl_oxy.shtml

[12] http://www.csc.noaa.gov/crs/definitions/Turbidity.html

sampling points which include a mangrove area (WQ_{16}) and were observed above NEPA's standard: Fats, Oil and Grease, Faecal Coliform and Total Coliform.

The high FOG content is expected within the surrounding regions of the proposed site. This is due to the Rocky Point Port where ships are docked for loading and is located west of the proposed site. The presence of oil and grease may be as a result of the berthing activities at the port and wave action, transporting the oil and grease toward the beach and the mangrove area.

The Faecal Coliform exceeded NEPA's standard. This exceedance was observed close to Peake Bay. The total coliform parameter was exceedingly high at the JAMALCO Port and Berthing Facility. At the immediate vicinity of the proposed site (WQ_4) the water quality parameters were exceedingly lower than NEPA's Standards.

This represents the baseline conditions and suggests there is some pollution loading arising from activities within the region such as septic pits, water transfer by the river among other possibilities.

Plate 5-2: Water Quality Sampling Site Locations

Table 5-5: Water Quality of Coastal Areas (Marine & Riverine)

Location	Coordinates		Depth	pH	COND	Turbidity	DO	Temp(°C)	Salinity
	North	West							
WQ_{13}	**17°50.016**	**77°09.263**	0.5m	7.73	43.0	3	6.51	27	2.76
			4.5m	7.98	44.5	10	5.70	27.5	2.89
WQ_8	**17°49.696**	**77°09.215**	0.5m	8	48.5	3	5.0	27.1	3.18
WQ_7	**17°49.446**	**77°08.509**	0.5m	8.08	48.4	4	6.67	27	3.17
			4.5m	8.08	50.0	2	6.58	27.4	3.29
WQ_{12}	**17°49.002**	**77°10.216**	0.5m	8.14	49.7	5	6.51	27.5	3.26
WQ_{11}	**17°48.812**	**77°10.122**	0.5m	8.14	49.7	6	6.95	27.6	3.26
			4.5m	8.15	50.0	2	6.93	27.6	3.29
WQ_{16}	**17°49.194**	**77°09.858**	0.5m	7.72	51.6	5	2.75	27.7	3.40
WQ_{10}	**17°48.598**	**77°08.344**	0.5m	8.16	46.6	7	5.92	27.2	3.04
			4.5m	8.18	50.0	4	6.16	27.1	3.28
WQ_9	**17°48.819**	**77°08.344**	0.5m	8.18	46.6	7	5.92	27.2	3.04
			4.5m	8.23	49.5	2	6.70	27.1	3.25
WQ_{15}	**17°49.198**	**77°08.631**	0.5m	8.23	47.8	1	5.87	26.7	3.13
			4.5m	8.26	50.1	24	6.09	27.4	3.28
WQ_4	**17° 49.241**	**77° 09.014**	0.5m	8.24	47.5	2	5.40	26.6	3.28
			3.5m	8.28	49.5	3.5	5.53	27.7	3.26
WQ_5	**17° 49.305**	**77° 09.308**	0.5m	8.28	45.4	2	5.78	26.7	2.95
			4.0m	8.31	48.4	20	5.39	27.7	3.17
WQ_6	**17°49.463**	**77°09.689**	0.5m	8.21	47.6	5	4.44	26.5	3.11

Table 5-6: Analysis of Key Parameters of the Marine Waters at Rocky Point, Clarendon

PARAMETERS	METHOD	SAMPLE LOCATIONS												NEPA STANDARD
		WQ_4	WQ_5	WQ_6	WQ_7	WQ_8	WQ_9	WQ_{10}	WQ_{11}	WQ_{12}	WQ_{13}	WQ_{15}	*WQ_{16}	
Total Phosphate (mg/L)	HACH Method 8190	0.03	0.02	0.05	0.03	0.03	0.01	0.01	0.03	0.01	0.03	0.01	0.03	5
Nitrate(mg/L)	HACH Method 8039 & 8171	0.88	1.76	2.20	2.20	2.64	1.76	2.20	3.08	2.20	3.08	1.76	3.08	10
BOD (mg/L)	HACH 8043	0.49	0.26	0.64	0.83	0.38	0.30	1.05	0.64	0.23	0.49	0.68	0.45	<30
Fats, Oils and Grease (mg/L)	1990 Annual Book of ASTM Standards, Section 11 Vol. 11.02	5.50	24.75	1.00	0.78	0.50	1.13	2.00	0.63	3.60	10.40	1.20	2.00	10
Total Coliform (MPN/100 mL)	SMEW Method 9221	2	<2	<2	<2	<2	<2	<2	<2	110	4	≥ 1600	<2	<500
Faecal Coliform (MPN/100 mL)	SMEW Method	2	<2	<2	<2	<2	<2	<2	<2	110	4	12	<2	<100

Analysed by: Scientific Research Council of Jamaica

Date of Analysis: 2008/3/11

***Mangrove**

5.2.5 *Geophysical Environment*

5.2.5.1 Geology

Conveyor Corridor

The regional geology of the area is contained on Geological Sheets 16, 17 and 20, at a scale of 1:50 000, of the Mines & Geology Division of the Ministry of Agriculture. **Figure 5-17** is a summary map.

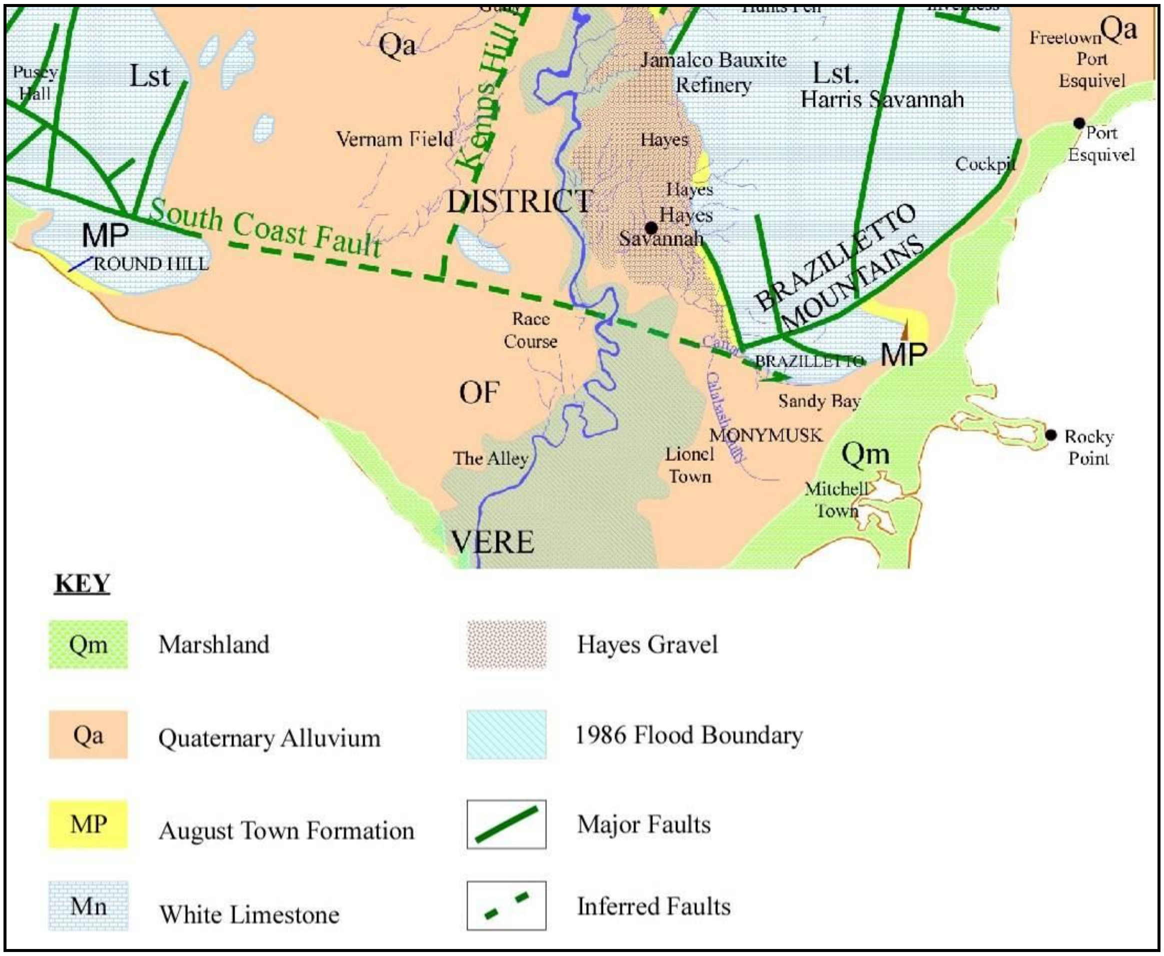


Figure 5-17: Geological map of the site and vicinity, modified from Geological Sheet 16 & 17

The geology of the area encompassing the proposed route of the transportation corridor consists of extensively faulted limestone of Neogene to Quaternary age forming the limestone hill, and superficial alluvial deposits with varying soil cover over the plains. The following units have been recognized.

Stratigraphic Unit	Geological Age
Superficial deposits of soil and wetland deposits	Sub-Recent to Recent
August Town Formation	Upper Miocene to early Pleistocene
Newport Formation	Miocene

5.2.5.1.1 The Newport Formation

It consists of poorly bedded relatively pure white to pinkish-brown micrite. It outcrops over almost the entire licence areas. Three informal stratigraphic units have been recognized (Geological sheet 17), a lower one, characterized by corals and larger foraminifera (*Lepidocyclina canellei*, *Heterostegina antillea*) diagnostic of the Lower Miocene, a middle rubbly layer, reported to contain quartz in some areas (Geological sheet 17), overlain by an upper limestone with molluscs and the foraminifera *Archaias* spp and *Miosorites americanus* indicative of a Middle Miocene age (Robinson, 2004). The Newport Formation was subsequently included in the Moneague Formation of Mitchell (2004).

Solution features in these limestones consist of joints widened by solution and there may be cave development. Most large features in the limestones of southern Clarendon and St. Catherine consist of vertical shafts, widening laterally into extensive cave complexes in some areas, such as Portland Ridge (Fincham, 1997). Caves similar to those of Portland Ridge have not been reported from the study area.

The bearing capacity of the limestone bedrock is good, although for large structures the presence or otherwise of caverns or fissures at shallow depth should be ascertained.

5.2.5.1.2 The August Town Formation

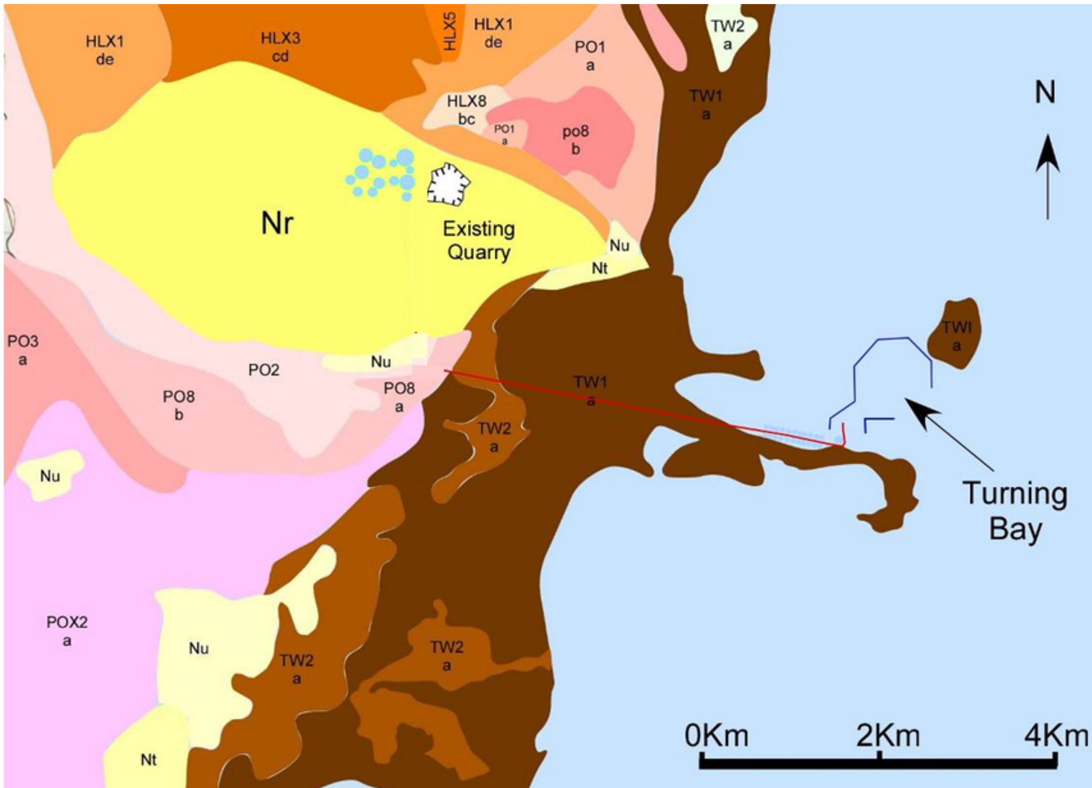
This unit consists of a sequence of yellow marls and rubbly limestones, fossiliferous with a fauna including oysters and foraminifera that forms a fringe along the southern margin of Brazilletto Mountain. Lithologically, they range from impure limestone, relatively resistant to weathering, to softer more easily weathered marls and clayey marls that erode into gullied slopes (**Plate 5-3**). The August Town Formation does not outcrop along the proposed corridor route.

Plate 5-3: Perennial gullies formed in the August Town formation

5.2.5.2 Soil Characteristics (Superficial Deposits)

Conveyor Corridor

These are indicated on **Figure 5-18** below.



The key follows:
Nu – urban areas or areas designated for future building
Nr – outcrops of hard white limestone

HLX1/de – Rockland- Bonnygate complex : complex of miscellaneous areas of hard white limestone outcrops and very shallow, less than 25 cm deep, excessively drained reddish brown to red gravelly, moderately fine textured soil with stony clay loam surface layer.
White limestone outcrops extend from few to hundreds of square meters with about 15-20% of the surface area consists of thin layers of soil in pockets.
HLX3/cd – Bonnygate – Curatoe Hill complex: complex of very shallow (25-50 cm deep) excessively drained reddish brown to red gravelly moderately fine textured and shallow, well drained reddish brown to red fine textured soils with stony clay loam surface layer
HLX8/bc
PO1a – Longville sandy loam: moderately well drained deep intermingled brown to yellowish brown and dark red or light grey fine textured over medium textured soil with dark coloured sandy loam surface layer . these areas are traversed by many rills and gullies with slopes
PO8b - Monymusk clay: moderately well drained deep brown to reddish brown fine textured cracking soil with clay surface layer
PO2b – Morelands gravelly sandy clay: moderately well drained deep brown to yellowish brown faintly mottled gravelly moderately fine textured soil with dark coloured gravelly sandy clay surface layer
PO3A
TW2a (salinas) – areas having salt crust on the surface
TW1a (tidal swamps)- areas permanently of periodically flooded by sea water

Figure 5-18: The main soil types encountered in the study area (redrawn from Soil Survey Report No. 5)

Of these the Nr, Nu. PO8a, TW2a and TW1 units are likely to be encountered along the proposed corridor

Proposed Port Area

The coastline of the area under consideration in this project are largely defined by narrow low lying (less than a metre) mixed clastic carbonate beaches developed in front of mangroves and swamps.

The geology of the proposed port consists of unconsolidated to more or less consolidated alluvial deposits at the surface. The bedrock is likely to consist of consolidated alluvium and, possibly, buried Quaternary coral reef, but boring will be required to prove the nature of the bedrock.

Salt Island

Salt Island was one of only two islands identified by Steers and Lofthouse (1940) comprising the Portland Cays. They describe it as a mangrove island composed of beaches of shingle, consisting of fragments of staghorn coral, with deep water "close to and on all sides" of the island. The south western and sections of the western coast comprise dense impenetrable mangrove swamp. The eastern coast consists of a more or less continuous narrow shingle ridge with mangroves. The eastern side of the island is that on which mangroves have developed. The more sheltered western side of the island consists of mangroves on sand. The interior of the island consists of mangroves rising from a lagoon.

It should be noted that the coral shingle deposited on the western exposed coast is similar in description to that deposited off the eastern coast of Rocky Point and the railway on the approach line by waves in Hurricane Dean (2007) and suggests that such material is common in the off shore area.

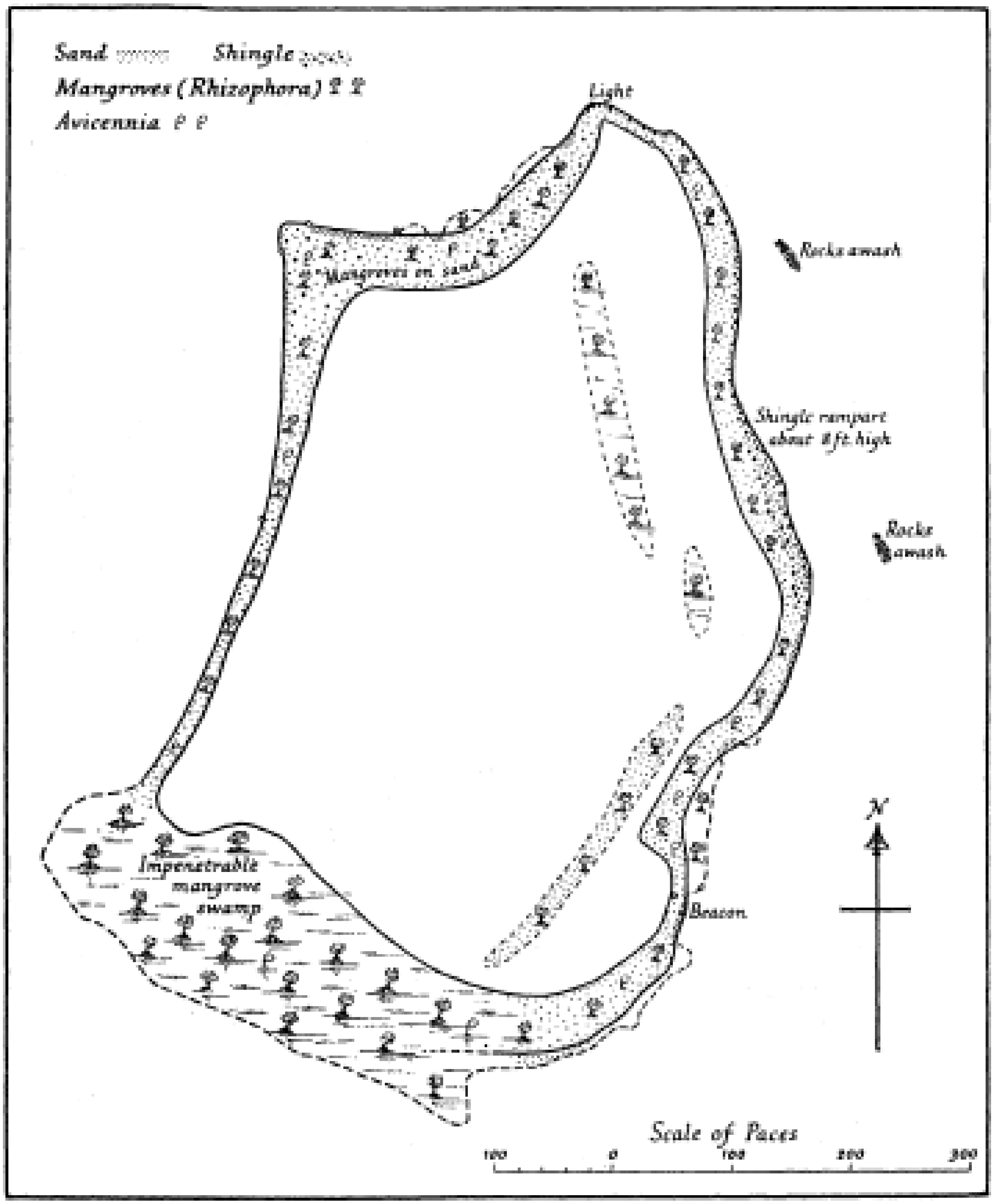


Figure 5-19: Map of Salt Island surveyed in 1939 by J. A. Steers (Steers & Lofthouse, 1940)

5.2.5.3 Tectonic History

A prominent feature of the geology of the Clarendon (Vere) plains south of Kemps Hill and Brazilletto Mountain is the South Coast Fault (**Figure 5-17**), south of which the alluvial cover thickens significantly. The influence of this fault system has produced the upfaulted blocks of Round Hill, Kemp Hill, Portland Ridge and Brazilletto Mountain. The latter mountain is separated by faults from the rest of Harris Savanna, which has structural characteristics more akin to the Hellshire Hills. The tectonic history of the Clarendon Plains includes block faulting in the surrounding limestone uplands, producing the half graben in the limestone bedrock underlying the central plains, west of the study area (**Figure 5-20**). This fault activity probably continued through the earlier stages of the formation of the alluvial fan complex. It is likely that the southern Clarendon Plains are still experiencing gradual subsidence in recent times, although a search for recent and current movements on the South Coast Fault has proved negative (pers. comm. Paul Mann, U. of Texas at Austin, January, 2008).

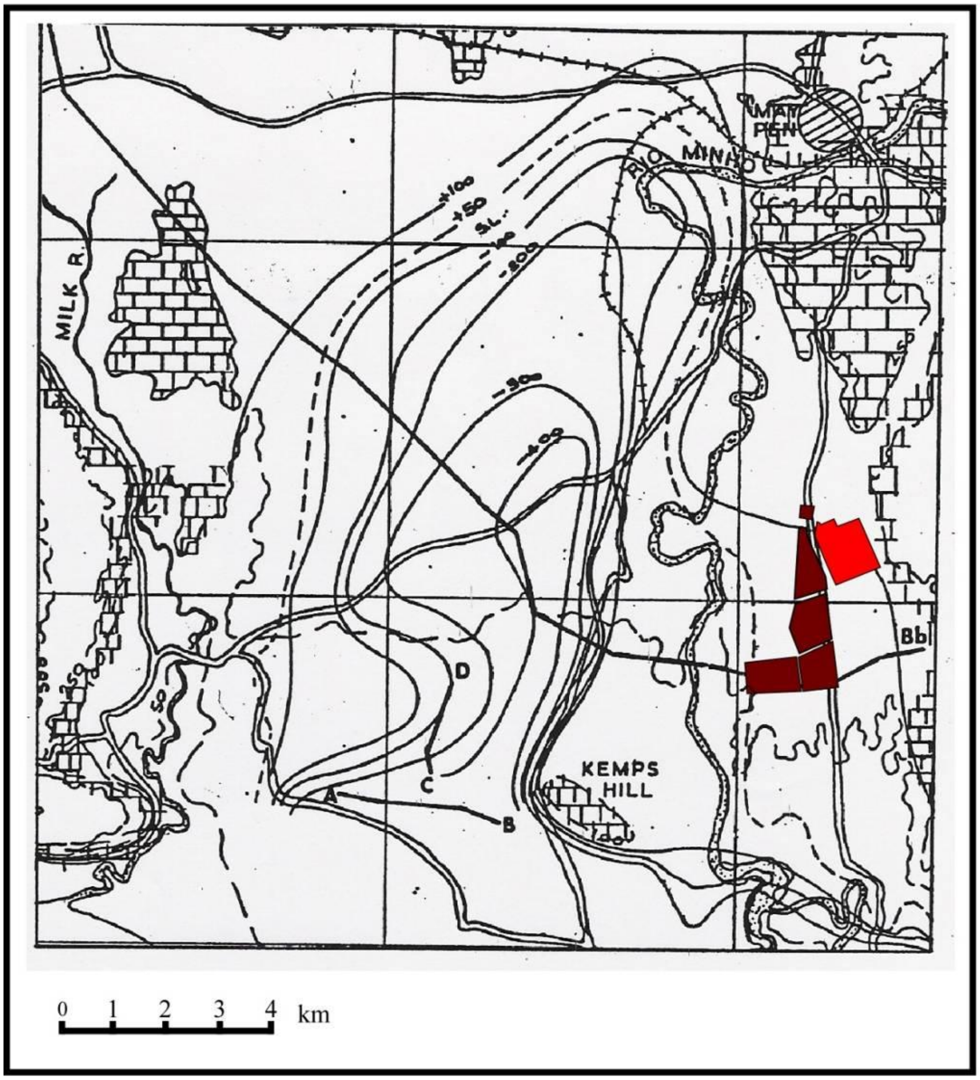


Figure 5-20: Contour map showing limestone elevations under plain (elevations in feet above sea level). (Source: Charlesworth, 1980, modified)

Charlesworth (1980) indicated significant thickening of the alluvium south of the South Coast Fault (**Figure 5-20**) based on well borings. This was supported by Wadge (1983) for the area south of Brazilletto Mountain, based on gravity studies.

5.2.6 *Hydrogeology and Groundwater Resources*

Southern Clarendon does not have a high mean annual rainfall, and is generally a dry area which does not support the more lush vegetation found in northern Clarendon.

Plate 5-4: Example of swamps in the area (Taken: 5/2/08; Location: at the mouth of the Salt River)

5.2.6.1 Rivers and Drainage

Apart from the two Salt River tributaries there are no perennial streams in the area. Storm gullies exist and are easily formed within the Coastal Group limestones. The older limestone area has no surface drainage, but gully systems exist on its surface. These were presumably eroded during times of exceptionally heavy rainfall.

5.2.6.2 Springs

There are several brackish springs along the eastern side of the Brazilletto Mountains and Harris Savanna that are fed by groundwater. The Cockpit springs, north of the area are supported by groundwater discharge from storage in the eastern part of the limestone aquifer. In 1927 the flow of these springs was reported at 80 migd. In 1984-85 the flow of these springs was measured by the then Water Resources Division at 25 to 35 migd. During the period 1968 to 1981 the FAO identified an increase in salinity from 350 to 750 mg/l chloride. The 1981 level would be classified by the USDA as being a medium alkali- very high sodium hazard water, unsuitable for irrigation.

Along the eastern base of the limestone hills springs emit brackish water into the two arms of the Salt River. These are further described below. The flow rates of the springs vary.

5.2.6.3 Canal

The Cockpit canal which channels the flow from the brackish springs which discharge from the fault-controlled, three-mile long zone of seepage extending from Freetown to Salt River, is used by Monymusk to meet its water demand in the eastern area of the Clarendon plains. At Salt River water is pumped from this low-level canal into the high-level canal which carries it to Monymusk. Although no flow measurements are available it is estimated that the flow in the canal is about 38 migd.

5.2.6.4 Hydrogeology (Groundwater)

The Brazilletto Mountain is a highly karstified limestone upland, as, to a lesser extent, is Harris Savanna. The limestone extends beneath the Cockpit wetlands fringing the eastern side of the limestone from Cockpit in the north to Tarentum in the south. The limestone stores groundwater which has become saline due to the development of groundwater resources inland from Freetown. This has reduced the outflow and enabled the saline wedge to move inland.

The water for Chemical Lime Quarry is sourced from a well drilled in 2005 to a depth of 120 feet, 6 inches in diameter. The groundwater from this well is very saline, exceeding 500 mg/l chloride. It is used for washing the aggregate, but there are concerns that the high salinity may percolate into and affect the quality of the aggregate for construction purposes.

Water for Rocky Point (JAMALCO) is coming from two sources. Potable water is trucked in for domestic purposes, while a well at Morelands, at the intersection of the Salt River and Mitchell Town roads, supplies water for general purposes. Because this well penetrates the alluvial aquifer, the water from it is less saline than that from the limestone.

5.2.6.5 Drainage and Topography, Coastal Stability

The development impacts on an area that may be defined as a coastal zone. The coastal zone is delimited by the Salt River, which traverse the coastal plain in a roughly southerly direction. A high water table and marshy conditions characterize the area and the Caribbean Sea (Colon Bay).

The east-drainage branch of the Salt River develops from a fault-related spring occurring at the southern limit of the Brazilletto Mountains. This branch of the Salt River is navigable out to sea. The Cockpit gully also emerges from a fault-related spring near the town of Cockpit. The latter traverses the mangrove swamp and joins the south-draining branch of the Salt River converge near the Gun Club. The Salt River discharges slightly brackish water immediately north of Burial Ground Point, into the Salt River Bay.

Surface drainage is not well developed on the limestone hills; dry river valleys and gullies observed are likely to be fault and joint controlled, and may only transmit storm water or is essentially seasonal. A waterway drains eastward through the Tarentum alluvial plain and connects with the south-draining limb of the Salt River.

The coastline around Salt River Bay occurs in a very well protected location within the Portland Bight. Waves approach from the southeast but are defracted at the Rocky Point. The fringing reefs, which have formed around Rocky point and Burial Ground Point, absorb some of the energy of storm waves. Salt Island is fringed on the eastern side by a coral reef, which provides an additional barrier to oncoming high-energy waves. Submarine sandbars between Salt Island and Burial Ground point may eventually develop to a point where the former may become tied to the coastline as well.

Dissipation of destructive wave energy by these offshore features creates an environment of relative stability and net accumulation of sediment. Rocky point appears to provide enough protection to allow for progradation of the shoreline north of it.

There are reasonably continuous barrier reefs occurring north of the mouth of the Salt River and along the eastern margins of Long Island and Short Islands. These barrier reefs provide adequate protection to the back reef lagoon and shoreline. Back reef lagoons are important generators of the carbonate component found in the beach and along this shoreline (although the clastic component appears to be more significant at Welcome Beach). The extensive development of wetlands along the shoreline suggests that the shoreline is well protected from high wave energy. Welcome Beach (north of the Salt River Pier) is likely to benefit from a net accumulation of sediment, and may prograde (become wider) in the long term.

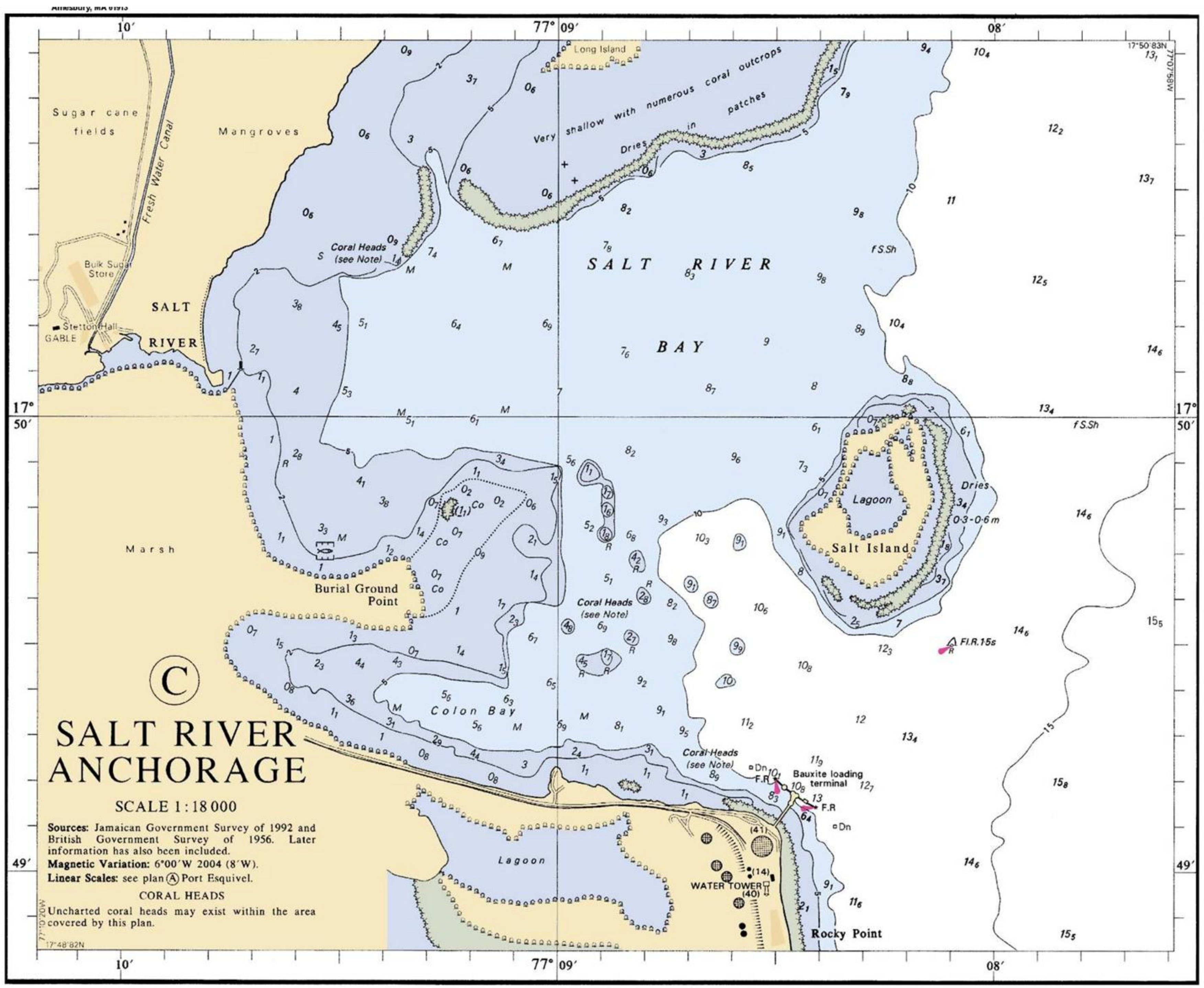
5.2.6.5.1 Bathymetry

The sea basin in the vicinity of Rocky Point extends to a depth of approximately 8.2 m (27 ft) on a gently sloping contour (**Plate 5-5**). This section is based in part on geophysical investigation undertaken and outlined in the JAMALCO Temporary Barge Docking Facility EIA.

All depths will be referenced to mean sea level, noting tidal variations onsite of +/- 6 inches or less. Corrections will be made for tidal variations that occur during the survey where necessary.

Based on a previous EIA done by Conrad Douglas & Associates Ltd. for JAMALCO in the vicinity of this proposed project, the depths in the area were observed to range from 1.2 – 8.2 m (4 – 27 ft) below mean sea level. The bathymetric surface is considered to be shallow and flat to the south near shore, sloping downwards to the north in the central part of the proposed dredge area and deeper and relatively flat to the north and northwest. There is an elongated localised depression along the slope between deep and shallow water at 2408550E, 2067650N.

Examination of the boreholes taken during that assessment indicated an upper 35 to 45 ft of sediments consisting mainly of loose sand and soft silty clay to clayey silt material. These sediments are underlain by a thick, relatively undifferentiated layer of stiff silty clay to clayey silt, to the maximum depth of the boreholes (about 80 ft below top of sediments).



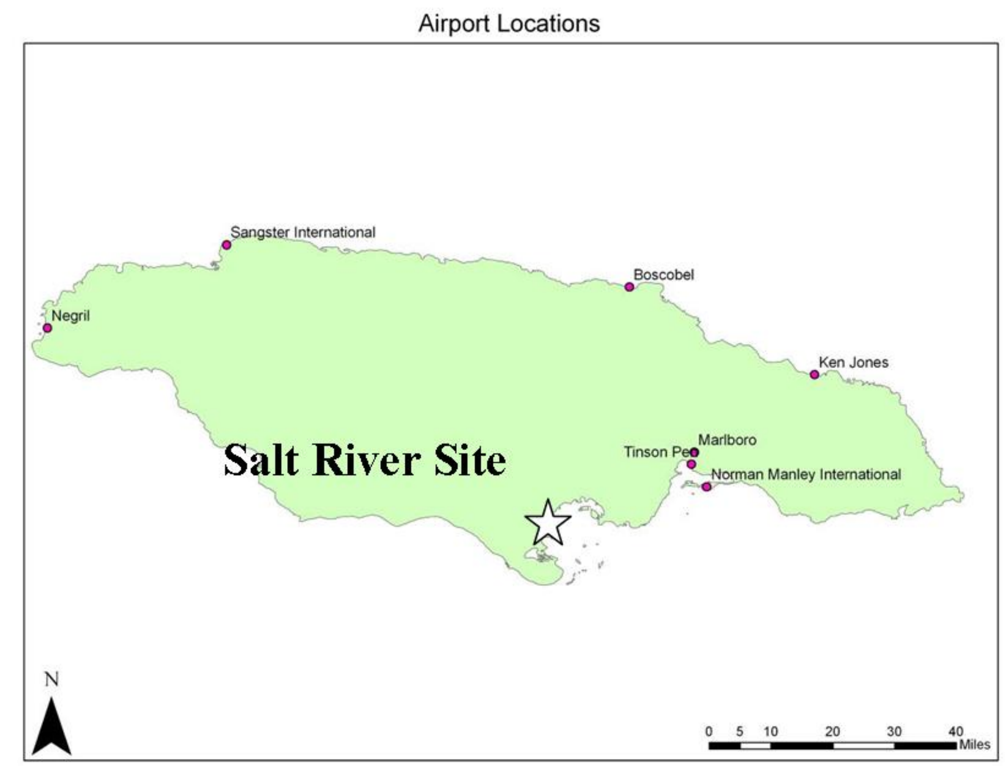


Plate 5-5: Project Location and Bathymetry

5.3 Hazard and Risk Assessment

5.3.1 *Traffic Analysis*

5.3.1.1 Methodology

Traffic survey was conducted to observe traffic flow on roads where the proposed project would more likely impact on traffic. The survey was done by the National Works Agency (NWA) over a 24 hours continuous assessment from the period of February 22 – March 2008 (13 days period).

The surveys were conducted in the following areas:

- Old Harbour Main Road
  - East of Salt River Intersection
  - West of Salt River Intersection
- Salt River Main Road
  - Before Hayes Intersection
  - North of factory
  - South of factory
- Sandy Bay
- Bushy Park

Classification was based on the type of vehicles that were counted. The vehicle classes that were used for the surveys were:

- Cars
- Light Commercial Vehicles
- Bus
- Truck
- Minibus

The traffic analysis for each location is provided below.

5.3.1.2 Old Harbour Main Road

East of Salt River Intersection

The period for which traffic volume was the highest on the Old Harbour Main Road east of Salt River intersection was between 7 a.m. – 8 a.m. during the morning and 5 p.m. – 7 p.m. during the evening for the eastbound traffic flow while that of the west bound was between 11 a.m. – 12 p.m. in the morning and 6 p.m. – 7 p.m. during the evening. However, traffic volume beyond the hours of 7 a.m. in the morning up to 11 p.m. in the evening consistently comparable to peak traffic volume for each day the survey was conducted. Therefore, the proposed project operation outside of peak traffic hours will not be critical of how traffic will be minimally impacted but also taking into consideration periods for which traffic volume is comparable to traffic during peak hours.

The average total traffic volume on the Old Harbour Main Road east of the Salt River intersection was little over 3660 for both the east and westbound. Cars represented more than 85% of the total traffic volume throughout the period the survey was conducted for the eastbound (86%) and westbound (88%). Heavy vehicles such as trucks were less than 2% of the total traffic volume for both the east (1.89%) and westbound (1.28%).

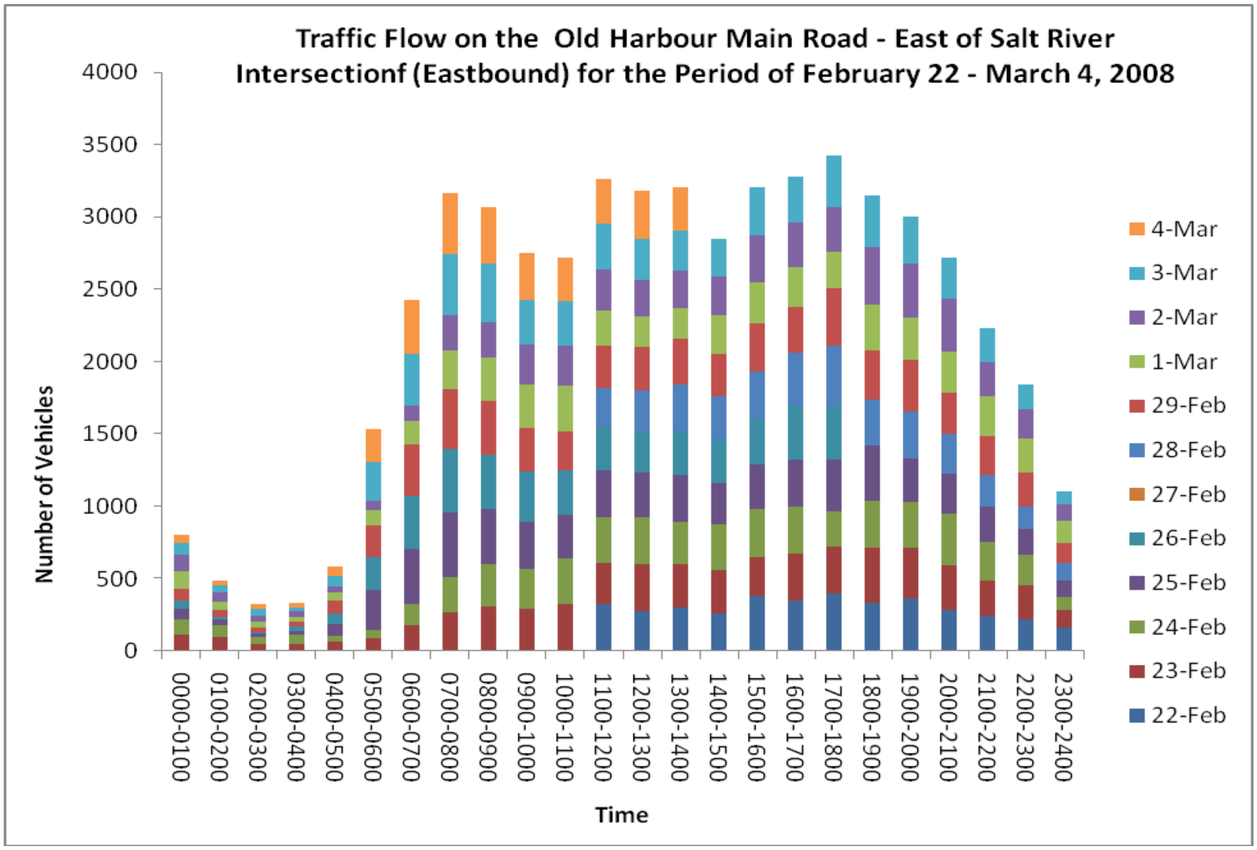


Figure 5-21: Old Harbour Main Road (East of Salt River Intersection) Eastbound Profile

Table 5-7: Old Harbour Main Road (East of Salt River Intersection - Eastbound) AM/PM Peaks

Hour	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar
0000-0100		110	108	72	57		86	121	111	79	60
0100-0200		94	81	43	17		45	60	66	48	36
0200-0300		50	47	23	12		27	47	41	44	33
0300-0400		49	64	28	31		28	38	34	29	32
0400-0500		66	39	84	74		89	51	43	75	60
0500-0600		92	58	272	230		220	98	66	270	231
0600-0700		180	146	379	368		351	163	105	359	377
0700-0800		270	244	444	440		412	267	240	426	424
0800-0900		309	293	380	376		367	305	239	408	388
0900-1000		291	276	322	351		303	295	279	313	318
1000-1100		322	315	303	310		270	311	278	312	295
1100-1200	322	284	318	323	303	267	295	241	285	318	305
1200-1300	279	322	325	307	288	282	295	218	244	285	339
1300-1400	302	302	289	321	307	321	313	211	265	271	306
1400-1500	262	296	317	285	297	306	288	271	266	258	
1500-1600	381	271	327	310	314	324	340	281	322	337	
1600-1700	345	331	318	329	374	365	315	275	313	312	
1700-1800	394	325	246	355	367	422	395	256	303	364	
1800-1900	330	381	324	385		316	338	321	398	356	
1900-2000	362	348	322	298		328	352	295	374	322	
2000-2100	285	308	353	277		280	282	285	363	281	
2100-2200	247	243	264	242		221	266	277	238	233	
2200-2300	222	229	213	178		157	238	230	203	172	
2300-2400	160	125	92	109		120	142	154	110	94	

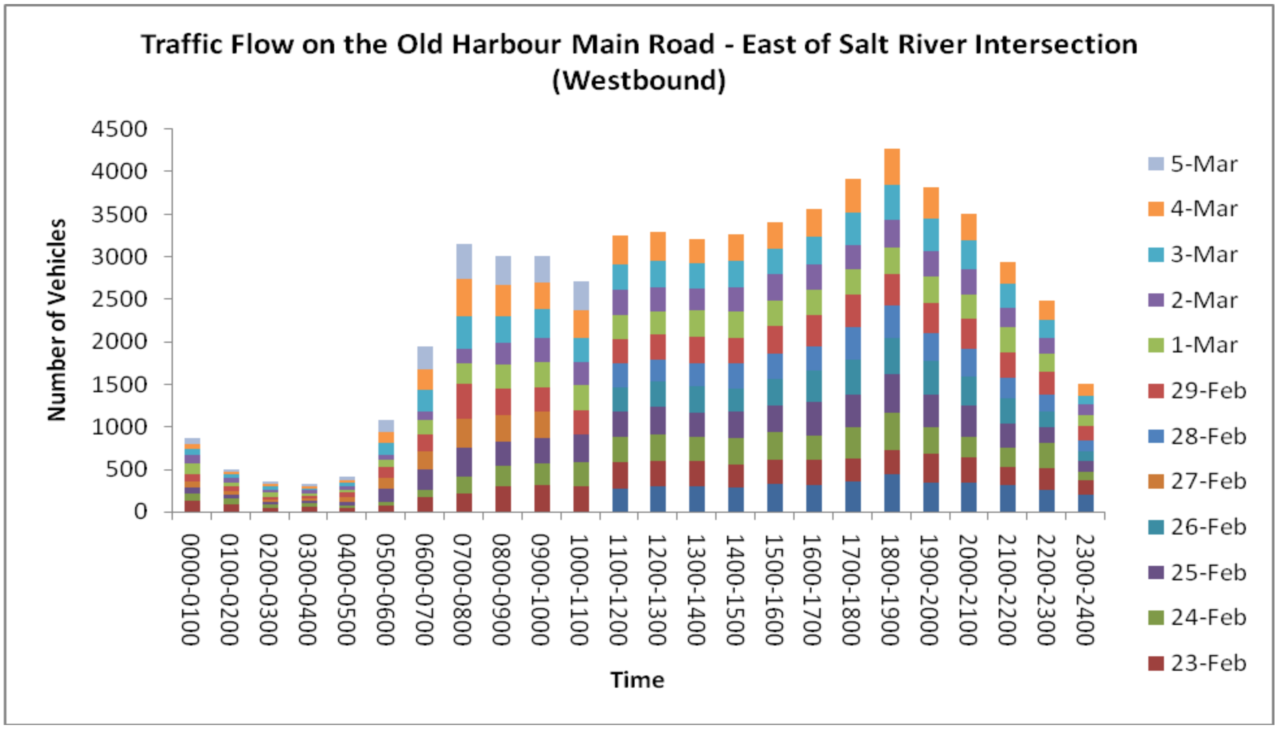


Figure 5-22: Old Harbour Main Road (East of Salt River Intersection - Westbound) AM/PM Peaks

Table 5-8: Old Harbour Main Road (East of Salt River Intersection - Westbound) AM/PM Peaks

Hour	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar
0000-0100		121	91	70		77		86	124	105	67	59	69
0100-0200		88	67	43		47		48	52	56	38	32	30
0200-0300		42	44	27		25		32	51	41	40	25	33
0300-0400		50	55	23		22		31	32	36	21	24	26
0400-0500		47	20	48		49		58	36	37	43	33	39
0500-0600		64	51	154		126		133	81	65	138	123	140
0600-0700		166	91	234		213		207	164	110	248	242	270
0700-0800		219	191	341		349		403	239	178	382	443	412
0800-0900		292	241	297		310		307	286	250	323	369	338
0900-1000		309	252	301		318		289	286	288	340	311	321
1000-1100		296	288	322				282	298	276	288	320	340
1100-1200	268	318	298	299	285		279	278	285	304	300	339	
1200-1300	299	301	309	327	291		257	306	270	286	310	335	
1300-1400	292	305	288	280	316		259	322	311	260	288	291	
1400-1500	289	270	303	322	267		290	303	309	285	313	311	
1500-1600	320	288	328	312	312		298	334	287	322	290	321	
1600-1700	315	295	284	396	372		287	363	297	301	326	321	
1700-1800	360	258	381	385	398		390	378	300	293	376	399	
1800-1900	434	294	440	455	419		387	372	313	323	403	433	
1900-2000	336	344	315	389	386		338	354	308	298	378	366	
2000-2100	345	299	243	367	341		324	353	285	297	337	309	
2100-2200	314	217	219	281	297		252	300	285	238	280	250	
2200-2300	259	253	292	196	182		188	270	221	188	211	224	
2300-2400	196	169	106	119	119		127	166	138	122	103	138	

West of Salt River Intersection

The period for which traffic volume was the highest on the Old Harbour Main Road west of Salt River intersection most frequently occurred between 10 a.m. – 12 a.m. during the morning and 5 p.m. – 6 p.m. during the evening for the eastbound while westbound traffic flow most frequently showed peak traffic volume between 7 a.m. and 8 a.m. in the morning and 5 p.m. – 7 p.m. in the evening. However, traffic flow on the eastbound did not show significant changes from peak traffic hours after 8 a.m. up to 10 p.m. while traffic on the westbound showed similar trend up to 8 p.m. After 10 p.m. and 8 p.m. for the east and westbound respectively, decrease in traffic volume becomes more evident until the following day when traffic volume increases as peak hours are approached.

Average total traffic volume of the Old Harbour Main Road west of the Salt River intersection shows a significant difference when the eastbound (4004) and westbound flow (3189) are compared. Cars accounted for the bulk of the traffic representing more than 85% of the total traffic volume for both the eastbound (86%) and westbound (88%). Traffic flow of trucks, light commercial vehicles and buses for the east and westbound were less than 2%, 1% and 3%respectively. Mini buses traffic flow was slightly different where the eastbound flow was 10% compared to 8% flow of the westbound.

The proposed project operation outside of peak traffic hours will not be critical of how traffic will be minimally impacted but also taking into consideration periods for which traffic volume is comparable to traffic during peak hours.

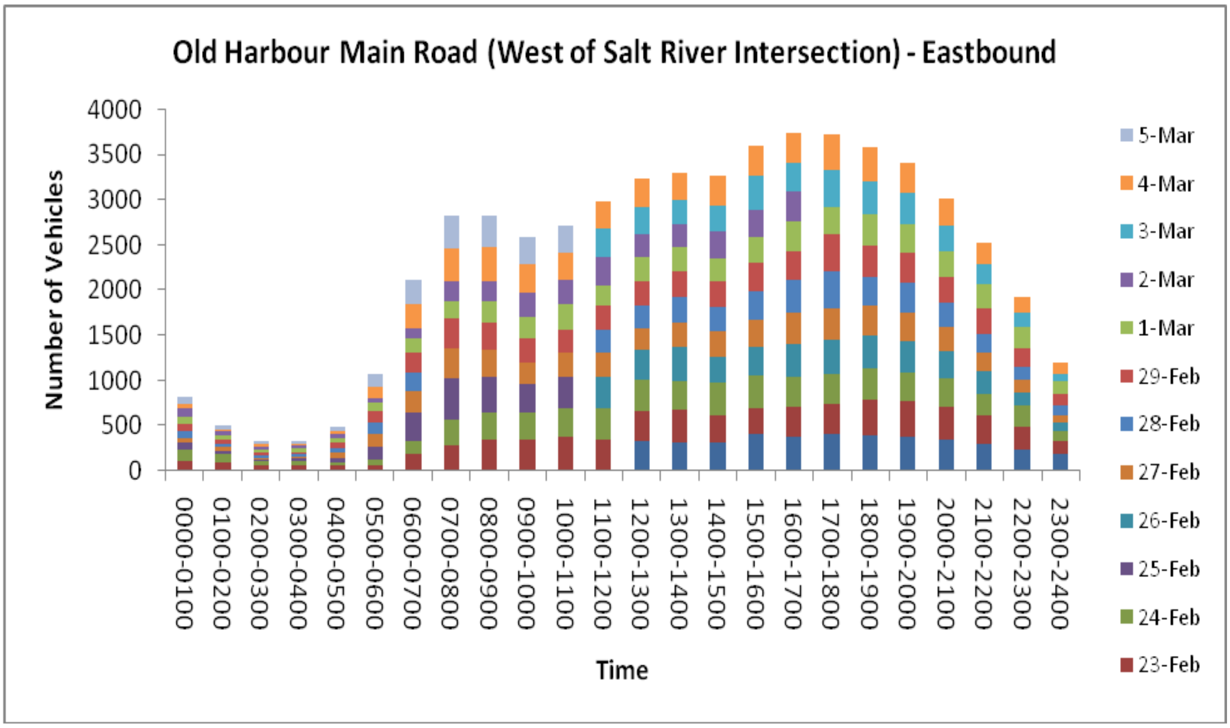


Figure 5-23: Old Harbour Main Road (West of Salt River Intersection) Eastbound Profile

Table 5-9: Old Harbour Main Road (West of Salt River Intersection - Eastbound) AM/PM Peaks

Hour	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar
0000-0100		117	124	70		57	76	73	84	95		43	80
0100-0200		95	88	44		36	32	44	50	47		28	46
0200-0300		56	50	25		18	27	24	33	39		22	30
0300-0400		56	59	27		23	23	21	37	30		22	25
0400-0500		57	31	61		56	53	62	47	36		45	45
0500-0600		69	52	154		136	121	131	88	52		128	143
0600-0700		192	146	314		226	204	231	149	109		271	268
0700-0800		291	270	461		328		338	188	216		368	366
0800-0900		344	303	387		299		299	237	231		379	343
0900-1000		349	292	322		229		275	239	266		314	302
1000-1100		378	318	339		273		258	284	266		298	301
1100-1200		353	346		342	273	243	265	228	306	318	310	
1200-1300	332	324	347		331	242	247	273	263	256	296	325	
1300-1400	318	357	310		392	264	280	291	259	258	268	287	
1400-1500	315	304	351		294	283	264	284	256	293	287	323	
1500-1600	404	290	362		307	314	315	306	288	301	369	335	
1600-1700	375	329	333		363	345	369	314	335	316	328	331	
1700-1800	408	326	344		373	352	409	395	313		405	399	
1800-1900	390	392	353		359	326	329	340	347		363	376	
1900-2000	384	387	322		341	321	318	336	316		338	336	
2000-2100	351	353	316		308	264	260	284	284		284	298	
2100-2200	307	309	238		244	214	196	285	269		225	230	
2200-2300	234	251	244		131	145	140	212	233		153	184	
2300-2400	183	155	100		93	90	105	130	130		89	117	

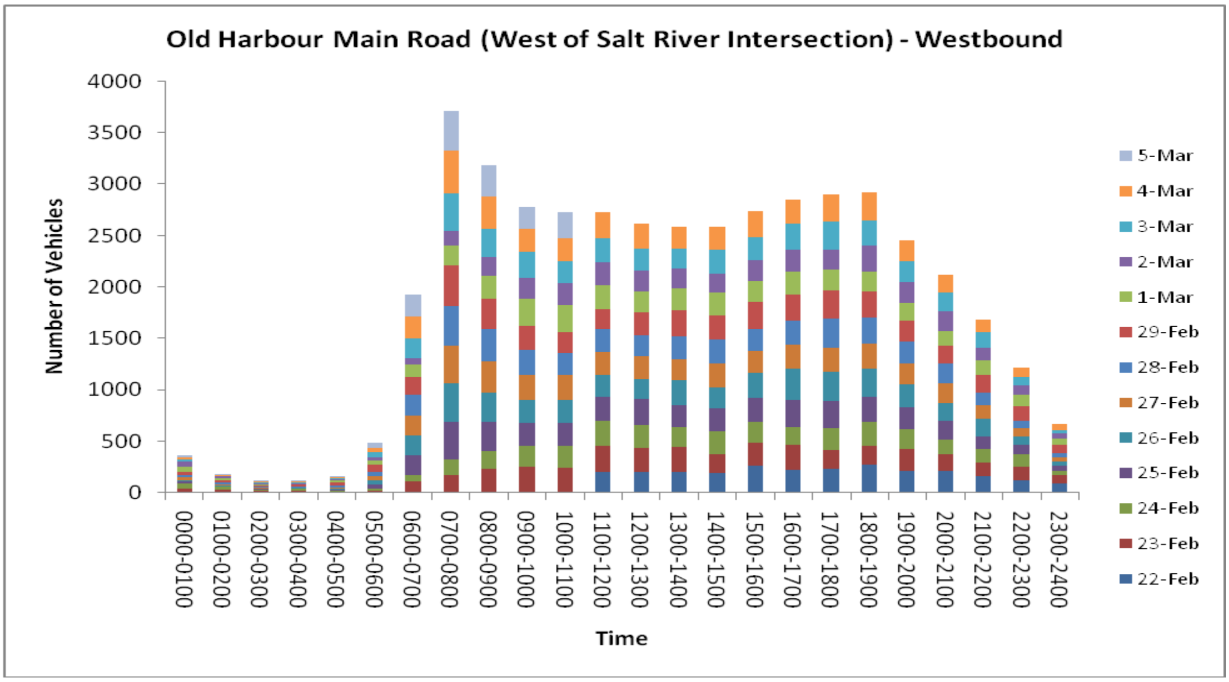


Figure 5-24: Old Harbour Main Road (West of Salt River Intersection) Westbound Profile

Table 5-10: Old Harbour Main Road (West of Salt River Intersection - Westbound) AM/PM Peaks

Hour	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar
0000-0100		45	47	15	17	26	24	24	51	56	21	18	17
0100-0200		31	30	5	4	16	13	20	19	21	13	5	10
0200-0300		20	17	8	1	8	7	6	17	9	9	10	6
0300-0400		20	23	6	6	5	5	12	13	6	6	8	7
0400-0500		15	6	8	15	11	14	33	17	9	9	12	16
0500-0600		18	23	44	32	48	36	69	47	29	50	39	47
0600-0700		112	59	191	195	192	203	172	117	62	195	211	219
0700-0800		173	153	361	376	360	392	390	192	145	367	412	388
0800-0900		231	175	281	282	305	311	297	221	184	273	316	308
0900-1000		258	193	223	228	242	245	229	262	202	256	219	221
1000-1100		240	214	223	227	241	217	199	259	212	213	226	253
1100-1200	206	247	242	233	215	220	224	198	229	227	227	258	
1200-1300	206	228	226	247	197	225	196	229	202	202	213	246	
1300-1400	204	237	198	216	238	208	218	255	211	188	200	212	
1400-1500	192	184	217	225	205	234	234	227	229	178	230	225	
1500-1600	259	227	200	232	243	216	215	258	208	202	224	250	
1600-1700	224	238	175	269	302	226	233	259	217	214	255	230	
1700-1800	231	188	206	262	290	234	278	279	202	191	273	264	
1800-1900	273	181	238	239	271	245	252	260	186	254	249	266	
1900-2000	209	218	195	205	225	207	205	207	171	201	208	202	
2000-2100	208	170	138	182	176	191	189	171	140	200	181	173	
2100-2200	165	127	131	123	171	132	124	174	135	122	155	119	
2200-2300	120	138	121	86	80	83	72	136	118	85	83	98	
2300-2400	96	75	38	51	45	37	45	80	56	52	36	62	

5.3.1.3 Salt River Main Road

Before Hayes intersection

The period for which traffic volume was the highest on the Salt River main road before Hayes intersection most frequently occurred between 8 a.m. – 9 a.m. for both the east and westbound traffic flow during the morning. In the evening, peak periods for eastbound traffic flow tend to occur between 12 p.m. – 2 p.m. and 4 p.m. – 6 p.m. while peak periods for westbound traffic flow were observed between 12 p.m. and 2 p.m. and 4 p.m. – 5 p.m. Although, there are peak periods where traffic volume is highest, the change in traffic volume throughout the each day for which the survey was conducted was not significant throughout the morning period up to 12 a.m. and the evening period up to 9 p.m. This was due to the low total traffic volume which has an average total of 227 vehicles (eastbound) and 246 vehicles (westbound).

Of the total traffic volume recorded, cars accounted for the bulk of the traffic representing more than 70% of the total traffic volume for both the eastbound (73%) and westbound (72%). Trucks represented a more significant percentage of traffic flow on the Salt River main road than on the Old Harbour main road. At least 6% of the total traffic flow is represented by trucks from both the east (6%) and westbound traffic flow (9%). Mini buses and buses accounted for 11.25% and 9.91% eastbound and 8.51% and 11.27% westbound.

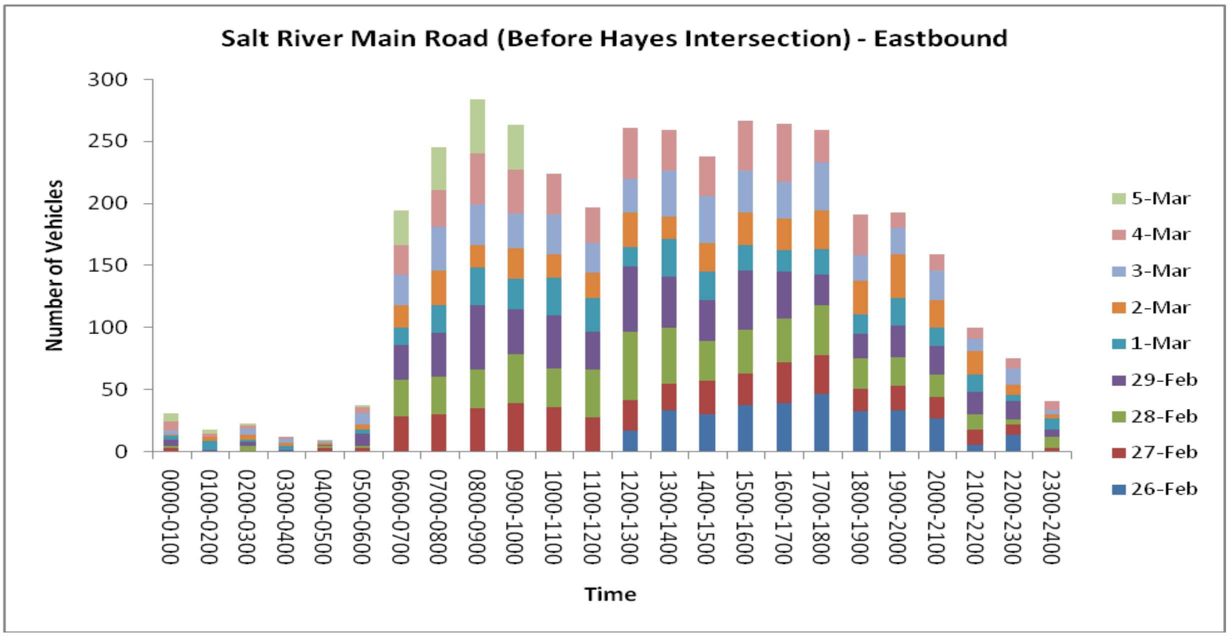


Figure 5-25: Salt River Main road (Before Hayes Intersection) Eastbound Profile

Table 5-11: Salt River Main road (Before Hayes Intersection - Eastbound) AM/PM Peaks

	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar
Hour								
0000-0100		3	2	5	3	1	3	8
0100-0200		0	0	2	7	3	0	3
0200-0300		0	5	3	2	4	5	2
0300-0400		1	0	1	3	2	4	1
0400-0500		3	2	1	0	1	2	0
0500-0600		3	2	10	3	4	9	5
0600-0700		29	29	28	14	18	25	23
0700-0800		30	31	35	22	28	35	30
0800-0900		35	31	52	30	18	33	41
0900-1000		39	40	36	24	25	28	35
1000-1100		36	31	43	30	19	32	33
1100-1200		28	38	31	27	20	24	29
1200-1300	17	25	55	52	16	28	27	41
1300-1400	34	21	45	41	30	18	37	33
1400-1500	30	27	32	33	23	23	38	32
1500-1600	38	25	35	48	20	27	33	40
1600-1700	39	33	35	38	17	26	29	47
1700-1800	47	31	40	25	20	31	39	26
1800-1900	33	18	24	20	16	27	20	33
1900-2000	34	19	23	26	22	35	21	13
2000-2100	27	17	18	23	15	22	24	13
2100-2200	6	12	12	18	14	19	10	9
2200-2300	14	8	4	15	5	8	13	8
2300-2400	1	2	9	6	9	3	4	7

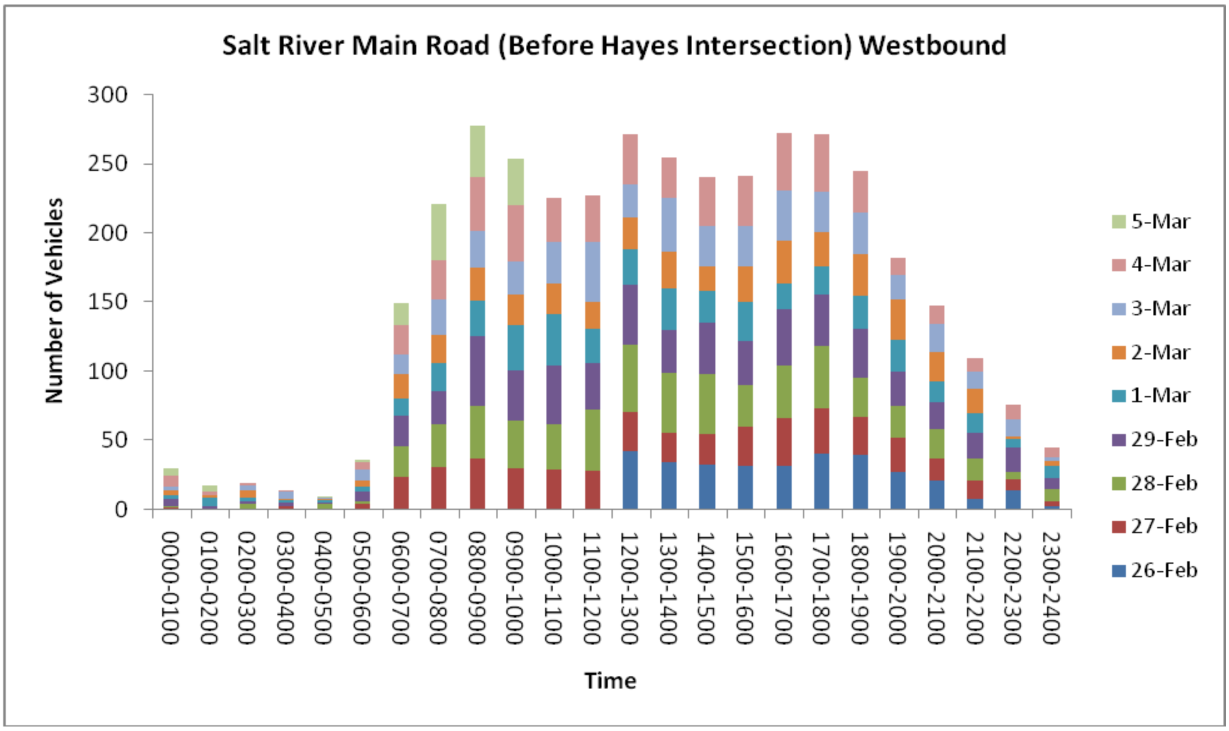


Figure 5-26: Salt River Main road (Before Hayes Intersection - Northbound) AM/PM Peaks

Table 5-12: Salt River Main road (Before Hayes Intersection - Northbound) AM/PM Peaks

Hour	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar
0000-0100		2	1	5	3	3	3	8	5
0100-0200		1	0	2	6	2	0	2	5
0200-0300		0	4	2	3	5	4	1	0
0300-0400		3	0	2	2	1	5	1	0
0400-0500		1	3	1	2	1	1	0	1
0500-0600		4	2	7	4	4	8	5	2
0600-0700		24	22	22	12	18	14	21	16
0700-0800		31	31	24	20	20	26	28	41
0800-0900		37	38	50	26	24	26	39	37
0900-1000		30	34	37	32	22	24	41	33
1000-1100		29	33	42	37	22	30	32	
1100-1200		28	44	34	25	19	43	34	
1200-1300	42	29	48	43	26	23	24	36	
1300-1400	34	22	43	31	30	26	39	29	
1400-1500	33	22	43	37	23	18	29	35	
1500-1600	32	28	30	32	28	26	29	36	
1600-1700	32	34	38	41	18	31	36	42	
1700-1800	41	32	45	37	21	24	29	42	
1800-1900	40	27	28	36	23	30	30	30	
1900-2000	27	25	23	25	23	29	17	13	

Hour	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar
2000-2100	21	16	21	20	15	21	20	13	
2100-2200	8	13	16	19	14	17	13	9	
2200-2300	14	8	5	18	6	2	12	11	
2300-2400	3	3	9	8	9	3	3	7	

North of the coffee factory

The period for which traffic flow was the highest on the Salt River main road north of the factory occurred in the morning between 8 a.m. – 10 a.m. (Northbound) and 7 a.m. – 9 a.m. (southbound). Highest traffic volume in the evening was observed in the period of 12 p.m. – 2 p.m. (southbound) and 2 p.m. – 4 p.m. and 5 p.m. – 7 p.m. on the northbound. It should be noted that change in traffic volume from peak period throughout the day from 6 a.m. up to 9 p.m. was not significant. Therefore, activities from the proposed project during peak period will not have any significant impact on traffic than if activities were done outside of peak traffic flow.

Average total traffic volume was 369 vehicles from the northbound and 203 vehicles from the southbound. The highest percentage of traffic volume was represented by cars which accounted for approximately 77% (north and southbound). Trucks (3.05% north vs. 3.57% south) represented least of the total traffic volume.

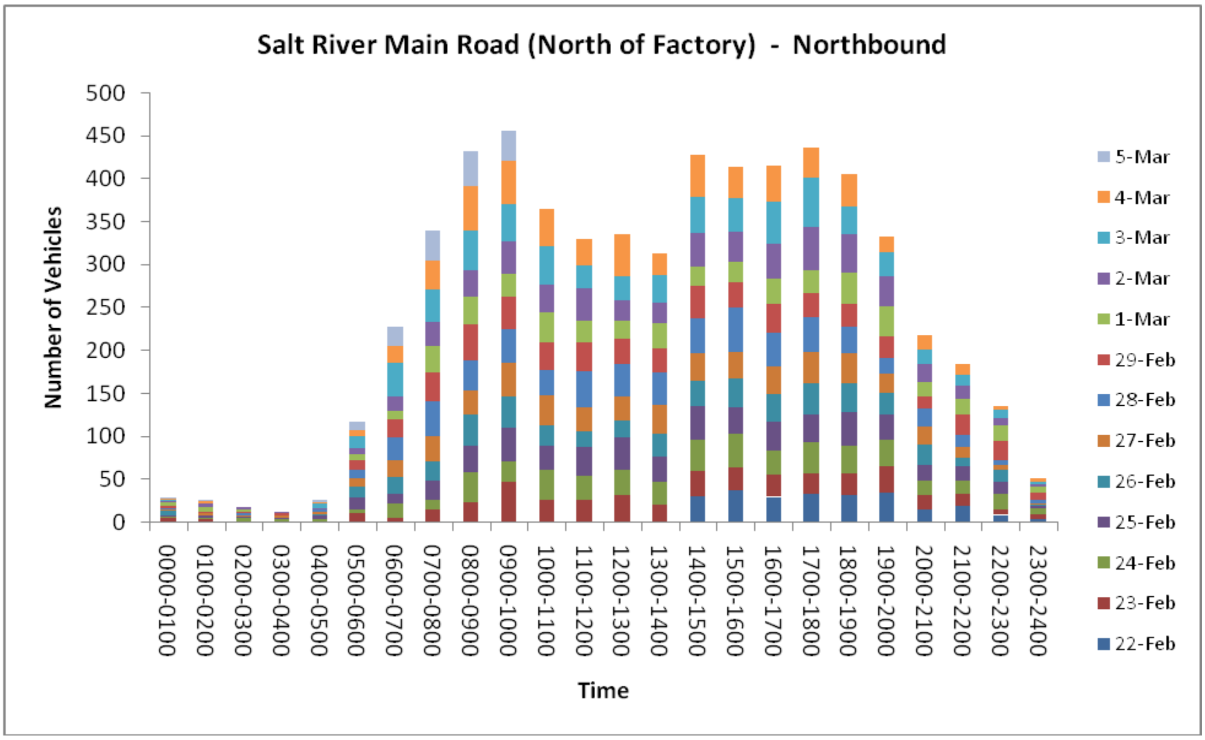


Figure 5-27: Salt River Main Road (North of Factory) Northbound Profile

Table 5-13: Salt River Main Road (North of Factory - Northbound) AM/PM Peaks

Hour	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar
0000-0100		5	2	2	5	1	2	2	5	2	1	1	1
0100-0200		4	1	3	0	3	0	1	6	4	0	3	1
0200-0300		1	5	1	0	1	3	1	4	2	0	0	0
0300-0400		1	3	1	0	4	0	2	0	1	0	0	0
0400-0500		2	2	4	2	2	3	0	0	2	5	2	3
0500-0600		11	5	14	12	9	11	11	7	6	15	7	9
0600-0700		6	17	11	19	20	26	21	10	16	40	19	22
0700-0800		16	10	23	22	30	40	34	31	27	38	33	35
0800-0900		24	34	32	35	29	35	42	31	31	47	51	40
0900-1000		47	24	39	37	39	39	37	27	38	43	50	35
1000-1100		27	34	29	23	35	29	33	34	32	45	44	
1100-1200		26	28	34	18	28	42	33	26	37	27	31	
1200-1300		32	30	37	20	28	37	30	21	23	28	49	
1300-1400		21	27	29	26	34	37	28	30	24	32	25	
1400-1500	31	29	37	39	29	32	40	38	23	39	42	48	
1500-1600	38	26	39	31	34	31	51	29	24	35	39	37	
1600-1700	30	26	28	33	33	32	39	33	30	40	49	42	
1700-1800	33	24	37	31	37	37	40	28	26	51	57	35	
1800-1900	32	25	33	39	33	35	31	26	37	44	33	37	
1900-2000	35	31	31	29	25	22	18	26	35	35	27	18	
2000-2100	15	17	17	18	24	21	20	14	17	21	17	17	
2100-2200	19	15	15	16	10	13	14	24	18	15	13	12	
2200-2300	9	6	19	13	14	6	5	23	18	8	10	4	
2300-2400	4	6	7	2	3	1	3	9	7	3	3	3	

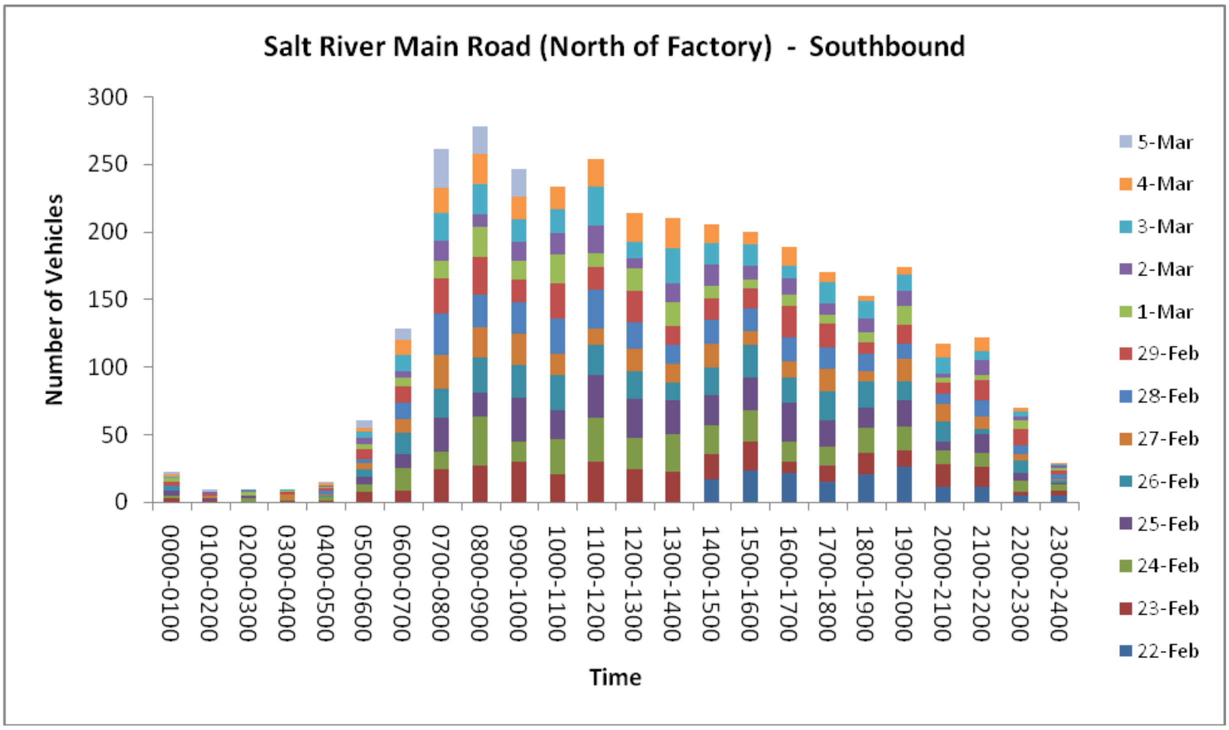


Figure 5-28: Salt River Main Road (North of Factory) Northbound) Profile

Table 5-14: Salt River Main road (North of Factory - Southbound) AM/PM Peaks

Hour	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar
0000-0100		3	2	3	3	0	1	3	3	0	1	1	2
0100-0200		1	0	2	0	2	0	1	0	1	0	0	2
0200-0300		0	3	2	0	0	0	0	2	1	1	0	0
0300-0400		1	1	0	0	4	0	1	1	0	1	0	0
0400-0500		1	3	0	1	1	2	2	1	1	0	2	1
0500-0600		7	6	6	5	5	3	7	4	4	5	3	5
0600-0700		8	17	10	16	10	12	12	7	5	12	11	8
0700-0800		24	13	25	22	25	30	26	13	15	21	18	29
0800-0900		27	36	18	26	22	24	28	22	10	22	22	21
0900-1000		30	15	32	24	23	24	16	14	14	17	17	20
1000-1100		20	26	22	26	16	26	26	21	16	17	17	
1100-1200		30	32	32	22	12	29	17	10	20	29	21	
1200-1300		24	23	29	21	16	20	23	17	7	12	22	
1300-1400		22	28	25	13	14	14	14	18	14	26	22	
1400-1500	17	18	22	22	20	18	18	15	10	16	15	14	
1500-1600	23	22	23	24	24	10	17	15	6	11	15	10	
1600-1700	21	9	15	28	19	12	18	23	8	12	10	14	
1700-1800	15	12	14	19	22	16	16	18	6	9	16	7	
1800-1900	20	16	19	15	19	8	13	8	7	11	13	3	
1900-2000	26	12	18	19	14	17	11	14	14	11	12	6	
2000-2100	11	17	10	7	14	13	8	8	4	3	12	10	
2100-2200	11	15	10	14	4	9	12	15	4	11	6	11	
2200-2300	5	2	9	5	10	4	7	12	6	3	4	3	
2300-2400	5	3	5	1	2	1	3	3	2	2	1	1	

South of the coffee factory

The period for which traffic flow was the highest on the Salt River main road north of the factory occurred in the morning between 8 a.m. – 10 a.m. (Northbound) and 7 a.m. – 9 a.m. (southbound). Highest traffic volume in the evening was observed in the period of 12 p.m. – 2 p.m. (southbound) and 2 p.m. – 4 p.m. and 5 p.m. – 7 p.m. on the northbound. Peak hours of traffic volume will not be emphatic in the operation of the proposed project as traffic volume throughout the day was relatively comparable to traffic volume observed during peak hours.

Average total traffic volume was 369 vehicles from the northbound and 203 vehicles from the southbound. The highest percentage of traffic volume was represented by cars which accounted for approximately 77% (north and southbound). Trucks (3.05% north vs. 3.57% south) represented least of the total traffic volume.

The proposed project, in general, should not impact significantly on traffic flow on the Salt River main road as the total existing traffic volume is relatively low. As such, the Salt River main road could serve very useful in maximizing transportation and haulage of materials to and from the project site.

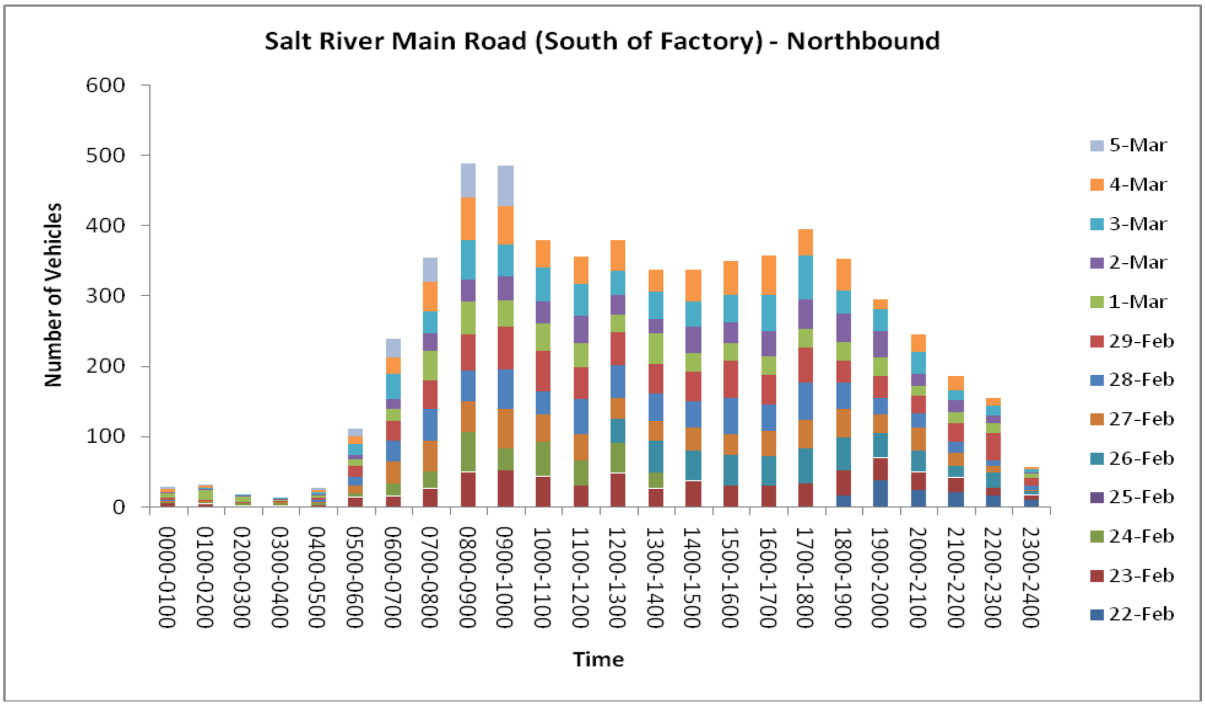


Figure 5-29: Salt River Main Road (South of Factory) Northbound Profile

Table 5-15: Salt River Main Road (South of Factory - Northbound) AM/PM Peaks

Hour	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar
0000-0100		5	2			1	2	3	6	2	0	4	3
0100-0200		4	2			2	0	2	13	3	1	2	2
0200-0300		1	3			0	2	1	8	1	1	0	0
0300-0400		1	3			3	0	1	2	1	1	0	0
0400-0500		2	2			3	3	3	2	2	4	2	3
0500-0600		14	5			10	13	16	9	6	16	10	11
0600-0700		15	18			31	30	28	16	14	36	24	26
0700-0800		26	24			44	45	40	43	24	32	41	35
0800-0900		50	56			44	43	51	47	32	56	60	49
0900-1000		52	30			56	57	60	38	35	44	55	57
1000-1100		43	49			39	32	58	39	32	48	38	
1100-1200		30	35			38	49	46	34	39	46	38	
1200-1300		48	42		34	31	46	47	25	28	34	44	
1300-1400		26	22		46	27	40	42	43	21	39	30	
1400-1500		37			43	32	38	42	26	37	37	44	
1500-1600		30			43	30	51	53	25	30	38	49	
1600-1700		30			41	37	37	42	27	35	52	56	
1700-1800		33			50	40	53	50	26	42	63	37	
1800-1900	16	36			46	40	38	31	27	40	33	45	
1900-2000	38	32			34	27	24	30	27	37	31	15	
2000-2100	25	25			29	33	20	25	15	17	31	25	
2100-2200	22	20			16	18	16	27	15	17	14	21	
2200-2300	16	11			22	9	8	39	14	10	15	10	
2300-2400	10	7			5	2	5	12	5	3	4	3	

Table 5-16: Salt River Main road (South of Factory - Southbound) AM/PM Peaks

Hour	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar
0000-0100		0	2	3	5	0	1	3	6	1	1	1	2
0100-0200		0	0	5	0	1	0	1	9	2	0	2	2
0200-0300		1	4	1	0	0	0	1	7	2	1	0	0
0300-0400		0	2	1	0	2	0	1	2	1	2	0	0
0400-0500		0	3	0	2	2	3	2	3	1	1	0	2
0500-0600		1	7	6	8	6	6	10	7	4	9	6	4
0600-0700		2	21	12	21	17	20	21	17	17	23	17	17
0700-0800		13	19	32	28	40	39	32	22	17	25	32	31
0800-0900		17	49	31	41	32	35	43	27	21	40	35	25
0900-1000		30	25	41	26	31	30	41	23	26	26	37	29
1000-1100		37	26	24	42	36	28	41	31	30	28	22	
1100-1200		24	37	35	26	22	30	34	15	30	34	24	
1200-1300		39	29	26	35	33	30	38	17	16	27	33	
1300-1400	24	24	40	32	21	29	27	29	32	28	38	25	
1400-1500	22	30	24	30	27	26	26	36	22	29	21	31	
1500-1600	12	28	35	27	31	20	35	31	21	22	29	27	
1600-1700	15	18	22	40	32	34	25	36	12	29	31	30	
1700-1800	11	18	29	39	39	27	36	34	14	14	35	20	
1800-1900	10	24	26	32	31	17	25	28	27	20	24	23	
1900-2000	5	19	23	20	21	21	16	17	18	15	20	11	
2000-2100	4	16	14	12	22	18	14	12	9	13	25	15	
2100-2200	2	18	13	22	9	13	15	20	11	11	9	13	
2200-2300	1	5	11	9	16	6	6	19	13	5	14	6	
2300-2400	1	3	8	1	3	2	3	10	4	2	3	3	

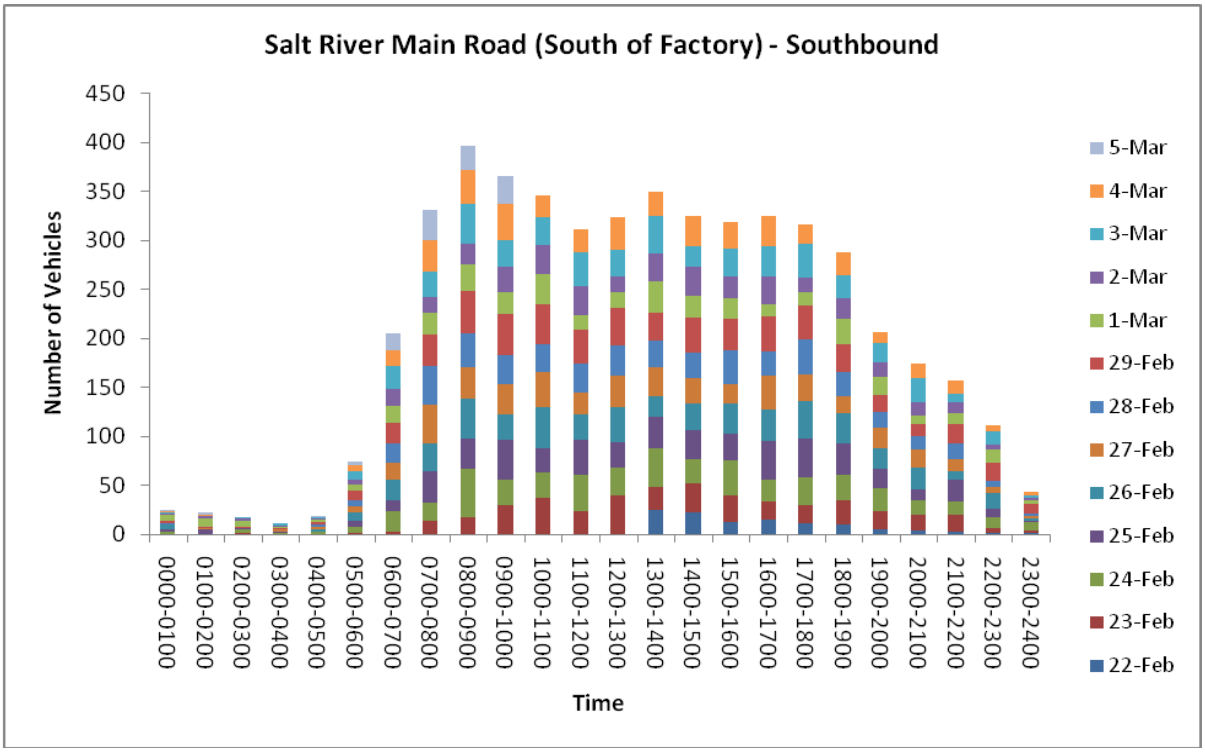


Figure 5-30: Salt River Main Road (South of Factory) - Southbound Profile

5.3.1.4 Old Harbour By-Pass – Bushy Park

Traffic volume was most frequently the highest at 8 a.m. – 9 a.m. in the morning and 6 p.m. – 7 p.m. in the evening. Traffic flow comparable to traffic volume during peak hours was also observed throughout the morning period (from 7 a.m.) leading up to the evening period (up to 8 p.m.) weekdays.

5.3.1.5 Sandy Bay – between Toll Road and May Pen

Peak traffic volume was observed between 8 a.m. – 9 a.m. in the morning and 6 p.m. – 7 p.m. in the evening. However, traffic volume throughout the day (between 8 a.m. – 8 p.m.) did not fluctuate significantly and was comparable to traffic volume observed during peak hours.

5.3.2 *Seismic Activity & Earthquakes*

Figure 5-31 and **Figure 5-32** show regional and local epicentres for earthquakes over the period 1998-2001. Local earthquake activity for the study area during this time was low. However, large earthquakes can seriously affect an area even though the epicentres are at a distance.

An investigation of the historical records carried out for an earlier EIA for the JAMALCO Hayes plant and RDAs (Conrad Douglas and Assoc. Ltd) of seismic activity in this area has shown that the adverse effects of earthquakes have been experienced there:

"The well-documented 1692 Port Royal earthquake had disastrous effects in the Lower Vere Plains, with modified Mercalli intensities of MM(X) being experienced in Alley and Salt River, both of which lie at about a 10 km radius from the study area.

The following quote from a newspaper clipping written by the local Rector illustrates: "all brick and stone building were thrown down and water spewed out of the chasms opened in the ground by the earthquake so that even dry gullies ran water". The St. Peter's Anglican Church in Alley built in 1671 was destroyed beyond repair. However, the Halse Hall Great House, where alluvial thicknesses are comparatively low, survived the 1692 earthquake, as well as subsequent ones."

For these reasons the risk from earthquakes needs to be derived from activity over the region, rather than locally. **Figure 5-33** to **Figure 5-34** indicates the likely maximum effects of an earthquake (horizontal accelerations and ground motion) with a 10% probability of exceedance in any one 50-year period.

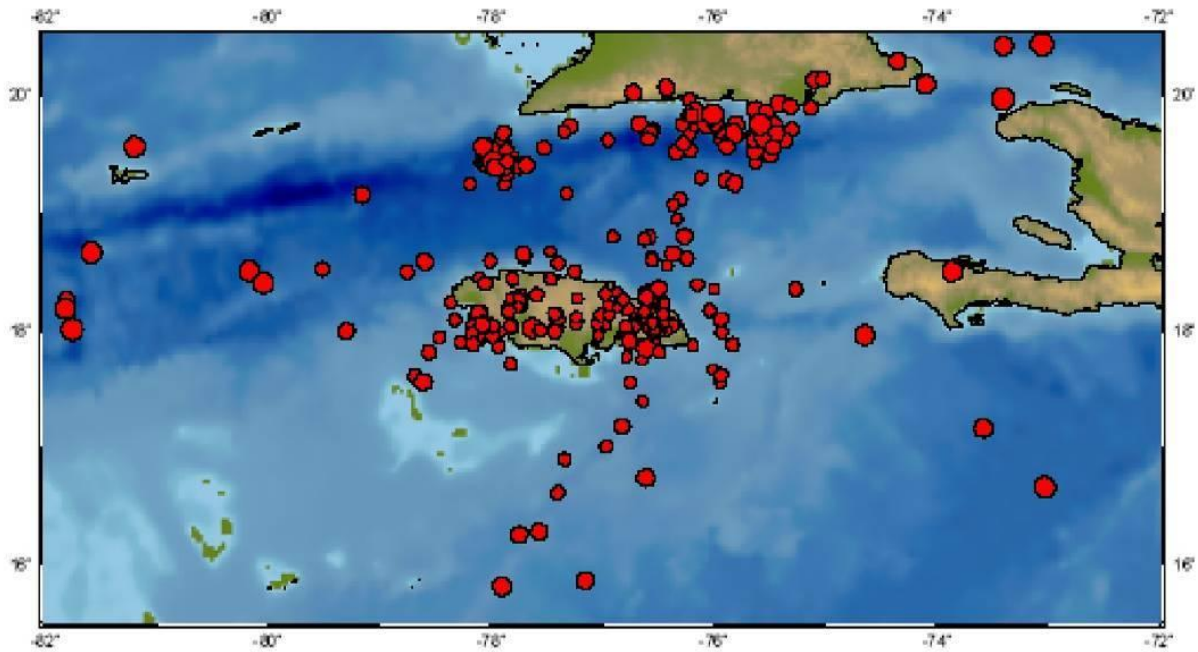


Figure 5-31: Epicentres of earthquakes occurring between 1998 and 2001 in the vicinity of Jamaica (Source: The Earthquake Unit, UWI*)*.

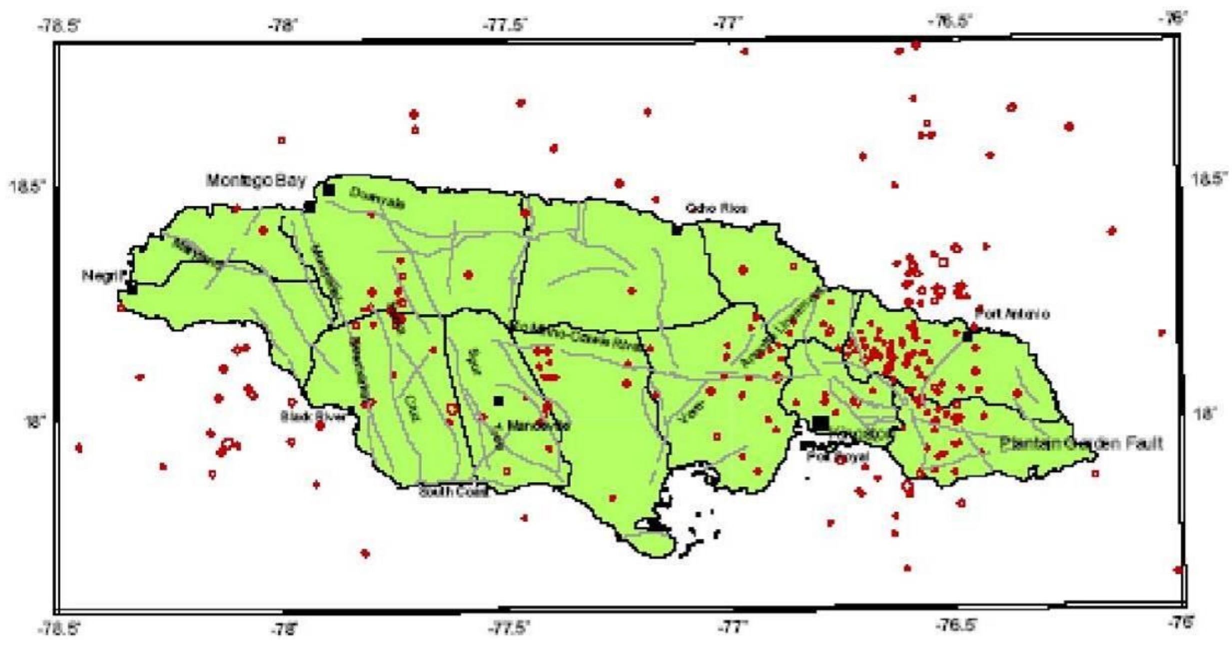


Figure 5-32: Epicentres of earthquakes occurring between 1998 and 2001 located in and around Jamaica. *(Source: The Earthquake Unit, UWI)*.

Table 5-17: Earthquakes known to have occurred in the parish of Clarendon between 2003 and 2007

Year	Month	Day	Time (EST.)	Mag., Mt	degrees N	degrees W	depth, km	Sub-area	Sub-area name	Epicentre location	Intensity, EMS
2005	January	11	5:27a.m.	3.2	17.89	-76.88	10	21	Kingston Offshore	Offshore Hellshire Hills, St. Catherine	Reports from St. Andrew (Red Hills III) and St. Catherine (Cumberland II, Greater Portmore)
2005	March	18	2:06a.m.	3.6	17.82	-77.29	10	25	South Coast fault Zone	South-Central Clarendon	Reportedly felt in May Pen III, Clarendon
2005	June	13	10:58p.m.	5.1	18.22	-77.42	5	9	Dry Harbour Mountains	Near Aenon Town, Clarendon	Reportedly felt in Clarendon (Aenon Town VII, Top Alston VII), Manchester (Silent Hill VII), Trelawny (Wait-a-bit VII, Lemon Walk VII)
2005	June	13	6:21a.m.	3.3	18.25	-77.43	10	9	Dry Harbour Mountains	Near Aenon Town, Clarendon	Reportedly felt by two individuals in Aenon Town III, Clarendon
2004	May	2	4:55a.m.	3	18.03	76.95	10	15	Rio Minho-Crawle River Fault zone	Approx. 5km north of Spanish Town, St. Catherine	Few residents of Havendale III, Meadowbrook III and Forest Hills III, Bull Bay III, St. Andrew
2004	August	10	12:19p.m.	4	18.17	77.22	10	15	Rio Minho-Crawle River Fault zone	Near Kellits, Clarendon	Reports from central and eastern parishes

Source: Earthquake Unit – UWI Mona www.mona.uwi.edu/earthquake/

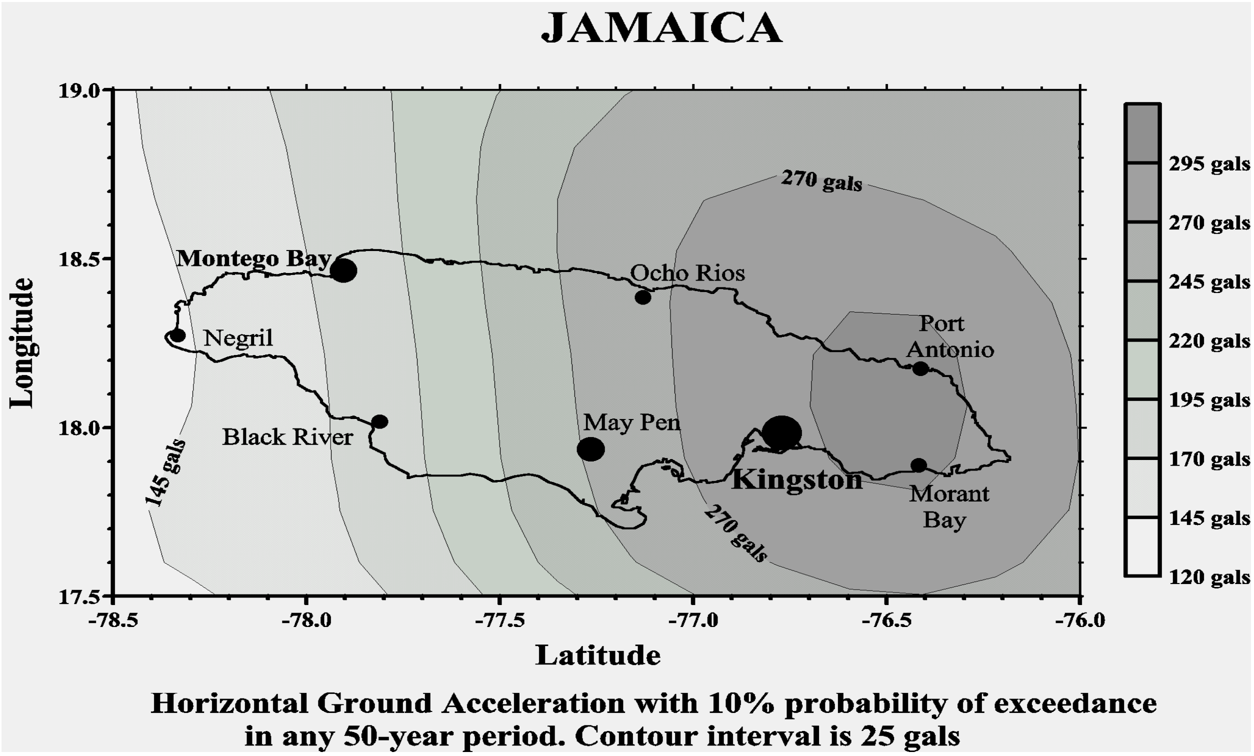


Figure 5-33: Horizontal ground acceleration with 10% probability of exceedance in any 50-year period. Contour interval is 25 gals.

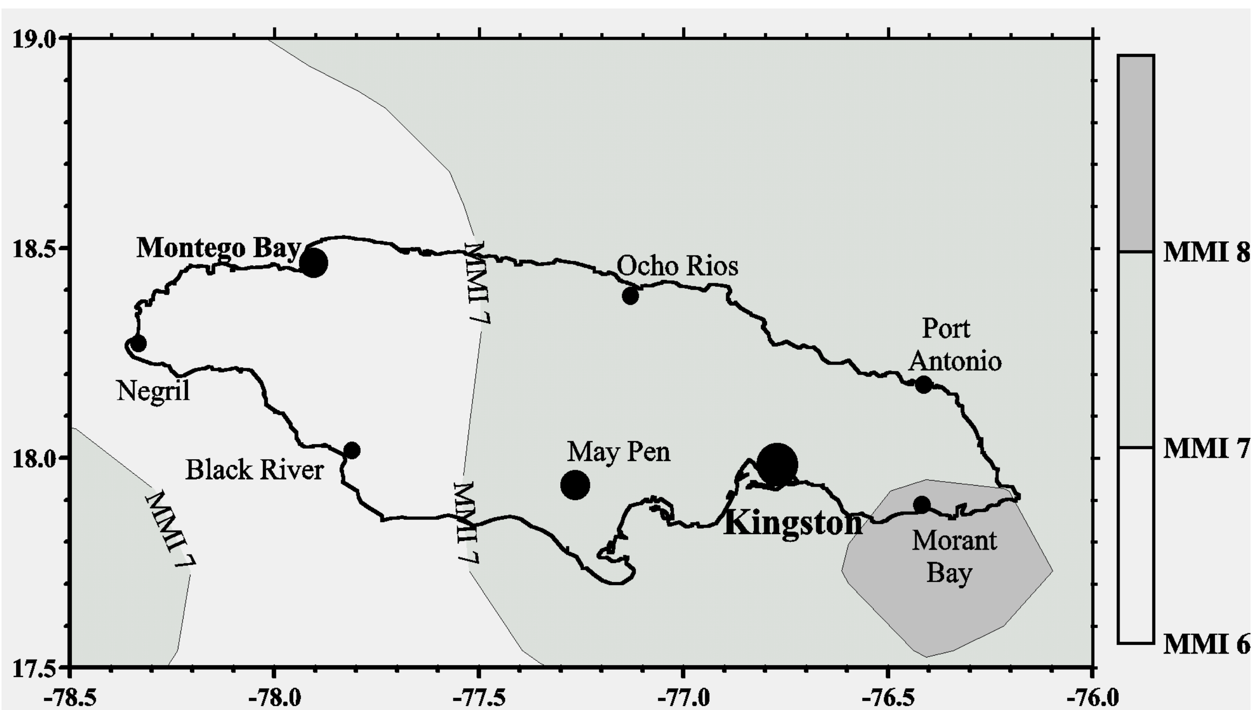


Figure 5-34 Expected maximum Mercalli Intensity with 10% probability of exceedance in any 50-year period.

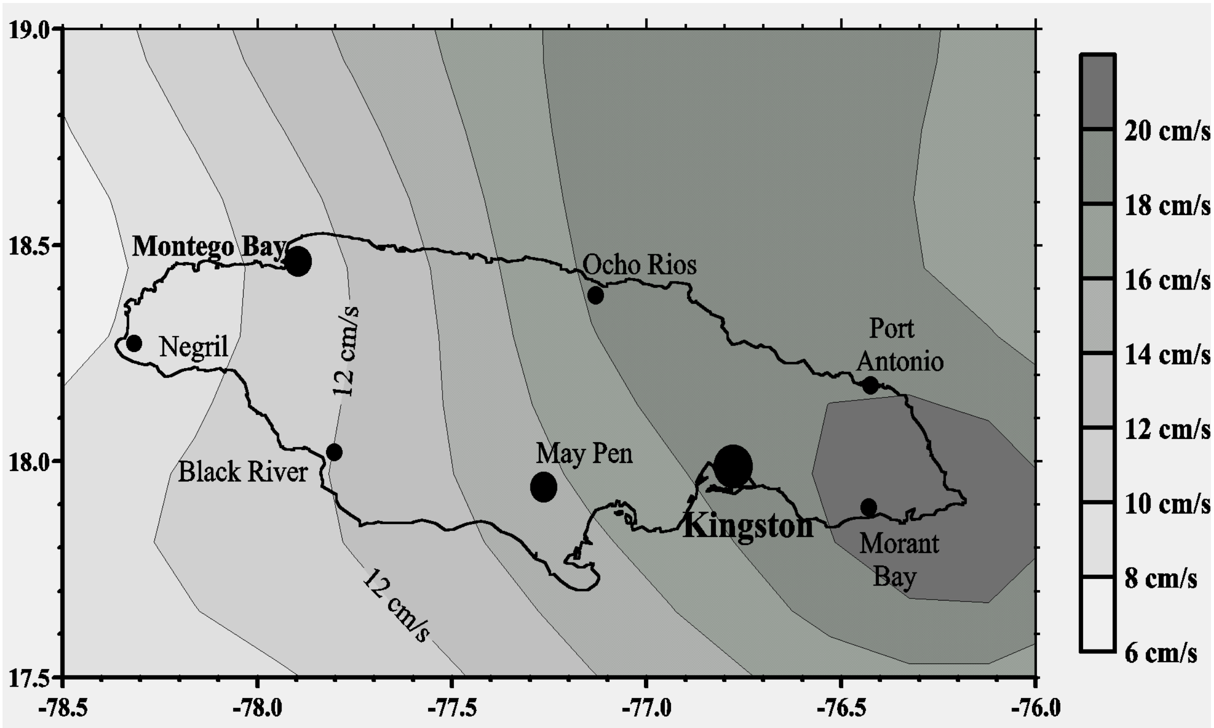


Figure 5-35: Horizontal ground velocity with 10% probability of exceedance in any 50-year period. Contour interval is 2 cm/sec.

In the vicinity of the conveyor corridor this indicates horizontal ground accelerations of between 245 and 270 gals, and velocities of between 14 and 16 m/s occurring with a 10% probability of exceedance in any 50-year period. These motions would probably be associated with an earthquake of Mercalli Intensity between 7 and 8.

5.3.2.1 Landslides

While no detailed assessment of the landslide susceptibility has been carried out in the southern Brazilletto Mountain, the preliminary landslide susceptibility map of southern Clarendon (**Figure 5-36**) indicates low to moderate susceptibility in the vicinity of the transportation corridor. The relatively gentle slopes of well lithified limestone would also indicate rather low susceptibility to landslipping, perhaps with higher local susceptibility in the vicinity of fracture zones. No landslides would be expected on the level land extending from the foot of the Brazilletto Mountain to the proposed port installation, although subsidence through liquefaction accompanying an earthquake might occur. Providing the marine excavations for the port and turning basin are properly graded there should be little chance of slope failure there.

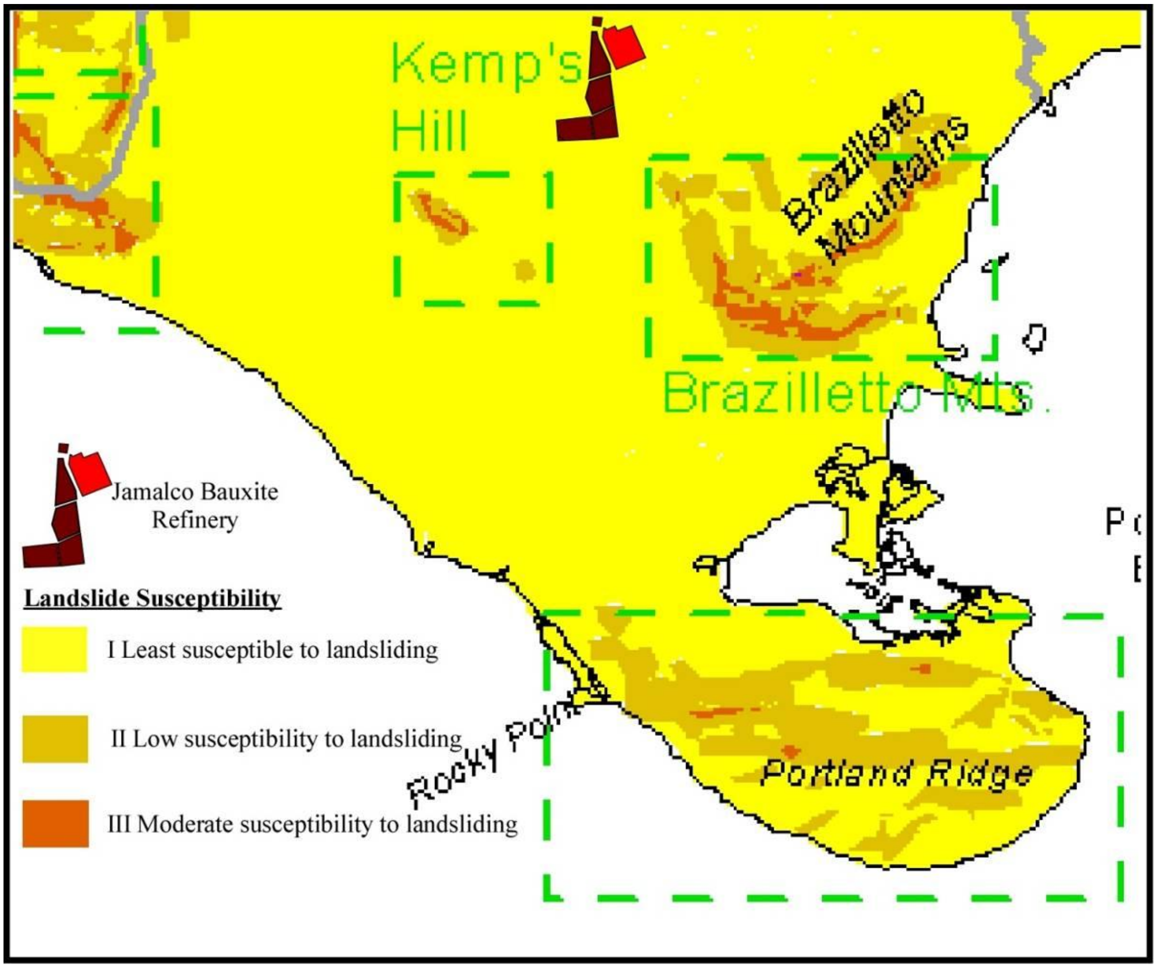


Figure 5-36: Landslide susceptibility map of Southern Clarendon (Source: South Coast Development Project.)

5.3.3 *Hurricanes, Storm Surge & Tsunami*

5.3.3.1 Hurricanes

Hurricanes are a serious seasonal threat from June to November; since 1886, 21 hurricanes have made landfall in Jamaica, while over 100 have passed within 240 km (150 miles) of the island. Tsunamis are also a major risk.

Considerations have been given to issues related to storm water and potential for erosion during the construction and operational phases of the development. As such, a storm water management system, involving the use of drains and absorption pits (French drains), where possible, has been recommended.

Using Norman Manley International Airport in Kingston as a reference point location: 17.93N, 76.78W, all recorded tropical storm and hurricane activity over a period of 100 years are considered to estimate any trends related to the hurricane activity and the return period of such activities to the island[13]. This can be done confidently as Jamaica is a small island and is likely to be affected wholly regardless of the point of approach of a tropical depression or storm system.

So far this year, no hurricanes have affected the island. The island was last affected by major hurricanes (Category 3 and above) passing on either side of the island during the 2004, 2005 and 2007 cycles. The last being hurricane Dean a category 4; though it has been speculated that the island would have experienced a category 2-3 condition due to the offshore route. Prior to this, the last major hurricane to have made landfall was hurricane Gilbert (1988), a category 3.

Figure 5-37 highlights the storm activity per 5 year period in the last 60+ years. Analyses of tropical systems passing within 60nm (= 60mi.) of the island is shown below. **Figure 5-38** below shows the storm tracks for tropical systems to have affected the island during the period 2000-2007. **Figure 5-39** highlights the intensity of storm activity within 100 miles of Jamaica for the period 2000-2007.

Based on the design specifications, the Proposed Port and Conveyor Corridor will be able to withstand winds up to 60 m/s which equates to a category 4 wind gust.

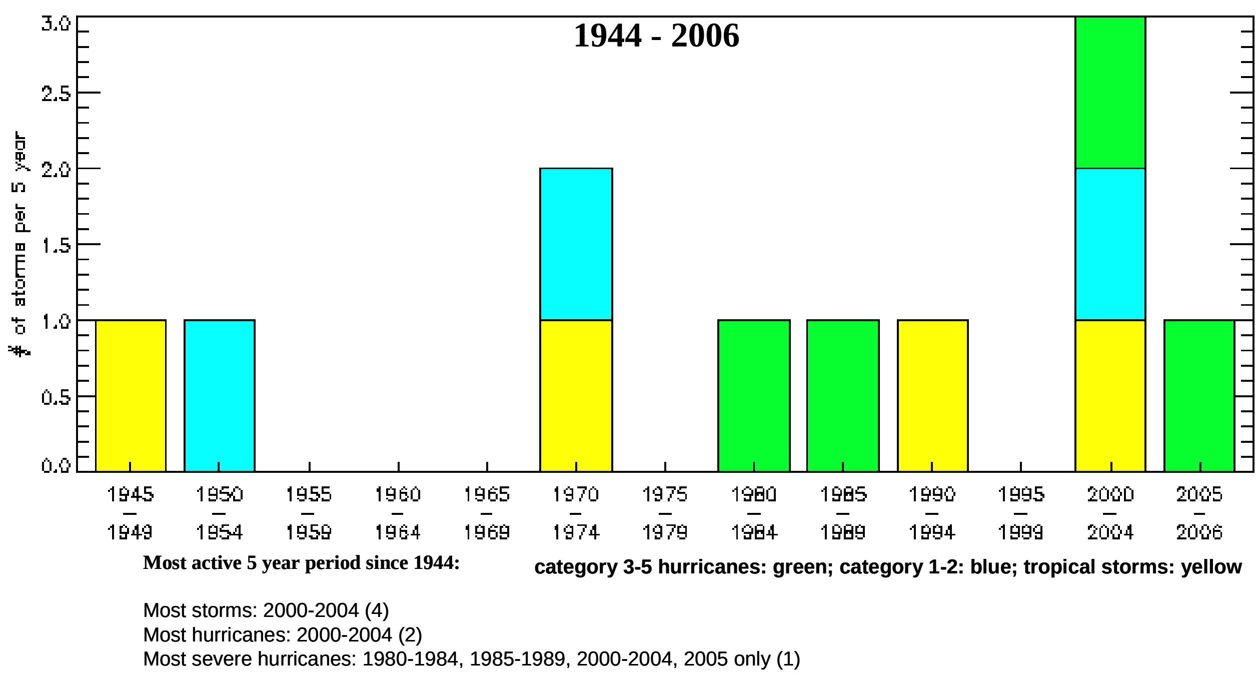
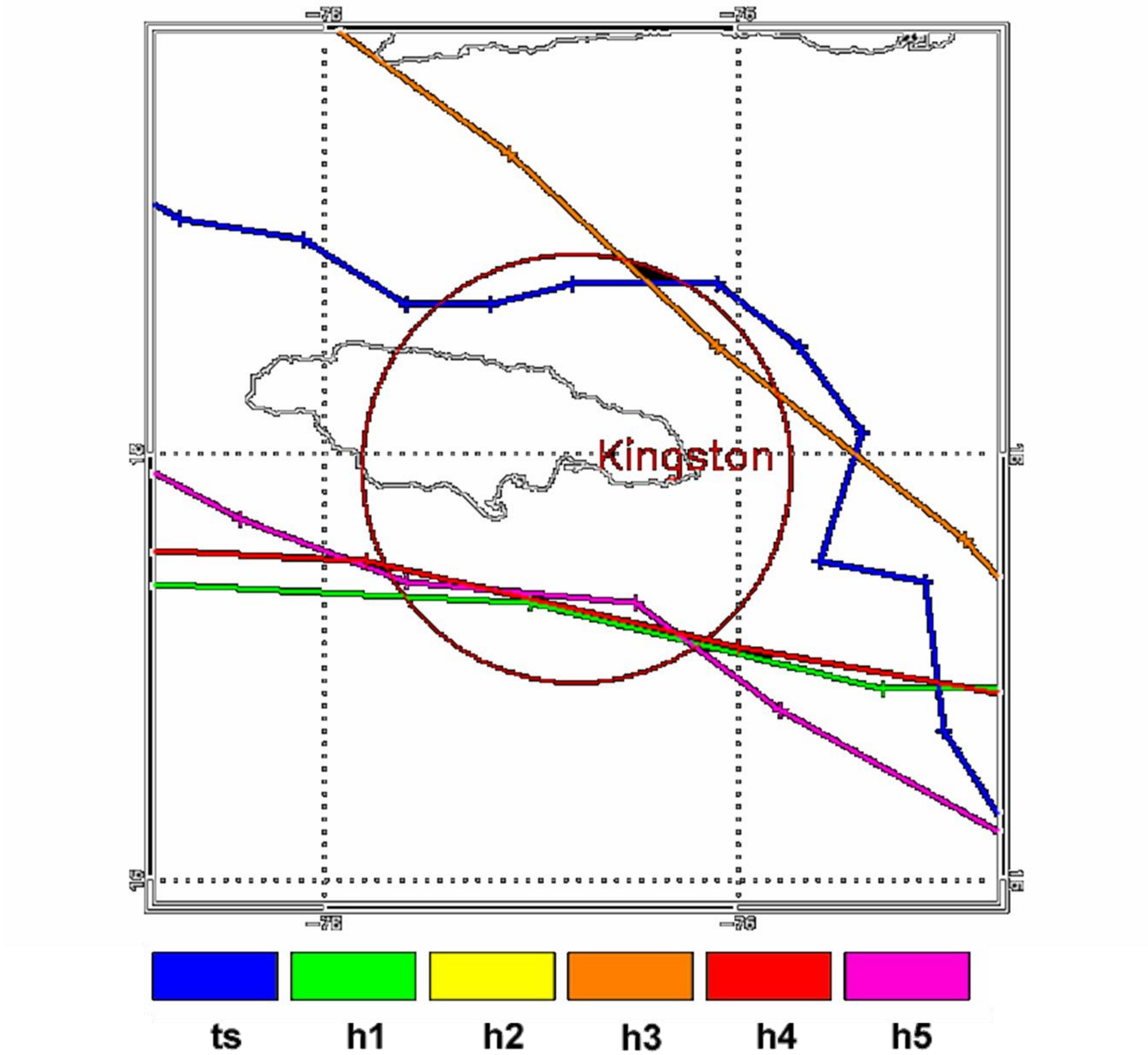


Figure 5-37: Hurricane Activity for the Period 1944 – 2006[14]

[13] StormCarib – Caribbean Hurricane Network http://stormcarib.com/climatology/
[14] StormCarib – Caribbean Hurricane Network http://stormcarib.com/climatology/MKJP_dec_isl.htm



date	wind	cat	cpoa	name
07 Oct 2001	86	h1	46	Iris
29 Sept 2002	58	ts	58	Lili
11 Sept 2004	155	h5	41	Ivan
07 Jul 2005	115	h3	59	Dennis
19 Aug 2007	144	h4	44	Dean

Figure 5-38: Hurricane Storm tracks within 60 miles of Jamaica for the Period 2001-2007[15]

[15] StormCarib – Caribbean Hurricane Network http://stormcarib.com/climatology/MKJP_dec_isl.htm

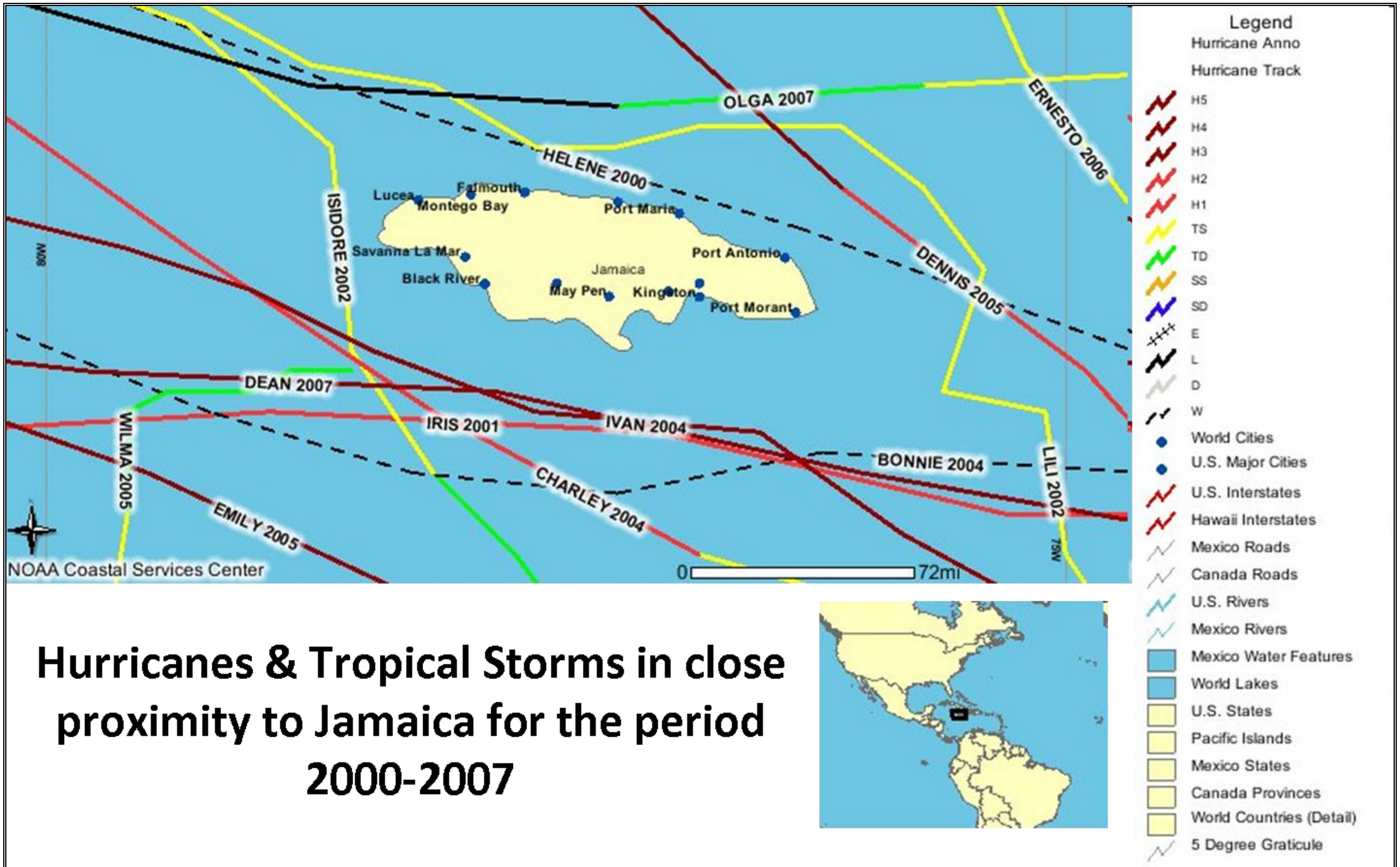
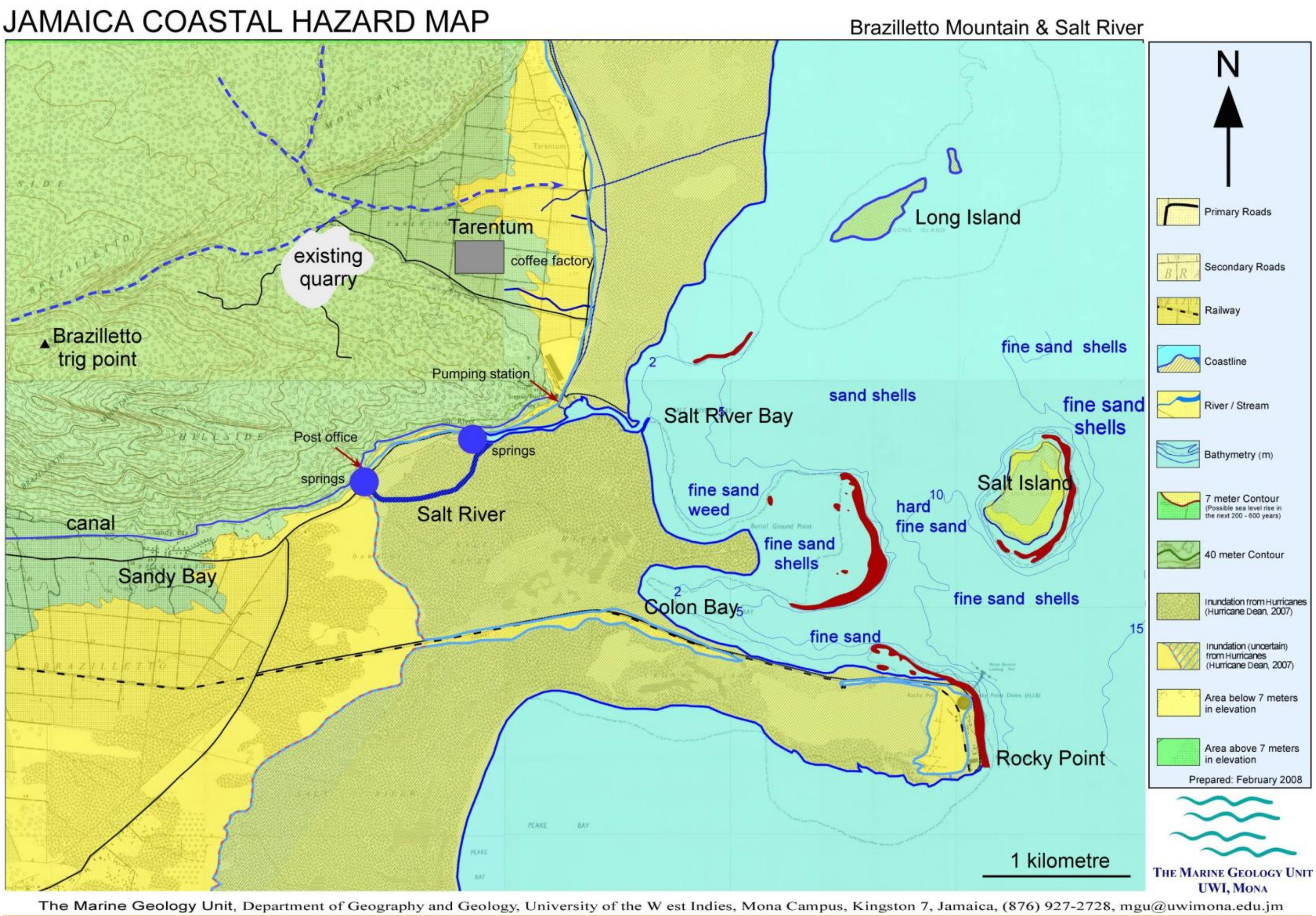


Figure 5-39: Hurricane & Tropical Storm Activity around Jamaica for the period 2000-2007[16]

[16] http://maps.csc.noaa.gov/servlet/com.esri.esrimap.Esrimap?ServiceName=hurricanes_ov&ClientVersion=4.0&Form=True&Encode=False

5.3.3.2 Storm Surge

Storm surges from hurricanes Ivan (September 2004) and Dean (August 2007) were recorded along most of the edge of Portland Bight, including the stretch of coast from Port Esquivel to Rock Point port and Portland Cottage (**Figure 5-40**). Sites visited by us are described in turn.



Burgundy-coloured marine features are reefs; Blue dots are the Salt River springs; Dashed blue lines north of the quarry are routes of storm gullies

Figure 5-40: Hazard map of the area (sheet 77D & 87C, 1:12500topographic map series). (Modified from the Marine Geology Unit coastal hazard map series).

Salt River

Anecdotal reports at the dock by the West Indies Sugar Company (WISCO) warehouse and pump station indicated a surge height of about 2.5 m and the inundation reached the bridge connecting the docks to the main road. It was generally felt that the Dean event was worse than Ivan.

At the Gun Club dock the surge height for Dean was measured at 2.2 m above current water level (11am on February 8) (**Plate 5-6**). The surge from Ivan was approximately 10 cm lower than that from Dean, as measured on the electrical switch box. The Dean surge inundated the road and reached houses on the mountain side of the road. It also moved a container several metres from its original position. It was reported that the high surge came in relatively slowly and did not last very long.

Plate 5-6: Surge height of 2.2 m above current water level at the Monymusk Salt River Gun Club (palms of hands). Photo taken 8/2/08

At the main Salt River spring, the surge was reported to have reached the level of the road (2+ metres above the level of the pool) (**Plate 5-7**).

Plate 5-7: The main Salt Spring, where the surge came over the road. (Photo taken 8/2/08 GPS Location N 17.83157° W77.17999°)

It can be concluded that Dean's storm surge flooded the entire area of wetland along this stretch of the coast.

Rocky Point port

A profile was surveyed from the sea across the road and railway to the swamp to the south at a point about a kilometre from the entrance to the port, where the railway had been washed out by hurricane Dean (**Plate 5-8**). The railway bed was 2.05 m ASL (at 9.45 am). The surge had torn a section of the rails and sleepers from the rail bed and moved it bodily 3 to 6 metres away (south) from the rail bed. A surge and wave height of at least 2.5 m was estimated. The power lines along the approach road to the port were also destroyed by Dean.

Plate 5-8: The railway approach to Rocky Point. Dean tore the lines from the track and deposited them in the area to the right where the hummocky Staghorn coral debris is located. (Photo taken: 12/02/08 GPS Location N 17.82036° W077.15578°)

At the time of this assessment strong winds were causing rough wave conditions, preventing an ore carrier from entering the JAMALCO port. Based on information supplied, the passage of hurricane Dean had not caused any changes in the depths of the shipping channel and turning basin, unlike the situation at Port Esquivel where some depths in the ship channel and turning basin had changed following the hurricane. The inundation distance near the administrative building was about 70 metres over the surface of the road and parking area, which stands approximately 2.5 to 3 metres above sea-level. A surge and breaking wave run-up height of up to 4 metres was estimated.

Plate 5-9: MGU personnel measuring inundation distances. The riprap on the right is of new, larger boulders replacing material that was moved across the parking area by hurricane Dean. (Photo taken 12/02/08)

Plate 5-10: The approach road to the dock partly destroyed (middle distance). The seawall on the left was damaged by hurricane Ivan. (Photo taken 12/02/08)

5.3.3.2.1 Comparison with TAOS predictions for Rocky Point and Port Esquivel

Our storm surge determinations for Hurricane Dean at Salt River and Rocky Point (of 2.2 and at least 2.5 to over 3 m respectively may be compared with the TAOS predictions for storm surge for the "50-year return storm" (**Figure 5-41**) generated by the Caribbean Disaster Management Programme project. Allowing for the fact that breaking wave run-up should probably be included in our estimates for Rocky Point, the correlation of surge height is close, as it is also for our estimate for Port Esquivel (Marine Geology Unit, 2008) However, the TAOS-predicted surge heights correspond with a high category 2 storm. Dean was a category 4 to 5 hurricane as it passed south of these localities, but with the storm centre at least 60 km offshore, the local effects would indeed be nearer that of a category 2 to 3 storm.

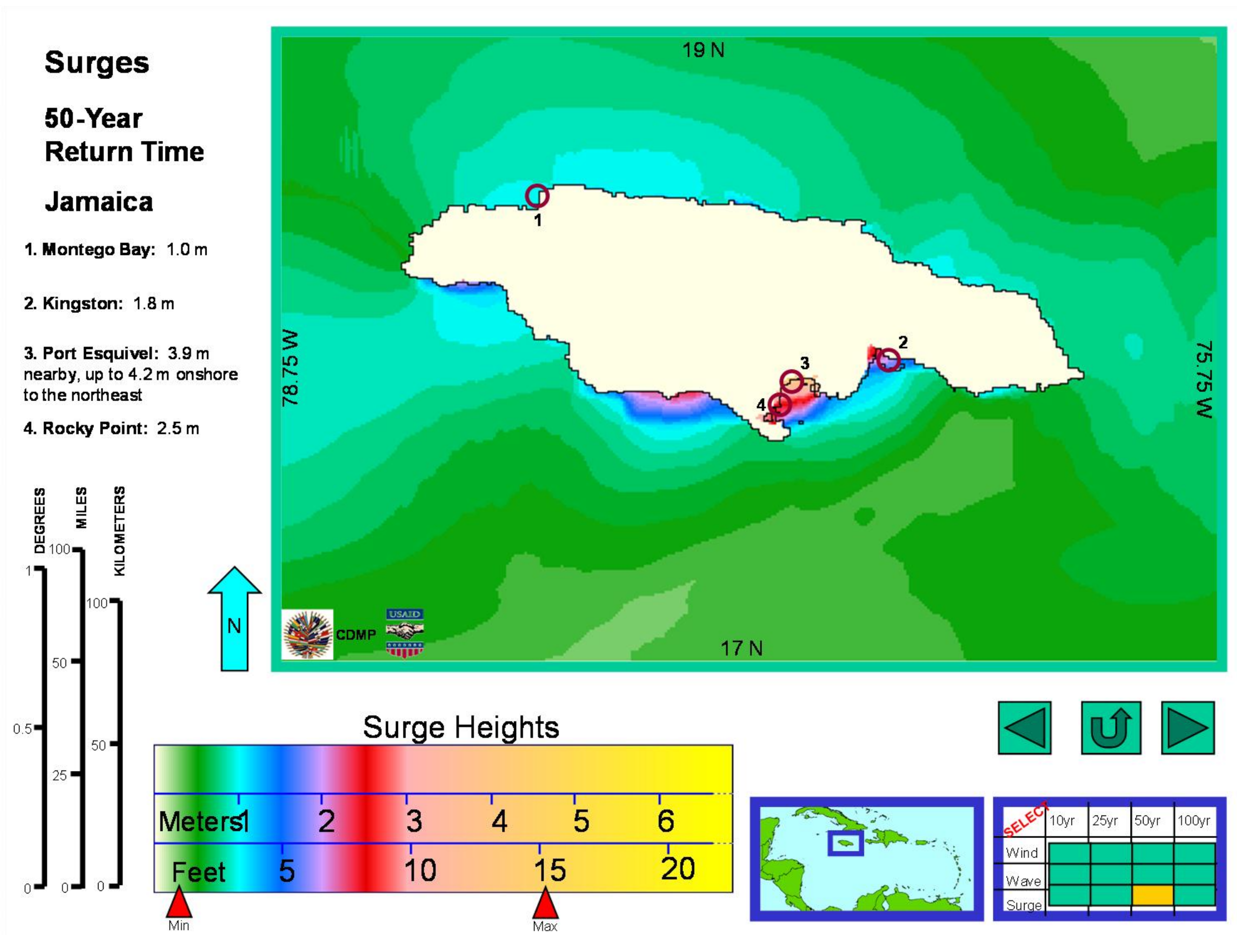


Figure 5-41: 50-Year return period for hurricane surge for Jamaica (Source: CDMP Atlas)

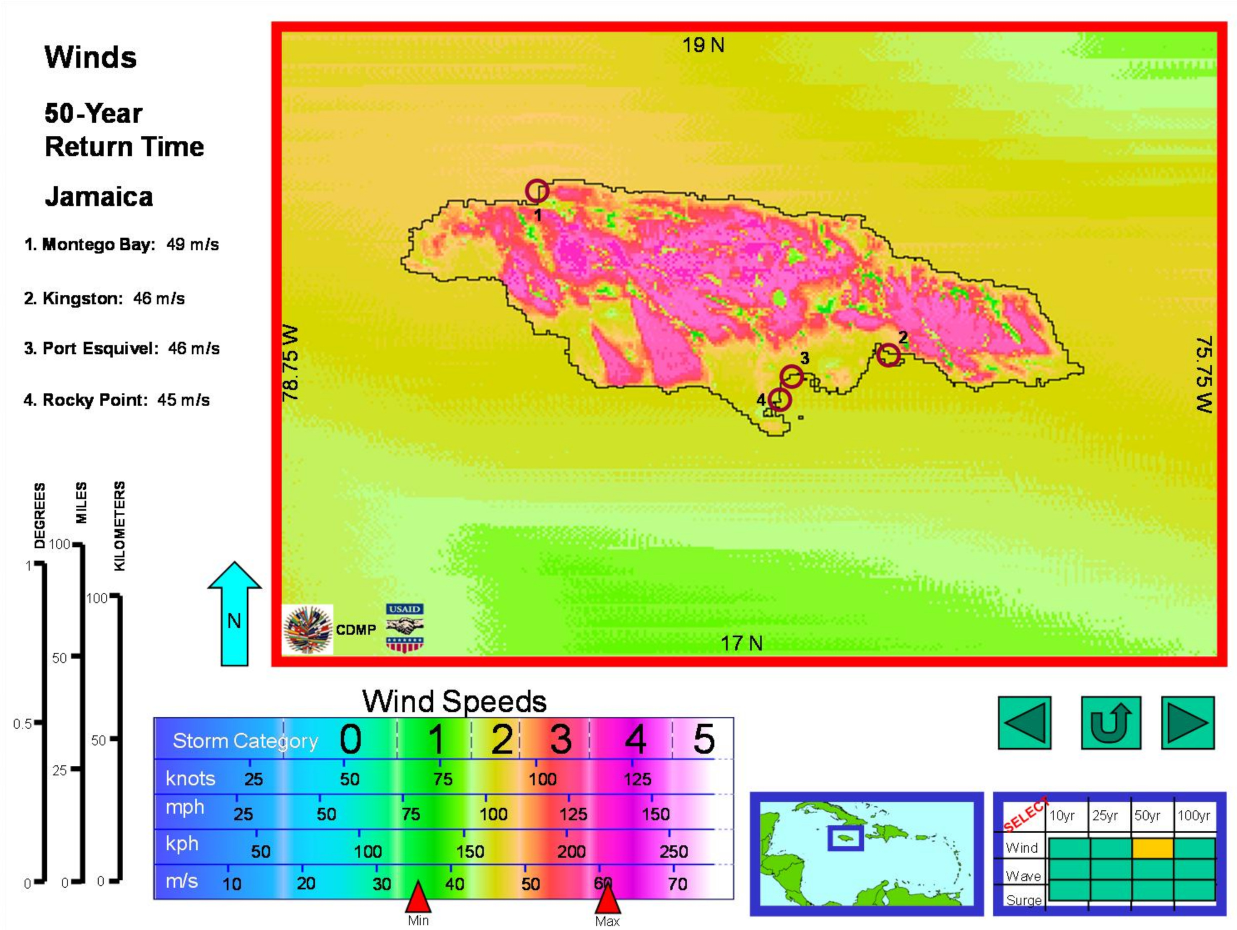


Figure 5-42: 50-year return period for hurricane wind speeds for Jamaica (source CDMP Atlas)

5.3.4 *Riverine & Flash Flooding*

The position of the main road through Tarentum exposes it to threats from erosion through bank failure of the canal and with an elevation of approximately 0.5m above the present height of the canal (08/02/08) is susceptible to inundation due to flooding during times of heavy rainfall (**Plate 5-11**).

Plate 5-11: The main road from Freetown to Tarentum showing undermining from failure of the canal bank (Photo taken 08/02/08 GPS Location N 17.86784° W077.15734°)

In the valley west of Tarentum, we received no reports of flooding in the gullies during times of intense rainfall. Nevertheless the gullies exist and presumably result from historic and prehistoric rainfall events such as that which caused massive coastal gully floods in June 1979 (Flood issue of the Journal of the Geological Society, volume 20, for 1981). The existing quarry and most of the access road would be above flood level should a similar event occur at Tarentum (30 to 40 inches of rainfall in 24 hours), but the main coastal road would be significantly affected.

5.3.5 *Sensitive Areas*

The following sites were identified in the area; some may be impacted as a result of the proposed project:

- Caves
- Middens and/or Taino sites
- Hydrological sites- Radioactive springs

5.3.5.1 Caves

Although caves exist in the area we were not shown any that would be adjacent to the proposed transportation corridor.

5.3.5.2 Middens and Taino Sites

Figure 5-43 shows the approximate locations of Taino sites that have been reported to us:

- Brazilletto Mountains - Four middens identified in 1897 and mapped in 1967, west of the trig station.
- Pieces of Taino artefacts, possibly from a midden found in 1997 northeast of the trig station,
- Three sites at Sandy Bay (south side of Brazilletto Mountain) one of which is a cave in which human remains and a boat shaped vessel were recovered.
- Small village mapped at Salt River in 1971

None are close to the proposed conveyor corridor

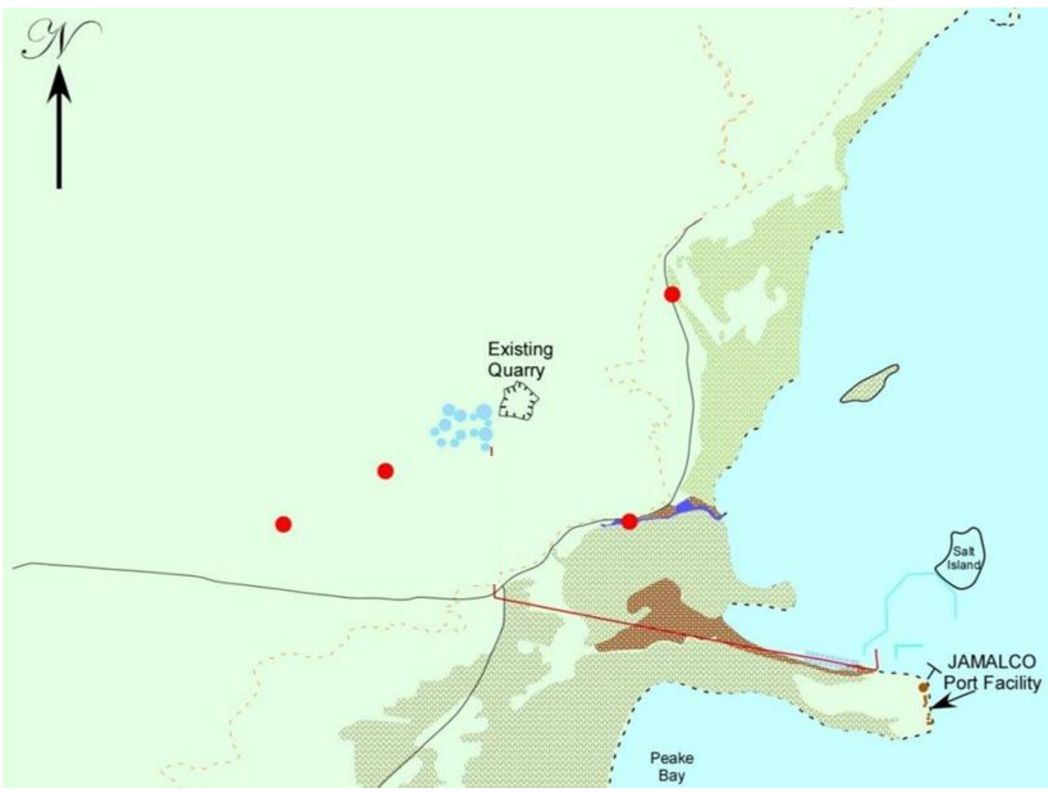


Figure 5-43: Red circles indicate locations where Taino artefacts have been collected. Red boxes identified proposed mining areas SM129 and SML 152

5.3.5.3 Special Hydrological Sites (Salt River Springs)

A site of special hydrological and geological importance is the system of radioactive springs that give rise to Salt River.

Springs have been identified at two locations, forming the sources for the two tributaries of Salt River (**Plate 5-12** and **Plate 5-13**). Both springs flow from fissures associated with the South Coast Fault which transects the White Limestone forming the Brazilletto Mountains (**Table 5-18**). These are brackish water springs and are thought to be formed by seawater ascending from depth along the South Coast Fault. The sea water is heated and modified before mixing with groundwater near the surface at depth and identified as having radioactive properties (Fenton, 1981). The springs are well-known historically and may have potential for development for their therapeutic value.

Radioactivity in the spring is almost entirely due to dissolved radon 222 with contribution due to dissolved solids being very small (**Table 5-18)** (Fenton, 1981).

A borehole drilled next to the springs at Salt River encountered dolomitic limestone at depth. Originally thought to be part of the Eocene Troy Formation, it is now thought to be Newport limestone that has been dolomitized from reactions with chemistry of the springs.

Table 5-18: Amount of dissolved solids identified at Salt River springs at the pool

Location	dissolved solids
Salt River (west spring)	0.006mg
Salt River (east spring)	0.003mg

Plate 5-12: Sites of springs feeding the west tributary of Salt River. Google image retrieved 28 February 2006

Plate 5-13: Three springs identified at the Monymusk Gun Club, feeding the east branch of Salt River. Google image retrieved 28 February, 2008

5.3.6 *Conclusions*

The main conclusions evident to us are:

- A conveyor line built to earthquake standards is not likely to suffer significant damage on the limestone slope segment of the route.
- On the level plain, underlain by what are believed to be relatively thick alluvial deposits which increase in thickness southwards, care would need to be taken to provide adequate foundations for the conveyor system against accelerations from an earthquake.
- The routing of the conveyor line should avoid built up areas (for noise reasons) as much as possible. The recommended route is through the gap between the housing at Salt River and the hotel at Sandy Bay with a turning point in the region of the intersection of the Salt River and Mitchell Town roads and the road to Rocky Point.
- The port would likely experience wind and wave/surge damage to superficial structures from a Dean-type hurricane.
- The examination of surge and wave run-up data from hurricane Dean suggests that the TAOS model predictions of about a 2.5 to 3 metre surge are in line with its 50-year return event for the port area (although whether or not this event can still be considered a 50-year one is open for discussion).
- The area around the two spring systems for Salt River should be avoided for any industrial development, as in our opinion these are historic sites, even if not “listed” as such.

5.4 Biological Environment

5.4.1 *Introduction & Regional Setting*

The Brazilletto Mountain (ca. 3,000 ha) and the coastal plains are located on the South Coast of Jamaica in the parish of Clarendon. Brazilletto Mountain is one of the largest remaining dry limestone forests in the island and is the least remote of all (located near communities) the other major dry limestone forests (Caribbean Coastal Area Management Foundation). It is one of the main sources of ground water in the area, which is utilized by the Monymusk Sugar Estate and is also said to be the main water source for the famous Salt River Mineral Bath.

The fauna and flora of the Brazilletto Mountain is similar to the southern sections of the Hellshire Hills (CCAM). A vast number of endemic plants and animals have been found in the area. However, the Brazilletto Mountain is the least studied of the major dry limestone forests in the island and is thought to share several plants and animals with the Hellshire Hills.

This section covers:

- The forestry and wetlands, estuaries and coastal zones, flora and fauna and endangered or endemic species that may be impacted by this project.
- It presents the species diversity and ecological relationships among them, identifies special or protected areas and the potential impacts on these, and
- Records the extent and potential impact of the proposed project.

Methodology:

The ecological assessment was conducted primarily through qualitative methods supported by literature research and ground-truthing. The literature review was based on a series of relatively current studies which employed the use of quantitative methods for several areas in the sphere of influence of the project sites. Methods employed included the following:

- Aerial photography and land use classification mapping to identify plant species distribution and classification.
- Ground-truthing to confirm land use classification and vegetation type and distribution
- Plant collection and plant identification, where necessary, through the aid of a recognized taxonomist and herbarium
- Literature research of information related to the geographical influence of the proposed project to generate species inventories.
- Species identification through field guides, photography, among others.

The declaration of the protected area status was initiated, owing in part to the presence of rich coastal and marine resources within the area. Some of the largest Mangrove wetlands and fresh water marshes in the island exist within and adjoining the borders of the Portland Bight[17]. Also integrally associated with wetlands are Seagrass Beds and Coral Reefs, which support a diverse array of fish, crustaceans and other forms of marine organisms[18]).

An additional protection measure initiated by the Government Environmental Agency was the declaration of the Portland Bight area as a RAMSAR[19] site, underscoring the location's importance as a habitat for wetlands.

Several studies have been initiated in the past, which have shed light on the extent and value of natural resources within the Portland Bight Protected area. The most extensive to date has been an environmental baseline study, which was commissioned by the Jamaica Public Service Company Ltd in 1997-98 for a Coal/Oil fired power plant, which was proposed for the Salt River area[20].

Extensive land-use, climatic, terrestrial, marine and socio-economic research was conducted to support the preparation of the baseline study**.** **Plate 5-14** represents a spatial representation of the marine resources within the study area, and as projected over the Protected Area using aerial interpretation techniques.

[17] Personal communications Coastal Zone Management Branch - NEPA

[18] Environmental Baseline Study to JPSCo for Coal/Oil Fired Power Plant 1998.Conrad Douglas and Assoc.

[19] The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 158 Contracting Parties to the Convention, with 1718 wetland sites, totaling 159 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance. http://www.ramsar.org/

[20] Environmental Baseline Study to JPSCo for Coal/Oil Fired Power Plant 1998.Conrad Douglas and Assoc.

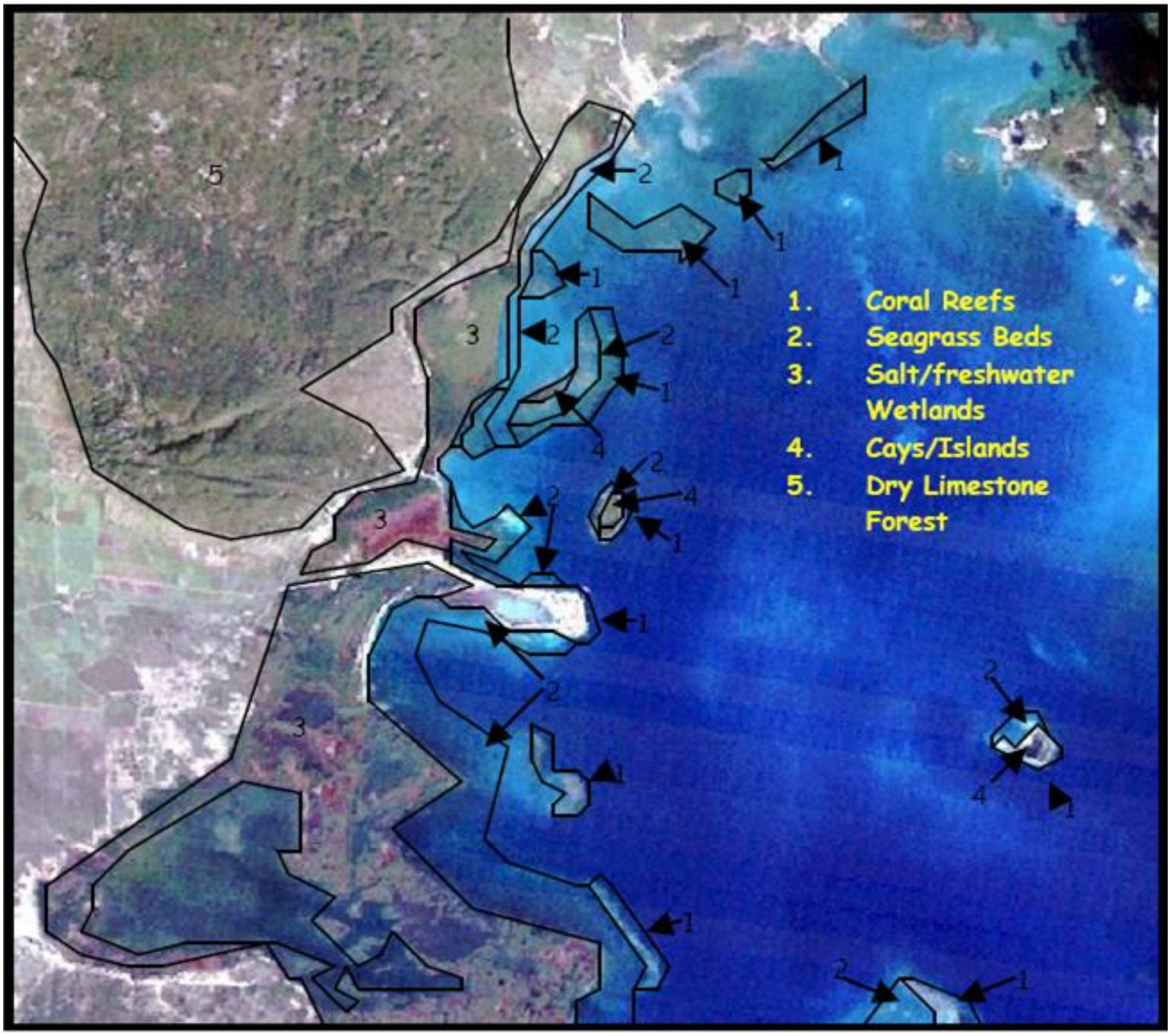


Plate 5-14: Spatial Location of Natural Resources Bordering the Development Location

In addition to the Baseline Study, another applicable source of information was an assessment of the marine resources immediately adjoining the JAMALCO Marine Terminal, which was commissioned by JAMALCO in 2004 as a component of its proposed expansion[21].

This report concluded that:

> "*The general area around the dock and pier was alive with a reasonable reef community showcasing multiple species of fish, coral and other expected species. The patch reef system within the project area does not appear to be very different from that found elsewhere in the area"*

[21] Environmental Impact Assessment for 2.8 Million Metric Ton per Year Efficiency Upgrade JAMALCO 2004.Conrad Douglas and Assoc.

> *"Staghorn coral populations are significant with a lot of new growth evident"*
>
> *"the seagrass community is very extensive and appears to be healthy, the large numbers of sightings of sea urchins within the project area is also a good indication of the feed palatability of the grass"*
>
> *"the presence of healthy sponges growing directly on the pilings is an indication that the marine community is not at present suffering from any substantial negative effects as a consequence of pier activity"*
>
> *"Water current activities are directly related to the wind patterns that prevail in that area. The overriding pattern seems to be towards Burial Point and Colon Bay".*

Information present within this report was used to assist in the preparation of the marine resource diagrams of the environs immediately adjoining the site.

It must be made clear these coral resources are not within the footprints of the project area. Neither do they stand to be significantly impacted by any development works associated with this proposed project. The following sub-sections and Section 6 will outline the impact areas and the natural resources contained within.

A comprehensive impact assessment was undertaken for actual footprint impacts on seagrass and mangroves (See Section 6 of this report). This section also provides specific mitigation measures for impacts to these resources.

Coastal communities are found on three types of substratum, namely sand; limestone and coral rock; and mud (such as in mangrove areas). The sandy beaches are highly calcareous containing high proportions of weathered limestone and coral rock, together with sea shells and calcareous algae. The vegetation on these beaches usually consist of open pioneer communities existing on motile sand; herbaceous communities on fixed dunes; scrub and a climax woodland communities.

Along the south coast of Jamaica there are a series of rocky limestone hills and rages that lift to altitudes of approximately 607 m (2,000 ft). The annual rainfall in these areas rarely exceed 1,016 mm (40 inches) and is provided by two rainy seasons (October & May) separated by six months of drought (Asprey & Robbins, 1953). Dry and wet limestone forests tend to characterise these limestone hills, with the dry forest being relatively low in stature; consisting, primarily, of scrub vegetation growing over exposed limestone rock.

5.4.2 *Methods*

5.4.2.1 Marine Resources

5.4.2.1.1 Study Area Demarcation

The area defined for the marine assessment was selected considering that the 2004 JAMALCO study of their Marine Terminal suggested that the area examined was representative of the general benthic conditions existing along the Peninsula at which the proposed limestone export facility is to be situated.

Thus, determinations made for the marine environment immediately adjoining the terminal could be extended by extrapolation to bordering areas, simplifying the process of in-field verification.

The study area for the present marine assessment was defined by the shoreline of the peninsula (extending along its eastern, western and northern limits), extending northwards to the northern, western and eastern limits of the footprint of the development area. This area is outlined on **Plate 5-15.**

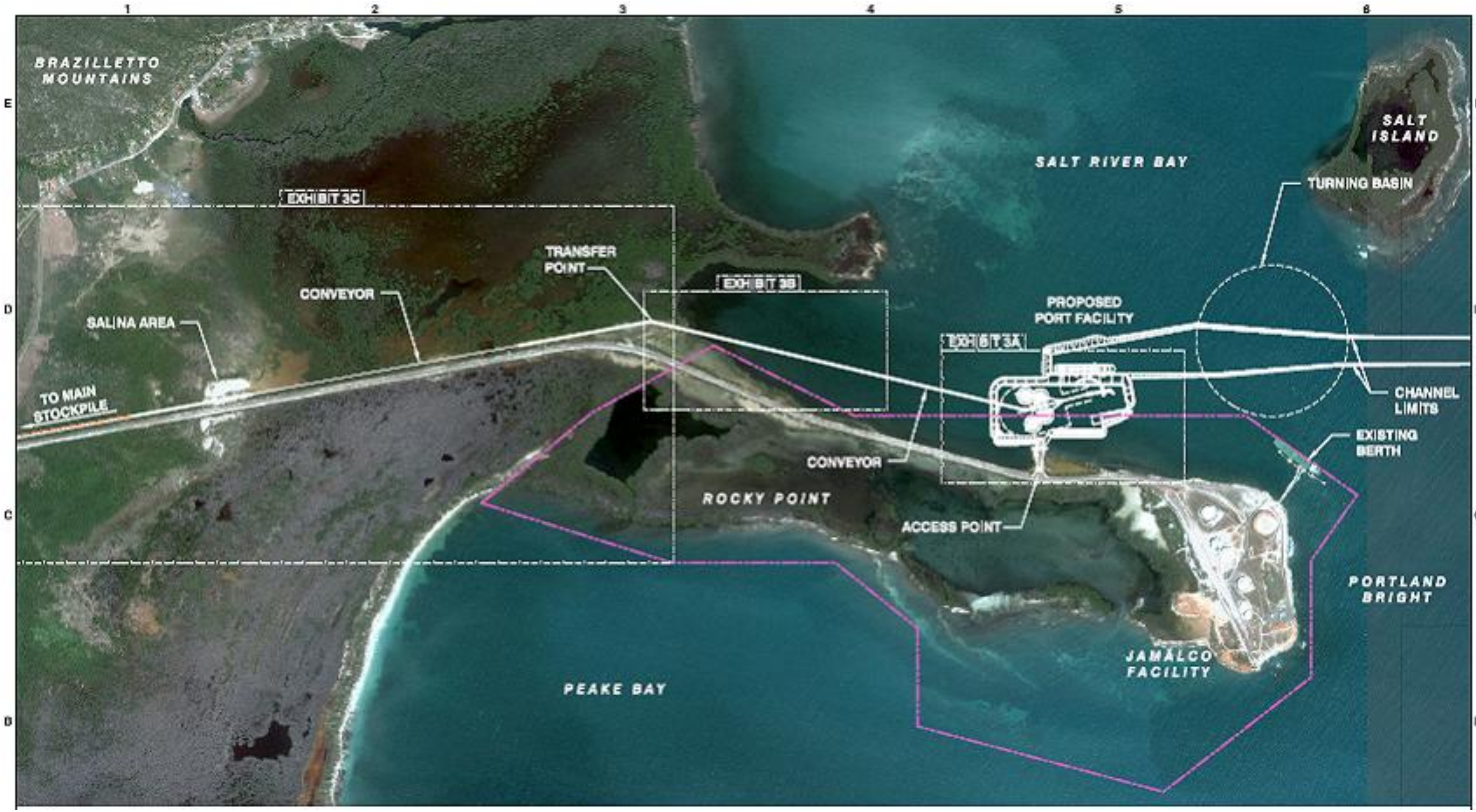


Plate 5-15: STUDY AREA: Defined by the Boundaries of the Proposed Development Works

5.4.2.1.2 Aerial Photo Interpretation

The marine assessment was initiated using photogrammetric[22] techniques to remotely identify and determine the spatial distribution of marine seafloor characteristics, which can be discerned with these methods. Vertical aerial coverage of the area for the year 2006[23] was accessed on-line and examined for the interpretation process. The analysis of this imagery was supplemented by the examination of low altitude oblique aerial imagery of the site taken in February 2008.

Once general distinctions were made, spatial mapping and area determination was done using MapMaker Pro Geographical Information Systems (GIS) software. GIS was also used to overlay the proposed development footprint onto natural resources data, so as to establish areas of possible impact.

5.4.2.1.3 Ground Verification

After the processes of aerial assessments and initial spatial mapping were completed, ground-truthing was conducted to verify interpretations made. In addition, verification was conducted to provide information on the status of natural resources that may exist within the immediate study area.

Several ground truthing methods were used during the course of the survey. A tethered clamshell Grab Sampler was used for the determination of seafloor substrate types over the area, with positions of the sample sites being tracked with a Garmin hand held global positioning system (GPS). This method was used due to the fact that water visibilities were very low – a common occurrence for the area. Vertical water clarity as was established with the use of a Secchi Disc.

Video footage of the seafloor at select locations were obtained through the use of underwater video equipment and facilitated with the use of SCUBA equipment. Each video sweep was conducted along a path 50 meters in length (as defined by a surveyor's tape measure). Additionally, a viewing box was used to facilitate the taking of photographs of the seafloor in areas where water depths were less than 0.5 meters.

Ground-truthing was conducted over two days, with nearshore assessments being done on the 9th and 23rd February, 2008 and offshore assessments being conducted on the 13th February, 2008.

[22] Photogrammetry is the science of using aerial photographs and other remote sensing imagery to obtain measurements of natural and human-made features on the earth **www.Physical** Geography.net
[23] Earth.google.com

5.4.2.1.4 Oceanographic Assessment Methods

A basic understanding of the oceanographic processes occurring within and surrounding the study area was obtained. This was done in order to determine the manner in which proposed development works could impact environmental features within and external to the development site study area.

Two approaches were adopted for the evaluation of the study's target oceanographic processes. Firstly, the contour of the seafloor immediately adjoining the development site was determined by inputting water depths sounded with a weighted tape measure and coordinates obtained with GPS into Quickgrid contour mapping software. This software was then used to generate a contour map of the survey area.

The second approach taken was the interpretation of oceanographic information existing within the 2004 assessment study, along with the examination of the 2006 aerial imagery to interpret water movement within and surrounding the development site.

5.4.2.1.5 Limitations

The most significant limitation experienced during the study period was sea state, which coincidentally was a limitation outlined in the 2004 assessment study. During the study period, a series of high-pressure ridges prevailed over the Central Caribbean for several days leading up to, during and past the time of the survey. As a result of this, south easterly day time winds in excess of 20 knots were experienced in the Portland Bight area generating 2 metre seas within the study area and reducing underwater visibility at all locations within the study area to less than one (1) metre. The rough seas led to low visibility conditions, which hampered underwater assessment work.

5.4.2.2 Floral Resources

An important part of any vegetation survey is determining the most efficient way to effectively sample the plant community. From carefully chosen sample sites one can confidently extrapolate the information gathered to describe the entire community. However, terrain and site-accessibility are major limiting factors in determining which sampling method may be successfully employed.

There are two main approaches in locating representative samples: one is completely subjective where sampling locations are determined based on one's interpretation of how representative the vegetation is of the entire community. The other method is based on a subjective-objective approach where representative stands are chosen subjectively and sampling carried out randomly or regularly through these stands. For this study two sampling methods were employed: subjective "Walkthroughs" and subjective-objective Belt Transects. In each case, the minimum geographical range covered by each method was limited to no less than those areas along the proposed path of the conveyor system to the quarry site.

Walkthroughs were conducted within the coastal floodplain (Site A - **Plate 5-16**). From these, a general species inventory for the site was derived, as well as the average tree diameter at breast height (DBH); the average vegetation canopy height; and the emergent vegetation height were assessed.

Plate 5-16: Study site outline

Belt Transects were employed mainly along the narrow, northern coastal fringe (Site B - **Plate 5-16**) leading towards the existing JAMALCO port at Rocky Point. Starting from the gate of the existing JAMALCO port and heading west along the roadway in Site B, sampling points for each belt transect were chosen based on perceived changes in vegetation or substrate composition. The method, as was implemented, entailed walking a straight line northerly from the roadway towards the water's edge while taking note of any plant species encountered within a 10 m swath of this line.

For any plant that could not be identified in-situ a specimen was either collected and tagged or photographed for later identification at the University of the West Indies' Herbarium at Mona. Also, any known endemic or nationally important species were geo-referenced using an Eagle Explorer GPS device.

The information gathered was used to characterize the vegetation communities present and derive an overall species list of the area. This vegetation survey (coastal and inland) was conducted between 2nd and 9th February, 2008.

5.4.2.3 Faunal Resources

5.4.2.3.1 Avifaunal Resources

Line transect:

Line transect was used for the assessment of the avifaunal community for the area, since there was a clear path along most of the proposed route for the conveyor belt. In addition, the line transect was adequate for the scope of the study area **(Plate 5-17)**.

Plate 5-17: Map showing bird survey transects for the proposed conveyor belt

The line transect survey method entails walking at a steady pace along selected routes for a given distance or time period and noting all the birds seen or heard in the area (Wunderle 1994). The line transect survey was conducted from sunrise until approximately 10:30 am in the morning.

Advantages of line transect method include:

- It covers the area quickly and the number of bird sightings is usually higher (Bibby et. al. 1998).
- It reduces the chance of double counting (Bibby et. al. 1998)
- It is good for observing mobile and conspicuous species (Bibby et. al. 1998)

Point counts:

The point count method is based on the principle of counting birds seen and heard at a defined point or spot. This is done for a predetermined time, usually 10 minutes, before moving to another point a specified distance away (this can be either 100m – 200m) (Bibby et al. 1998).

Points counts were done in areas, where the transect routes could not follow the proposed path of the conveyer belt **(Plate 5-18)**. The points were conducted as close as possible to the path of the proposed conveyer belt.

Plate 5-18: Map showing the point counts used for the bird survey Observance of mudflats and water bodies

This method is based on the principle of counting birds at an area where water has accumulated. Species and their number are then recorded for a time period usually 20 – 30 minutes. Identification of species was done through sight (visual identification) and sound (audio identification). Anecdotal notes as to the behaviour of the species were made during that time period.

Overall bird survey technique weaknesses:

As with all survey techniques, there are weaknesses, which influence results. Below are factors which affect the census techniques used.

- Time of Day – the best time for conducting a census is in the morning from sunrise until about 10am in the lowlands. It is recognized that as the day continues it gets hotter and the ability to detect birds decreases due to lack of movement. (Wunderle 1994).
- Time of Year – the change in behaviour of birds during the breeding and non-breeding seasons affect detection. However for this report, the assessment was done in the non-breeding season, when birds are less vocal. (Wunderle 1994).
- Weather – things such as wind, rain, fog or temperature, affect conducting a census (Wunderle 1994).

5.4.3 *Marine Resource Findings*

5.4.3.1 Aerial Photo Analysis

The form, colour and texture patterns observed during aerial photo analysis led to the conclusion that there were both hard and soft substrate areas within the study area. The spatial distribution of these substrates defined an area characteristic of a near-shore sandy/silty area, fringed to its north-eastern corner by an area of hard substrate.

The soft substrate area was inferred to be composed of sediments of a marine origin.

5.4.3.2 Water Clarity Observations

Secchi disc readings taken revealed vertical visibilities less than 1 meter throughout the entire study area.

5.4.3.3 Diver- Grab Sampler Assisted Visual Observations – Substrates:

Near-shore areas interpreted as being composed of soft substrates were confirmed as possessing sandy /silty sediments of a marine origin. Offshore grab sample areas revealed bottom substrates composed of grey coloured muds and clays, possibly of mixed land and marine origins.

Video transects taken at locations defined on **Plate 5-19** assisted in the confirmation of substrate types.

Plate 5-19: Location of Video Transects (Composite Images from Fixed Wing Aircraft)

The area interpreted as being of a hard bottom character was confirmed during the visual surveys as possessing a combination of soft substrates (sand / rubble) with scattered coral heads existing within. Towards its seaward (northern) boundary, the substrate type changed to that of dead Elkhorn Coral rubble (see **Plate 5-20). Plate 5-21** illustrates the spatial distribution of substrate types as confirmed with visual observations. A total seafloor area of 57 ha was assessed; approximately 34 ha had muddy substrates, 22 ha had sandy substrates and the remainder (1 ha) was comprised of mixed hard and soft substrates.

The substrate (land based sediment and broken down shells) is characteristic of the location which is at the mouth of a river (Salt River) and receive particulate matter both from the marine and terrestrial environment.

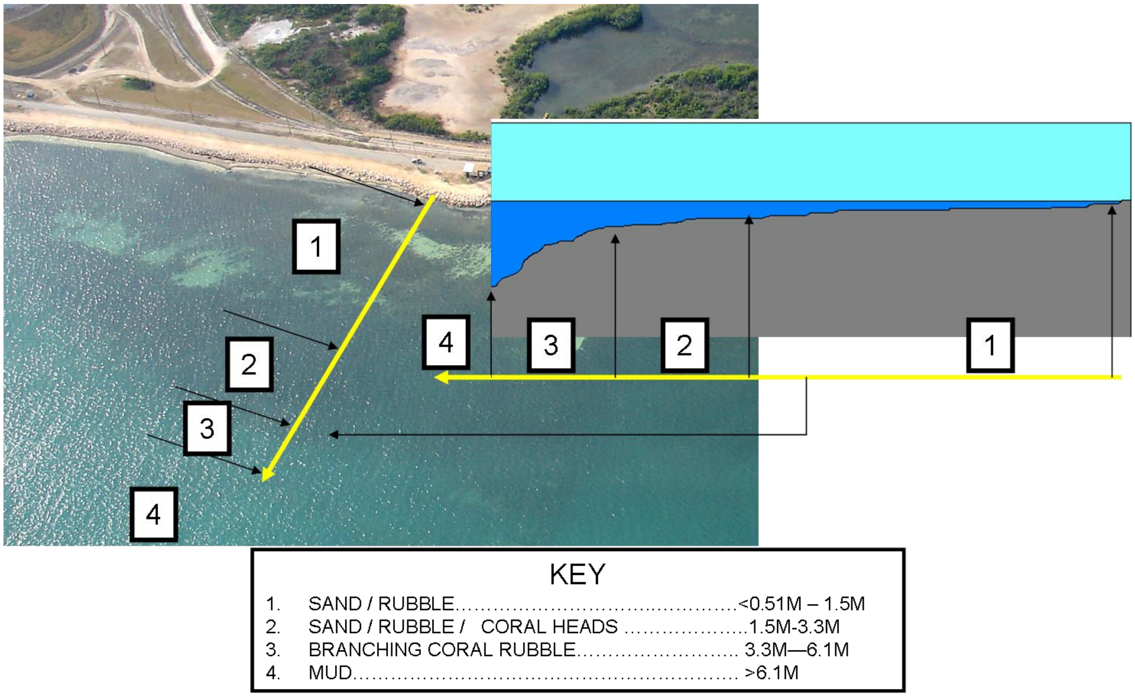


Plate 5-20: Substrates at Suspected Reef Zones, as interpreted from 2008 Video Survey

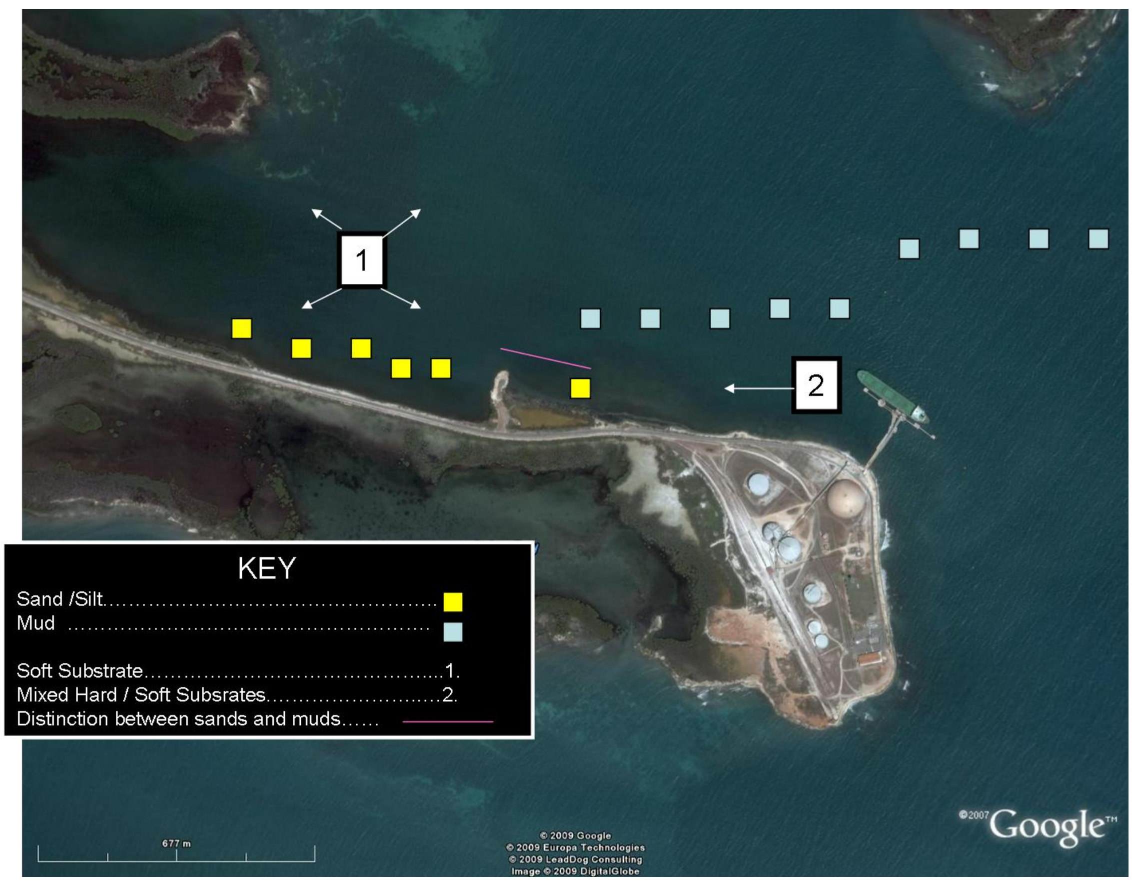


Plate 5-21: Substrate Distribution at the Development Study Site

5.4.3.4 Diver- Grab Sampler assisted Visual Observations - Marine Species Distribution

Visual (video) and grab sample observations confirmed the presence of seagrass lifeforms populating the sand / silts bordering the shoreline at the proposed development site. The spatial extent of this lifeform is outlined on **Plate 5-22** and **Plate 5-23.** Both Turtle (*Thalassia testudinum*) and Manatee Grass (*Syringodium filiforme*) varieties were observed, with the former being the dominant variety. **Plate 5-20** illustrates the distribution of benthic lifeforms within the area suspected to be a reef area. The distribution of these species is further outlined in Section 6 of this report.

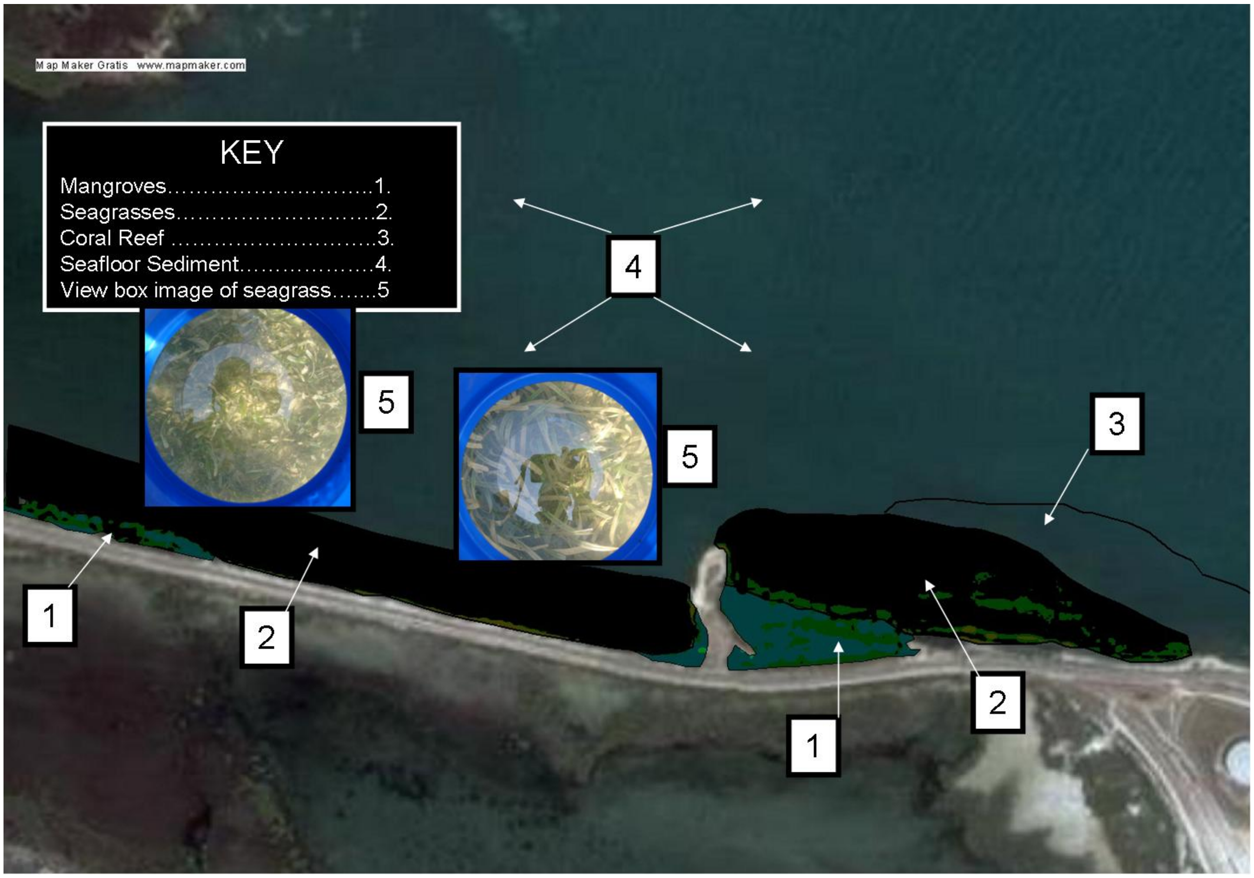


Plate 5-22: Shoreline & Seafloor Formations

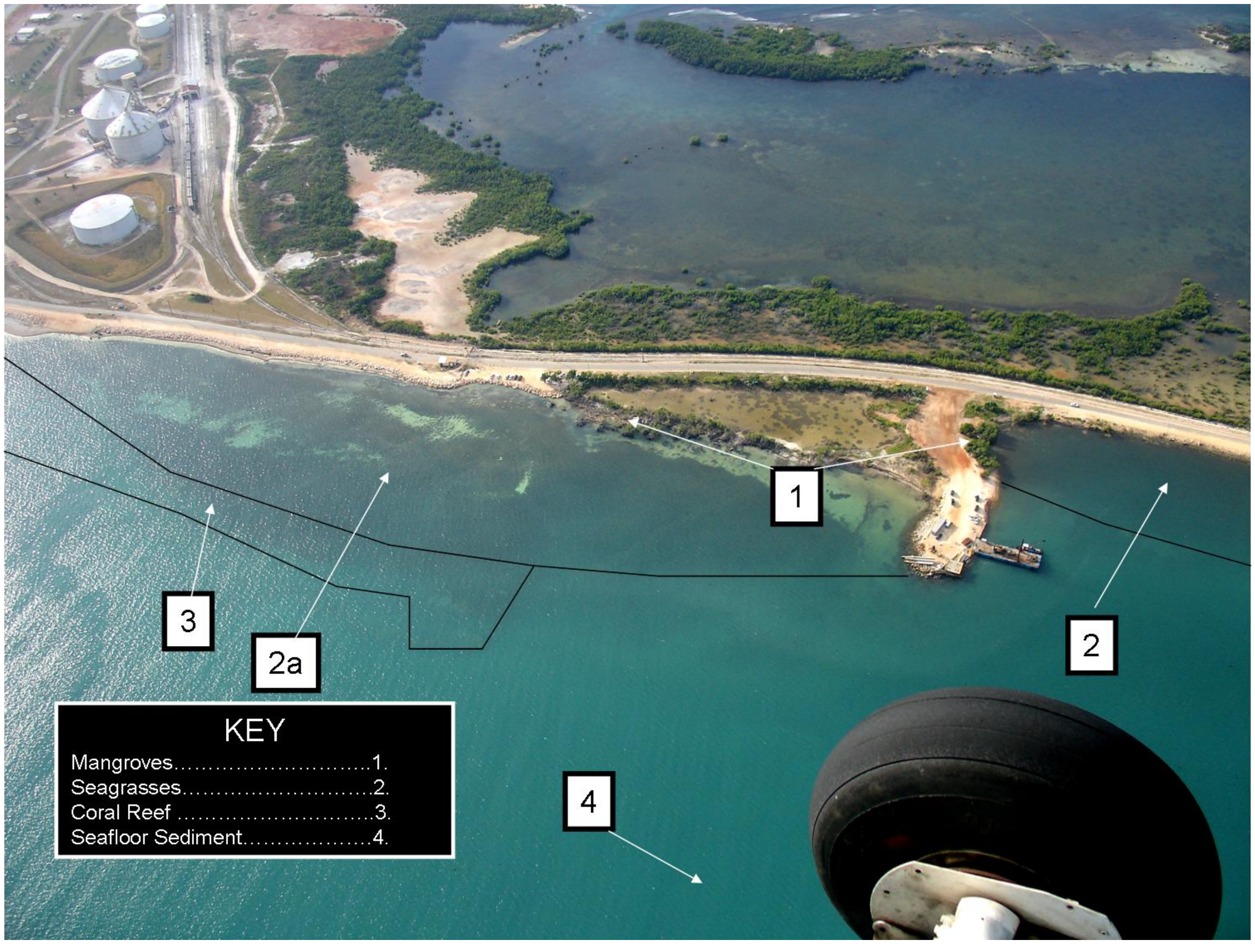


Plate 5-23: Shoreline & Seafloor Formations in Vicinity of Proposed Port

Other benthic and mobile lifeforms were observed within the study area and these have been summarized, according to video transects assessed and illustrated below. Abundance estimated using the DAFOR method for some species.

The algae were only found in the extremely shallow regions (>0.1 meters deep) and are all typically found in nutrient rich brackish water. The Salt River is the major source of nutrients, brought down from the land it drains in south east Clarendon. The increased nutrient has led to the domination of the three species of algae recorded.

Table 5-19: Species List

Common Name	*Scientific Name*	Transect Found & Rating					
		1	2	3	4a	4b	5
	Marine Plants						
Turtle Grass	*Thalassia testudinum*	D	D	D	D	D	D
Manatee Grass	*Syringodium filiforme*	F	F	F	F	O	O
Green algae	*Bryopsis pennata*	-	-	-	-	F	O

Common Name	***Scientific Name***	**Transect Found & Rating**					
		1	**2**	**3**	**4a**	**4b**	**5**
Green algae	*Chaetomorpha linum*	-	-	-	-	F	O
Green algae	*Acetabularia calyculus*	-	-	-	-	F	O
Green algae	*Caulerpa mexicana*	-	-	-	-	F	O
Brown algae	*Dictyota cervicornis*						O
Green algae	*Cladophora prolifera*						O
Algae frequency related to amount of hard surfaces observed on transect							
Benthic Invertebrates							
Blushing Star Coral	*Stephanocoenia mechelinii*	-	-	-			R
Massive Starlet Coral	*Siderastrea siderastrea*						R
Lettuce Coral	*Agaricia* sp.						R
Fire Coral	*Millepora sp.*						R
Mobile Invertebrates							
Caribbean Starfish	*Oreaster reticulates*	-	-	-	O	O	O
Reef Urchin	*Echinometra vividis*				O	F	F
Black Spiny Urchin	*Diadema setosum*	-	-	-			O
Fish							
Dusky damselfish							
Yellow Tail damselfish	*Chromis enchrysurus*						
Bi-colour damselfish	*Eupomacentrus partitus*						
Sergeant major damselfish	*Abudefduf saxatilis*						
Four-Eye Butterfly Fish	*Chaetodon sp*						

5.4.3.5 Reef Status

The area studied could not be classified as a reef but was for the most part a deposit area for materials brought in by both the Salt River and prevailing ocean currents. The study failed to reveal the presence of extensive corals and other marine organisms associated with reefs. This is a direct effect of the poor visibility brought on by the high incidence of suspended particulate matter from the river discharge and periods of dredging. This is, however, not a confirmation of the areas potential as organisms (especially mobile ones) may have been missed during the survey exercise.

The nature of the area does not promote a healthy reef structure, as the main requirements (stable substrate and relatively good light penetration) are absent. The health of a reef is usually defined by accessing the ratios of the dominant seafloor-covering organisms as an indicator. Healthy reefs are defined as those with a higher ratio of coral to algal cover (Hughes 1970's and 1990's). In the early 1970's, Jamaica's north coast reefs had an average live coral cover of 52%. Algae cover at the time was approximately 4% (Hughes 1970's). Studies conducted at the north coast in the 1990's revealed a significant change in the relationship, with live coral cover dropping to 5% while algae cover increased to 95% (Hughes, 1994). Factors such as land-based eutrophication of marine waters (contamination with nutrients), over fishing and tropical storm events have contributed to this drastic change (Woodley, 1998).

It was demonstrated that the reef adjoining the proposed development site did not share the same character as that studied in the 2004 report. However, the 2004 report identified the reef resources adjoining the Marine Terminal as being “indicative of a reef undergoing coral stress and this was indeed true of the coral examples observed at the study site. The main sources of stress at this location appear to be turbidity (as indicated by the poor prevailing visibility), wave/current action, causing physical reef damage and introducing turbidity causing agents, and finally, eutrophication (as indicated by the percentage cover of algae estimated)”.

The report was, however, quick to identify that coral regrowth had been observed, suggesting that nature was attempting to recover from the stresses impacting the area. In the case of the study site, while re-growth was not observed (visibility being a limitation), there were examples of corals observed, leading to the conclusion that these resources were present and were worth preserving. It should also be noted that since the 2004 study, two major hurricanes have battered this region, namely: Hurricanes Ivan (2004) and Dean (2007).

The area proposed for the port is currently a launch point for various marine vessels including barges. The depth of the water is on average 4.5 feet. The area is more prone to turbidity than the area adjacent the existing Jamalco terminal. There are only a handful of coral heads in the area in question and these corals are covered largely in algae. Only one or two are in a “good” state. Relative to those adjacent the terminal mentioned in the 2004 study, they are in relatively “poor” health.

A more recent study, the Jamalco Barge EIA submitted in January 2007, in the area slated for development also indicated the poor visibility in the area and the general paucity of any corals that could be negatively affected. The water quality in the area was defined in the same Barge Dock EIA as follows:

The following parameters were evaluated within a 100 m radius (of marine waters) of the proposed project area at Rocky Point, Clarendon:

- ❖ *Total and Faecal coliform*
- ❖ *Total suspended solids*
- ❖ *Phosphates*
- ❖ *Nitrates*
- ❖ *Oil and Grease*

Table 5-6 below outlines the findings of this assessment. The certificates of analysis can be seen in the Appendix. The results as given by Poly-Diagnostics Centre Ltd for phosphates, oil and grease, total and faecal coliform, and total suspended solids all fall within acceptable NEPA standards as seen below. The value for nitrates was slightly elevated.

It should be noted that when compare with NEPA's trade effluent standards and the National Ambient Water Quality Standard for Freshwater, these values are all within limits and are exceedingly low. NEPA has no standard for marine water bodies along any of Jamaica's coast.

Table 5-20: Analysis of Key Parameters of the Marine Waters in the Immediate Vicinity of the Proposed Project Site at Rocky Point, Clarendon

PARAMETERS	**METHOD**	**RESULTS**	**NEPA STANDARD**
Phosphate as PO_4 / (mg/L)	Colorimetric (Spectrophotometric) Method # Hach 8048 Page 537 2nd Edition	0.029	0.001 - 0.055
Phosphate as PO_4-P / (mg/L)		0.009	
Nitrate as NO_3 / (mg/L)	Colorimetric (Spectrophotometric) Method # Hach 8039 Page 400 2nd Edition	2.480	0.001 – 0.081
Nitrate-Nitrogen NO_3-N / (mg/L)		0.560	
Total Suspended Solids / (mg/L)	Gravimetric Method # Hach 8158 Page 605 2nd Edition	20.000	All times <150 mg/l Monthly average 50 mg/l
Oil & Grease as HEM / (mg/L)	Gravimetric n-Hexane Extractable Method # Hach 10056 Page 877 3rd Edition	2.290	10
Total Coliform / (MPN/100 mL)	Multiple-tube Fermentation Technique	2.000	$4.8 \times 10^1 – 2.56 \times 10^2$
Faecal Coliform / (MPN/100 mL)		2.000	$<2.0 – 1.3 \times 10^1$

When compared with the more recent Rinker marine water quality assessment it can be noted that coliform (both faecal and total) levels have been a problem in the area. It is hard to identify the exact source of this pollution. However, it may be a function of river transport, sewage waste disposal system in the area (largely septic pits) and coastal currents.

The corals adjacent to the Jamalco pier do not appear to have suffered greatly from the *ad hoc* dredging that has occurred since the inception of the Jamalco Rocky Point Port.

5.4.3.6 Visual Observations – Shoreline Lifeform Distribution

Plate 5-24 to **Plate 5-27** illustrates the types of lifeforms found at the shoreline bordered by the proposed development. The most important lifeform observed within this area was mangrove vegetation. The distribution, impact and mitigation for mangroves are given in Section 6 of this report.

Plate 5-24: Shoreline Vegetation Character Mangroves at Eastern Section of Development Area – View To West

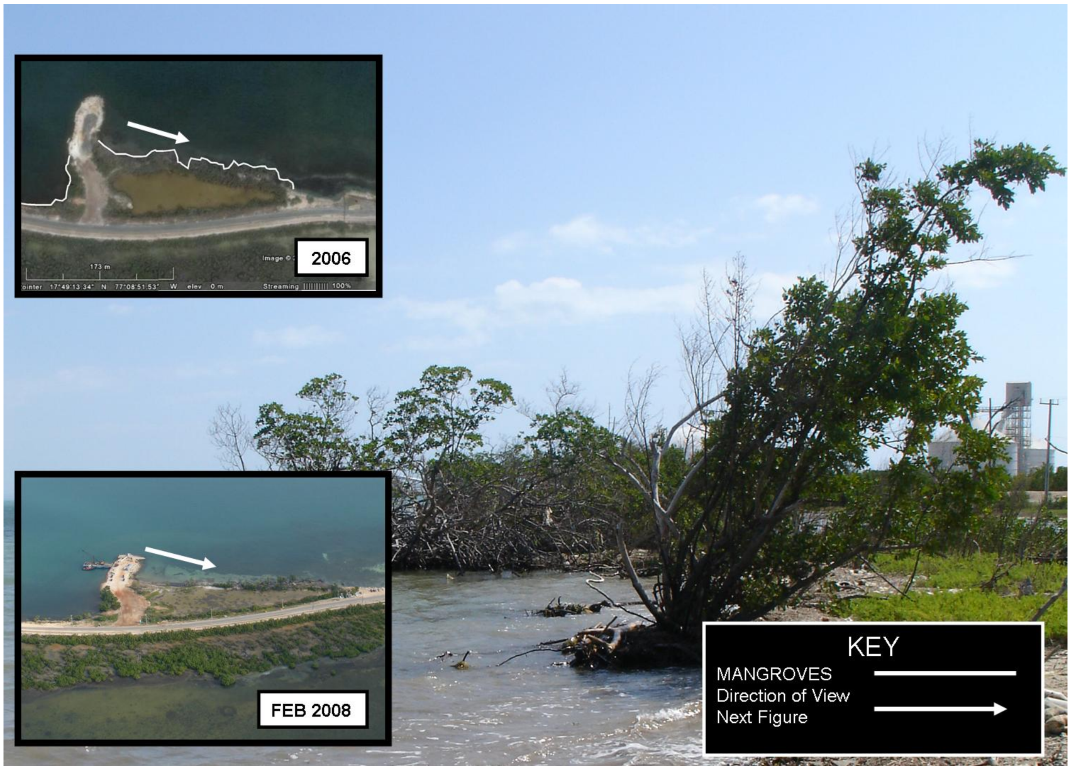


Plate 5-25: Shoreline Vegetation Character Mangroves at Eastern Section of Development Area –View To East

Plate 5-26: Shoreline Vegetation Character Mangroves and Landfill Shoreline at Eastern Section of Development Area –View to South

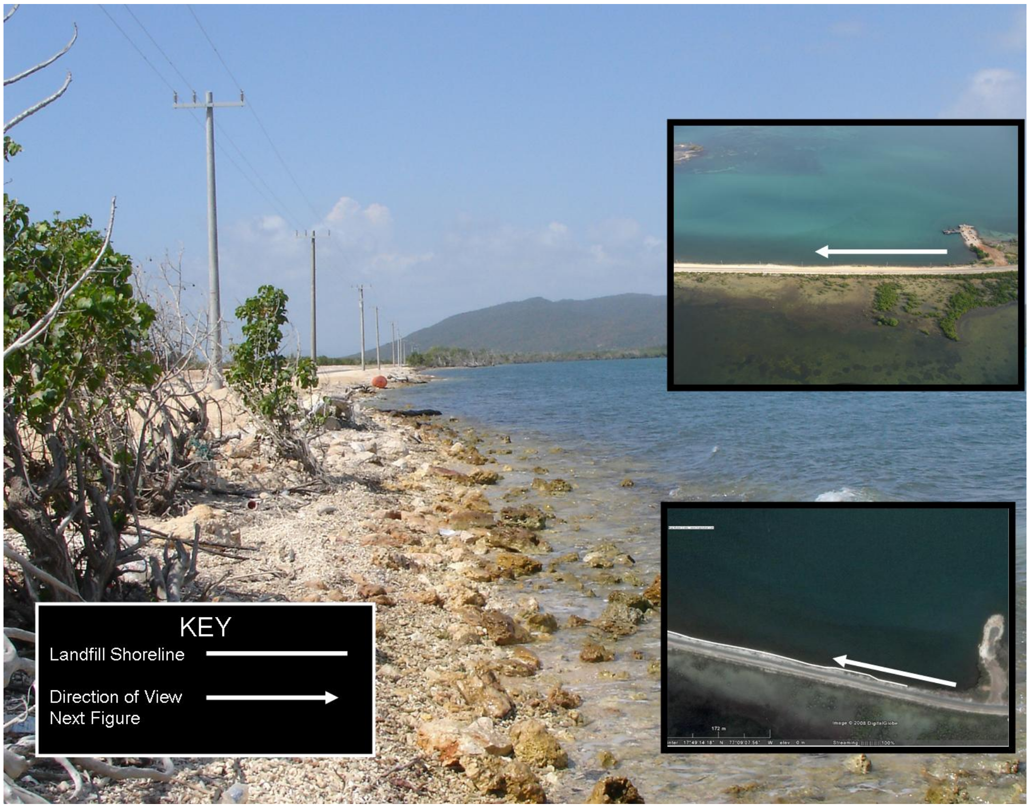


Plate 5-27: Shoreline Vegetation Character Landfill Shoreline at Central Section of Development Area –View to West

Plate 5-28: Shoreline Vegetation Character Landfill & Mangrove Shoreline at Western Section of Development Area –View To West

5.4.3.7 Comparisons – As reported (2004 Study) and as interpreted from Field Observations and Photo Interpretations:

The reef area assessed in the 2004 report ranged over a depth of 1.5 to 3 meters. Video observations made at locations illustrated on **Plate 5-19** showed seagrass present on sandy / rubbly substrates between 1- 3.3 meters depth. **Plate 5-20** further summarizes the observations, revealing a mixture of seagrass and scattered coral heads (zone 2 on **Plate 5-20).** The only similarity between this environment and that described in the 2004 study was a zone of dead branching coral rubble **(Plate 5-20 -**compare with **Plate 5-29).**

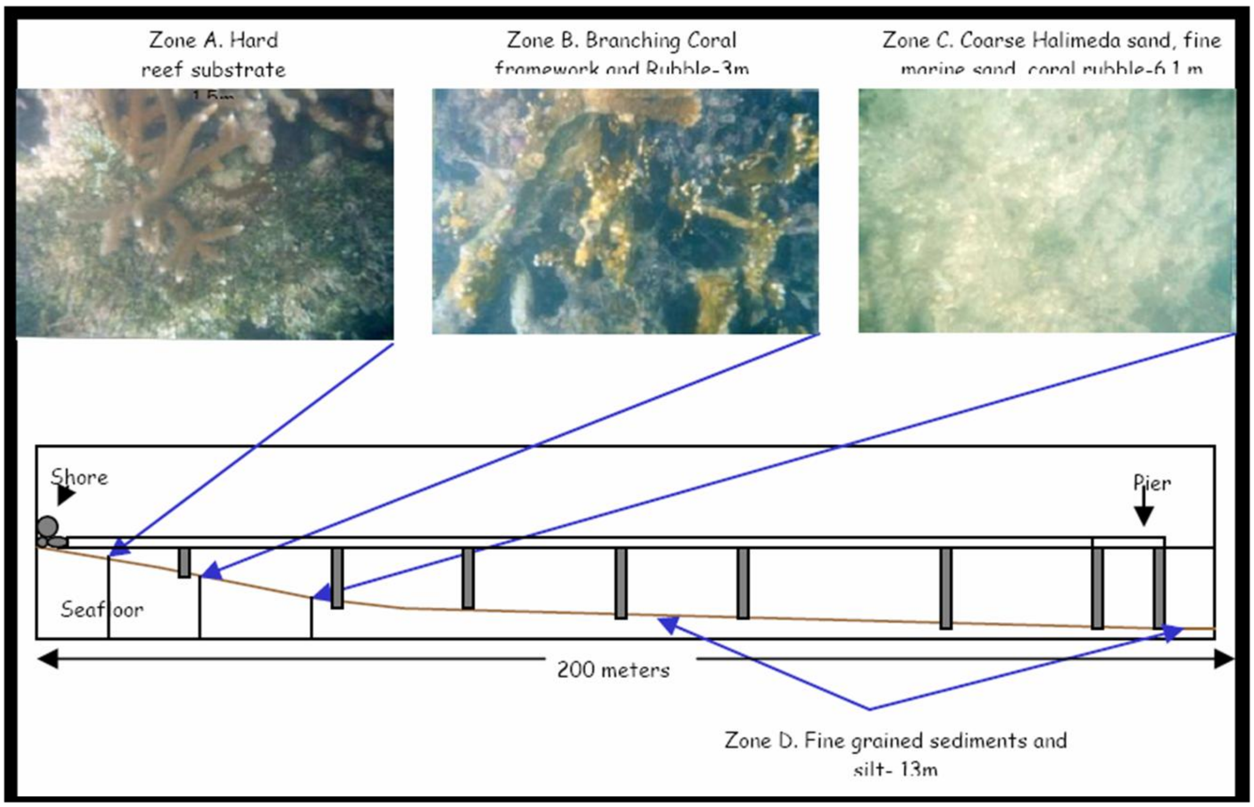


Plate 5-29: Reef Zones for 2004 Study Image Obtained from 2004 Study

5.4.3.8 Oceanography Observations

Water Movement

The 2004 study interpreted that the direction of water currents passing through the proposed development area shifted in direction dependent on the time of day. Land-derived winds from the North would influence a southerly setting current in the night and leading into early morning; while south easterly daytime winds would influence a north westerly current movement.

The effect of freshwater inflows from the Salt River has resulted in low salinities (brackish water). This influences the type of marine flora and fauna that can survive in the area.

Current movement was generally towards the west. Surface water current movement was determined to be a factor of wind movement. There was a gyre effect as a consequence of water movements within the bay and this resulted in the current being deflected to the south-east.

Water Depth

Water depths were obtained at the locations from which grab samples were obtained. Depths ranged generally from in excess of 12 meters towards the north eastern section of the development site to less than a meter within 50 meters of the shoreline towards the western section of the development site. A 3 dimensional representation of the seafloor was attempted using Quickgrid contour mapping software. The results are illustrated on **Plate 5-30**.

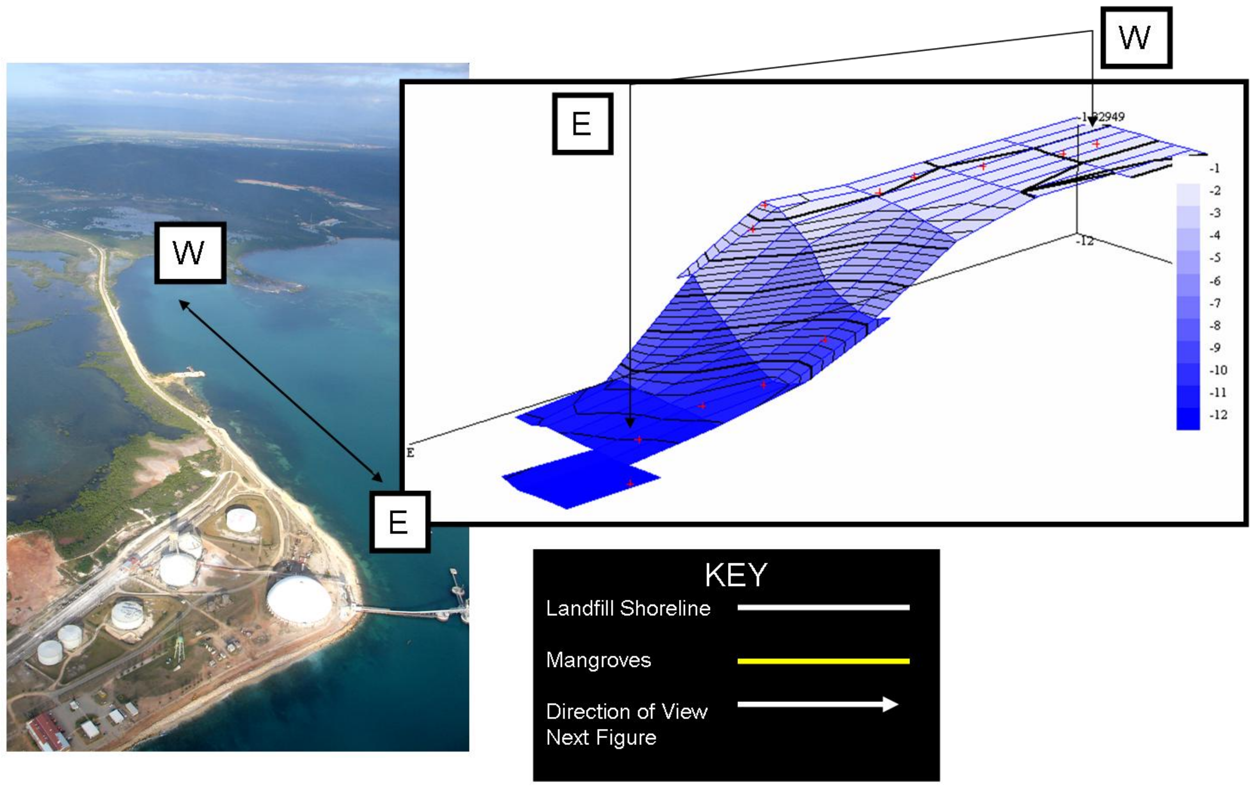


Plate 5-30: QUICKGRID Seafloor Contour Map of Study Area [Image Obtained From 2004 Study]

5.4.4 *Terrestrial Floral Resource Findings*

Owing to the contrast in terrain, two main vegetation types were encountered. Inland, the vegetation of the Brazilletto mountain area assessed appeared to be consistent with that of a disturbed dry limestone forest. This transitioned sharply to that of a mixed coastal thicket and mangrove community along the coastal plain, where anthropogenic disturbance appeared greatest. Dividing these plant communities was a narrow corridor of residential settlements along the existing Salt River main road.

Site A – Coastal Floodplain:
This site was the most disturbed with human dwellings existing among the vegetation. The plant community present exhibited characteristic features similar to that of a thorn thicket. The flora consisted mainly of thorny leguminous phanerophytes such as Wild Poponax, Park Nut, *Haematoxylum campechianum* (Logwood), and *Caesalpinia vesicaria* (Indian Savin Tree). These provided a vegetation canopy with an average height of 3 – 6 m.

Sedges (*Cyperus sp*.), *Cynodon dactylon* (Bermuda Grass) and *Rhynchelytrum repens* (Natal Grass) dominated the ground layer which covered an area that appeared to be inundated during times of extreme rainfall or tidal activity. Also, the endemic, God Okra, was encountered here as a conspicuous epiphyte.

Site B – Coastal Fringe:
The original vegetation here was severely disturbed, some time before, to make way for an access road and railway line to the JAMALCO port. However, what exists on this coastal fringe is a disturbed mangrove woodland community associated with coastal strand vegetation. The Red Mangrove (*Rhizophora mangle*) dominates the vegetation (especially near the shoreline), followed by *Avicennia germinans* (Black Mangrove) and *Thespesia populnea* (Seaside Mahoe), further from sea. These constitute a vegetation canopy with an average height of 5 m. In the dry Salinas or salt flats, however, the herb, *Batis maritima* proliferates accompanied by *Sesuvium portulacastrum* (Seaside Purselane).

The substrate transitions from coralline rubble and sand mix, nearer to the JAMALCO port, to sand and then sand mixed with clay as one progresses further towards the mainland. As such, the occurrence of other land based species increases along this trend with the most obvious being the presence of trees such as, Logwood, *Laguncularia racemosa* (White Mangrove) and *Conocarpus erectus* (Button Mangrove) as well as herbs and grasses, namely, *Waltheria indica* (Raichie) and Bermuda Grass.

Of special note is the occurrence of a large area of destroyed mangrove vegetation just south of this fringe. This was possibly due to recent hurricane damage its effects on the environment

(**Plate 5-31**). Impacts to mangroves and possible mitigations are covered in Section 6: of this report. Overall there were 56 species encountered in Site A & B.

Plate 5-31: Destroyed mangrove stand (background)

Table 5-21: Plant species encountered in Sites A & B

Botanical Name	**Common Name**	**Special Note**	**Occurrence Ranking**	**Habit**
Hylocerus triangularis	God Okra	Endemic	R	Epiphytes
Cynodon dactylon	Bermuda Grass		A	Grasses
Rhynchelytrum repens	Natal Grass		O	
Sporobolus indicus	-		F	
Acalypha alopecuroidea	-		O	Herbs
Asclepias curassavica	Red Top		R	
Batis maritima	Jamaican Samphire		A	
Crotolaria verrucosa	Blue Rattleweed		F	
Emelia javanica	Cupid's Shaving Brush		F	
Heliotropium curassavicum	-		A	
Hiptis pectinata	Piaba		R	

Botanical Name	**Common Name**	**Special Note**	**Occurrence Ranking**	**Habit**
Leonotis nepetifolia	Christmas candlestick		O-F	
Mimosa pudica	Shame Weed		F	
Ruellia paiculata	-		O	
Scoparia dulcis	Sweet Broom		F	
Sesuvium portulacastrum	Seaside Purselane		A	
Sida acuta	Broomweed		F	
Sida sp.	-		A	
Stachytarpheta jamaicensis	Vervine		F	
Stemodia maritima	-		F	
Tridax procumbens	-		O	
Urena lobbata	Ballard Bush		F	
Alteranthera ficoidea	Crab Withe		F	Trailing, climbing & twining plants
Antigonon leptopus	Coralita		O	
Ipomoea pes-caprae ssp. brasiliensis	Beach Morning Glory		F	
Ipomoea sp.	-		R	
Merremia dissecta	Know You		R	
Cyperus sp.	-		O-F	Sedges
Eupatorium odoratum	Christmas Bush		O	Shrubs
Gossypium barbadense var. barbadense	Sea Island Cotton		R	
Jatropha gossypiifolia	Belly-ache Bush		F	
Malpighia glabra	Wild Cherry		O	
Nerium oleander	Oleander		R	
Opuntia cochenillifera	Smooth Pear		O	
Ricinus communis	Castor Oil Plant		F	
Stenocereus hystrix	Dildo Pear		O-F	
Waltheria indica	Raichie		F-A	Shrubby herb
Acacia macracantha	Park Nut		O	Trees
Acacia tortuosa	Wild Poponax		A	
Avicennia germinans	Black Mangrove		A	
Caesalpinia vesicaria	Indian Savin Tree		O	
Coccoloba uvifera	Sea Grape		O	
Cocos nucifera	Coconut		R	
Conocarpus erectus var. erectus	Button Mangrove		F	

Botanical Name	**Common Name**	**Special Note**	**Occurrence Ranking**	**Habit**
Conocarpus erectus var. sericeus	Button Mangrove (Silver)		O	
Crescentia cujete	Calabash Tree		R	
Guazuma ulmifolia	Bastard Cedar		R	
Haematoxylum campechianum	Logwood		O	
Laguncularia racemosa	White Mangrove		O	
Leucaena leucocephala	Lead Tree		F-A	
Rhizophora mangle	Red Mangrove		D	
Samanea saman	Guango		O	
Terminalia catappa	Almond		R	
Thespesia populnea	Seaside Mahoe		A	

5.4.5 *Faunal Resource Findings*

5.4.5.1 Avifauna

The mangroves had a large number of water birds, such as Herons, Egrets and Black Necks. However, no Tree Ducks and Rails were seen, which are common in the nearby Portland Bight area. Most of the mudflats in the area, where several shore birds usually forage, were flooded as a result of the high tide. Only a few coastal birds, such as the Brown Pelican and the Frigate Bird were seen. In addition, many of the water fowls are migratory including shore birds and ducks.

There were large numbers of migrant Warblers in the mangrove and acacia-cacti scrubland. Migrant Warblers are known to be frequent in acacia scrublands. Five endemic birds were seen in the area and none of the species were habitat specialist.

The Brazilletto Mountain had a large number of bird species, typical of a dry limestone forest, such as the Columbids, Parakeets, Hummingbirds, Jamaican Woodpeckers, migrant Warblers, Orioles and Vireos (Downer & Sutton 1990). However, migrant Warblers' numbers were greater in the Coastal area than in the dry limestone forest. Seven (7) endemic birds were seen in the Brazilletto Mountain. The bore holes of migrant Yellow Bellied Sapsucker was observed on a number of the trees in the forest.

It should be noted that birds are highly mobile and their habitat range is large. The overall construction will have minimal impact on the avifauna once best management practices and proper mitigative measures are carried out. The bird list below was compiled from the use of transects and point survey.

Table 5-22: Birds seen in the coastal area

Proper Name	Code Used	*Scientific Name*	Status	DAFOR
Black-necked Stilt	BNST	*Himantopus mexicanus*	R	D
Brown Pelican	BRPE	*Pelicanus occidentalis*	R	O
Cattle Egret	CAEG	*Bubulcus ibis*	R	D
Great Blue Heron	GBHE	*Ardea herodias*	R	R
Great Egret	GREG	*Casmerodius albus*	R / Mw	O
Little Blue Heron	LBHE	*Egretta caerulea*	R / Mw	R
Magnificent Frigatebird	MAFB	*Fregata magnificens*	R	R
Royal Tern	ROYT	*Sterna maxima*	R	R
Tricoloured Heron	TCHE	*Egretta tricolor*	R / Mw	A
Yellow-Crowned Night Heron	YCNH	*Nycticorax violaceus*	R	R
American Kestrel	MAKE	*Falco sparverius*	R	O
American Redstart	AMRE	*Setophaga ruticilla*	Mw	F
Bananaquit	BANA	*Coereba flaveola*	R	F
Black and White Warbler	BAWW	*Mniotilta varia*	Mw	****
Black-Throated Blue Warbler	BTBL	*Dendroica caerulescens*	Mw	****
Common Ground Dove	COGD	*Columbina passerina*	R	O
Common Yellow throat	COYT	*Geothlypis trichas*	Mw	R
Great Antillean Grackle	GRAG	*Quiscalus niger*	R	F
Jamaican Euphonia	**JAEU**	***Euphonia Jamaica****	**E**	**F**
Jamaican Mango Hummingbird	**JAMH**	***Anthracothorax mango****	**E**	**O**
Jamaican Vireo	**JAVI**	***Vireo modestus****	**E**	**O**
Loggerhead Kingbird	LOKI	*Tyrannus caudifasciatus*	R	F
Louisiana Waterthrush	LOWT	*Seiurus noveboracensis*	Mw	R
Mangrove Cuckoo	MACU	*Coccyzus minor*	R	R
Northern Mockingbird	NOMO	*Mimus polyglottos*	R	D
Northern Parula	NOPA	*Parula americana*	Mw	****
Oven bird	OVBI	*Seiurus aurocapillus*	Mw	****
Prairie Warbler	PRAW	*Dendroica discolor*	Mw	O
Sad Flycatcher	**SAFL**	***Myiarchus barbirostris****	**E**	**R**
Smooth-billed Ani	SMBA	*Crotophaga ani*	R	O
Turkey Vulture	TUVU	*Carthartes aura*	R	O
Vervain Hummingbird	VEHU	*Mellisuga minima*	R	O
White Crowned Pigeon	WCPI	*Columba leucocephala*	R	R
White-Collared Swift	WCSW	*Streptoprocene zonaris*	R	O
White-Winged Dove	WWDO	Zenaida asiatica	R	O
Yellow Warbler	YEWA	*Dendroica petechia*	R	A

Proper Name	**Code Used**	***Scientific Name***	**Status**	**DAFOR**
Yellow-faced Grassquit	YEFC	*Tiaris olivacea*	R	O

NB **** Birds which were not observed in during the line transect survey.
* Endemic birds are bold

Key:

E – Endemic,	E/sub – Endemic subspeciec	R – Resident	Mw – Winter Migrant	Ms – Summer Migrant

DAFOR scale used to categorize birds

	Total number of birds observed during the survey
D	≥ 20
A	15 – 19
F	10 – 14
O	5- 9
R	< 4

Table 5-23: Birds observed in the Brazilletto Mountain

Proper Name	**Code**	***Scientific Name***	**Status**	**DAFOR**
American Redstart	AMRE	*Setophaga ruticilla*	Mw	O
Bananaquit	BANA	*Coereba flaveola*	R	A
Black-Throated Blue Warbler	BTBL	*Dendroica caerulescens*	Mw	R
Black-Whiskered Vireo	BWVI	*Vireo altiloquus*	Mw	R
Caribbean Dove	CADO	*Leptotila jamaicensis*	R	R
Common Ground Dove	COGD	*Columbina passerina*	R	O
Common Yellow throat	COYT	*Geothlypis trichas*	Mw	R
Comon Barn Owl	CBOW	*Tyto alba*	R	****
Great Antillean Pewee	GAPE	*Contopus caribaeus*	R	R
Jamaica Tody	**JATO**	***Todus todus****	**E**	**R**
Jamaican Euphonia	**JAEU**	***Euphonia Jamaica****	**E**	**F**
Jamaican Mango Hummingbird	**JAMH**	***Anthracothorax mango****	**R**	**O**
Jamaican Vireo	**JAVI**	***Vireo modestus****	**R**	**F**
Jamaican Woodpecker	**JAWO**	***Melanerpes radiolatus****	**E**	**O**
Loggerhead Kingbird	LOKI	*Tyrannus caudifasciatus*	R	D
Northern Mockingbird	NOMO	*Mimus polyglottos*	R	F
Olive-throated Parakeet	**OTPA**	***Aratinga nana****	**E/ subs**	**O**
Palm Warbler	PAWA	*Dendroica palmarum*	Mw	O
Prairie Warbler	PRAW	*Dendroica discolor*	Mw	R
Red-Billed Streamertail	**RBST**	***Trochilus polytmus****	**E**	**O**
Sad Flycatcher	**SAFL**	***Myiarchus barbirostris****	**E**	**R**

Proper Name	Code	*Scientific Name*	Status	DAFOR
Smooth-billed Ani	SMBA	*Crotophaga ani*	R	O
Turkey Vulture	TUVU	*Carthartes aura*	R	O
Vervain Hummingbird	VEHU	*Mellisuga minima*	R	O
White Crowned Pigeon	WCPI	*Columba leucocephala*	R	O
White-Winged Dove	WWDO	*Zenaida asiatica*	R	R
Yellow Warbler	YEWA	*Dendroica petechia*	R	R
Yellow-bellied Sapsucker	YBSA	*Sphyrapicus varius*	Mw	****
Yellow-faced Grassquit	YEFC	*Tiaris olivacea*	R	F

Table 5-24: Tree species observed

Local name	*Scientific name*
Acacia	*Acacia sp.*
Black Mangrove	*Avicennia germinans*
Bull Hoof	*Bauhinia divaricata*
Candle wood	*Cassia grandis*
Crabwood	*Ateramnus lucidus*
Damson	*Simaruba sp*
Fig	*Ficus. Sp*
Guango	*Samanea saman*
Ironwood	
Lignum vitae	*Guaiacum officinale*
Panchallon	*Cordia gerascanthus*
Red Birch	*Bursera simaruba*
Red Mangrove	*Rhizophora mangle*
Silver Thatch	*Thrinax sp*
Sweet wood	*Octea sp*
White Mangrove	*Laguncularia racemosa*
Wild lime	*Adelia ricinella*
Wild Pimento	*Pimenta jamacensis*

5.4.5.2 Other Fauna

Insects are fairly well represented in the Portland Bight area, with butterflies and bees being the most obvious of the group. At least 5 different species of Lepidoptera (butterflies etc,) are known to exist in the area. More importantly is the ecological functions of these insects where they act as pollinators. Other insect's species included ants, beetles, stinkbugs, wasps and honeybees.

At least four species of the snake *Arrhyton* sp are known to exist in the Portland Bight area, three of which are endemic. The snakes feed on other reptiles and amphibians such as *Anolis* spp, *Eleutherodactylus* adults and eggs as well as *Sphaerodactylus* spp (Gecko). Of the *Sphaerodactylus* spp one, not endemic, has a range extending to the study area.

In addition, at least six *Anolis* spp are suspected to occupy the area. Of these six species at least five are endemics with one species thought to be extinct.

Portland Bight is thought to have at least 15 species of amphibians, thus the potential exist for occurrences in the study area, and of these fifteen species twelve are endemic. Furthermore, nine of those species are *Eleutherodactylus* spp (frogs).

Several local residents reported seeing conies in the foothills of the proposed path of the conveyer belt. This was not verified during sampling of the area, but is neither disputed because the environment is conducive to such animals. The coal burners also reported seeing yellow snakes and the Jamaican Brown Owl in the Brazilletto Mountains. The nature of the limestone hills lends itself to many crevices that could conceivably house organisms such as owls.

Only two species of reptiles were observed at the site, both are lizards and endemics, *Anolis grahami* and *Anolis lineatopus*. Both have wide distribution in Jamaica. Our largest reptile *Crocodylus acutus* has also been reported in the Portland Bight area but was not observed at or near the proposed site. Observations of the crocodile were done further east along the Tarentum to Bratts Hill road.

Only two species of butterflies were observed during site inspection, a common skipper, *Pyrgus* sp. and the West Indian Buckeye, *Precis evarete zonalis*. Other fauna observed were dragonflies, grasshoppers, snails, ants and flies. However, literature reviews indicated the likely occurrence of certain species of reptiles and amphibians generally within Portland Bight. Portland Bight is thought to have a distribution of seven families of butterflies, accounting for approximately 41 species, of which nine are endemic species or sub-species.

5.4.6 *Protected Area Status*

The proposed site is located within the Portland Bight area which is a designated protected area known as Portland Bight Wetlands and Cays. It is regulated through various instruments but primarily the NRCA Act of 1991 and RAMSAR, and is managed by the non-governmental organization, Caribbean Coastal Area Management (see **Plate 5-32** below).

It is not envisioned that this project will result in significant and irreversible negative impacts of the protected area. This will be discussed in detail in the Impact Identification and Mitigation sections of this report.

A comprehensive impact assessment was undertaken for actual footprint impacts on seagrass and mangroves (See Section 6 of this report). This section also provides specific mitigation measures for impacts to these resources.

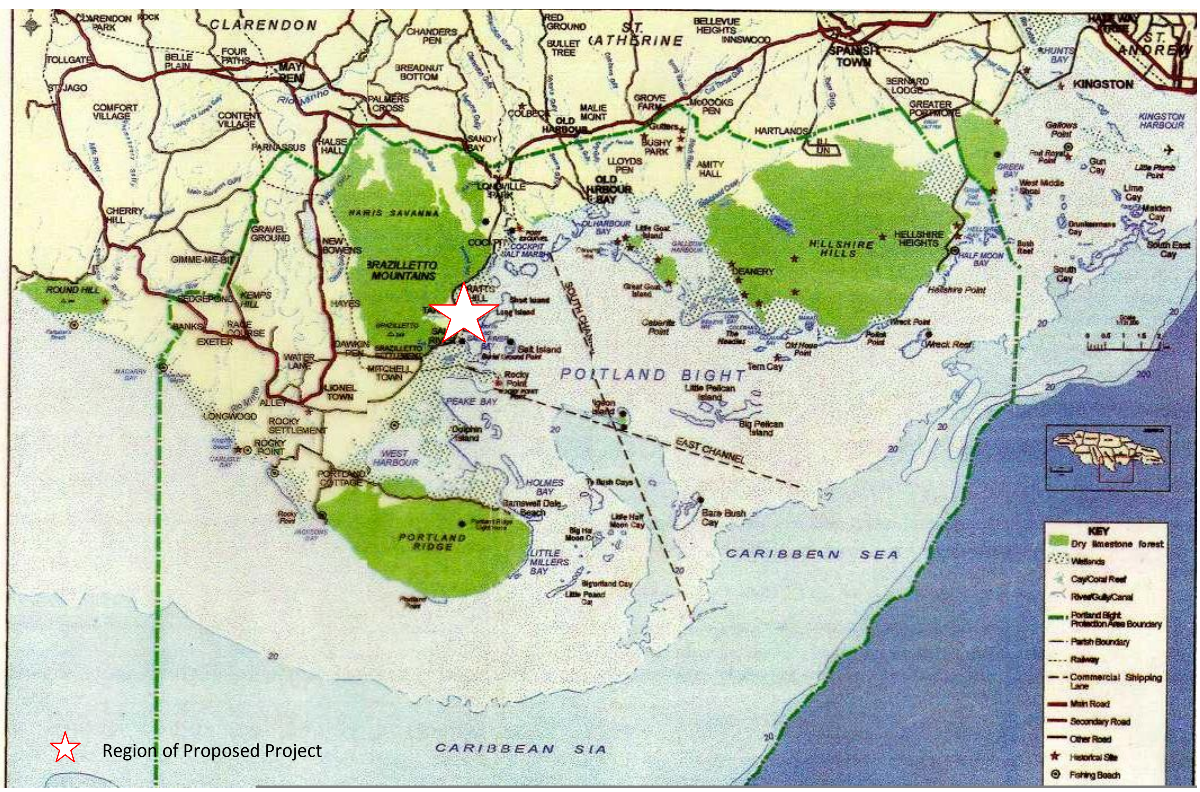


Plate 5-32: Portland Bight Protected Area (Source: www.portlandbight.com.jm)

5.4.7 *Implications for Future Development at the Site*

Any construction works within the study area will see minimal impact on marine resources determined to be at this location. More consideration should be given to the natural impacts (surge and waves from marine environment) as well as currents (marine and terrestrial) on any structures placed within the study area. Proper protective devices would be necessary and essential to the survival of any such structure. In addition, considerations would have to be given to the extent to which these structures would impinge on the movement of currents along the shoreline. Currents are known to transport sediments, which may be vital to the stability of any marine sediment bearing areas down current of any structure that may be deployed in its path.

Finally, careful consideration will have to be given to the impacts that any land-based development could have on the marine environment. Past experience has determined that development areas adjoining the coastline exert their influence on the marine environment by way of direct or indirect discharges of storm water, solid waste and sewage. Development plans for the project site will have to carefully define the ways in which these three elements will be controlled so that no net increases in the transmission of these elements to the marine environment is caused by the construction and operation of the development.

It is anticipated that the impacts that could occur during the course of the development will emanate from the following activities:

1. Dredging of the marine access channel to facilitate access to the development site
2. Disposal of dredged materials
3. Landfilling to facilitate the construction of support facilities for the development

All aspects of impact identification and mitigation for seagrass and mangrove areas are covered in Section 6 of this report.

There are possible sediment transport impacts that could occur due to the movement of particulates by currents. Marine resources existing south of the development site could be impacted by particulates falling out of turbid plumes transported during the night and early morning Marine resources existing within Colon Bay could be impacted by similar plumes being transported during the day.

The following considerations have also been taken:

- The Government Environmental Agency promotes a no-net loss policy where impacts on mangrove, seagrass and coral reef resources are concerned.
- The RAMSAR designation that exists within the Portland Bight area will certainly ensure that specific attention is placed on the protection of the wetlands to be impacted in the area.

It must be noted that an analysis of the 1991 aerial photographs of the area suggest that extensive dredging has been done within the Colon Bay area in the past (see reproduction of image in **Plate 5-33**).

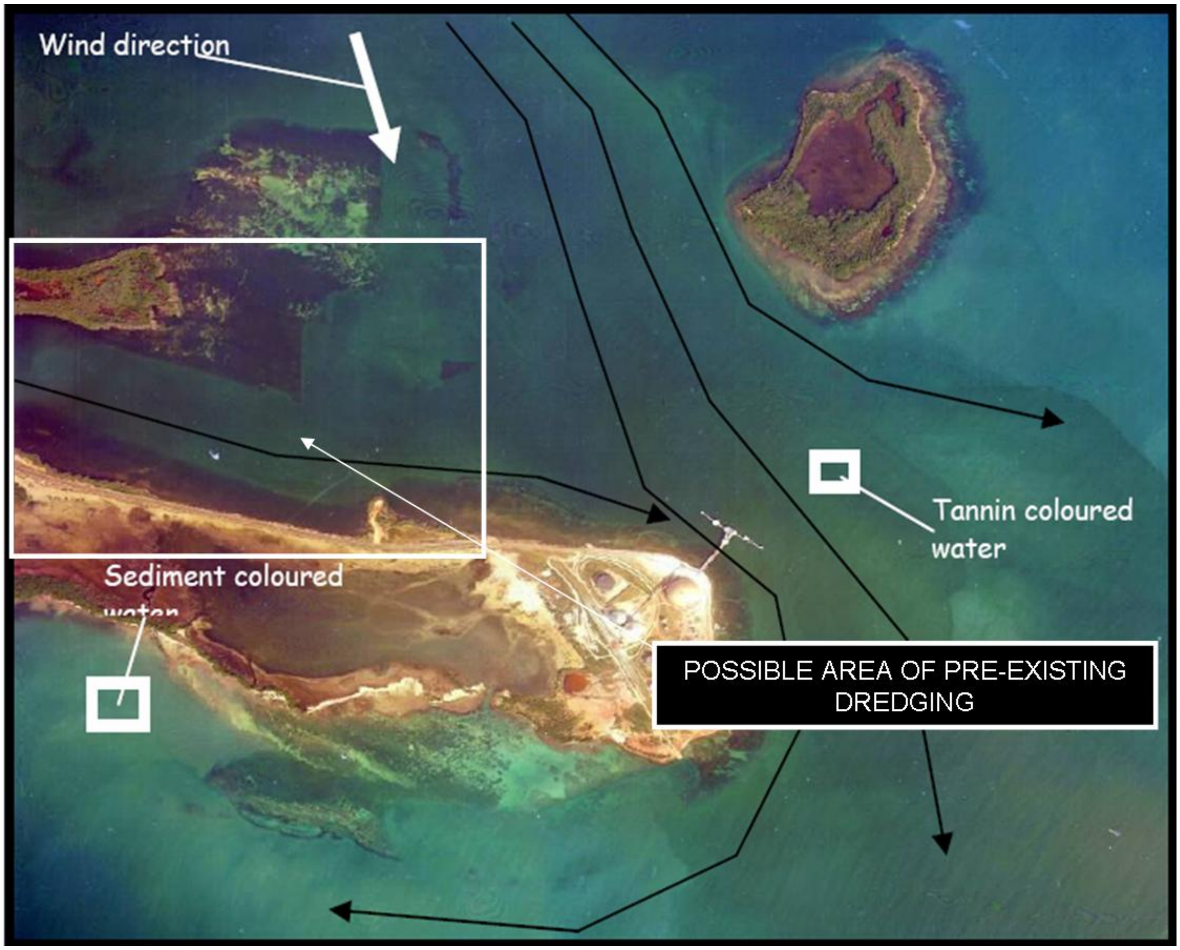


Plate 5-33: Suspected Dredge Cut Edges Predating 1991 Image Obtained From 2004 Study Mitigation Considerations.

SEAGRASS & MANGROVE SPECIFIC IMPACT ASSESSMENT & MITIGATIONS

6 Seagrass & Mangrove Specific Impact Assessment & Mitigations

6.1 Introduction

This plan is the second revision of the Mangrove and Seagrass Rehabilitation Plan and has been prepared based on additional field assessment and review of the project site. In addition, the layout of the proposed facility has been realigned to significantly reduce impacts to seagrass within the project area. An additional component has been added to this plan to revise the proposed seagrass and mangrove impact calculations. The primary purpose of this revised mangrove and seagrass rehabilitation plan is to address the concerns of the National Environment and Planning Agency (NEPA), as referenced in their letter dated October 29, 2008, regarding the proposed Rocky Point Project.

Secondarily, this plan also considers the review comments provided to NEPA by the Caribbean Coastal Area Management Foundation (C-CAM) (October 30, 2008) and discussions between NEPA and the project team during meetings held on November 17, 2008 and December 8, 2008. On behalf of the applicant (Rinker Jamaica Limited/CEMEX), WilsonMiller, Inc. (WM) in coordination with Conrad Douglas and Associates, Ltd. (CD&A) has developed the practicable mitigation alternatives presented herein to appropriately and sufficiently compensate for the estimated impacts to mangroves (5.59 ha) and seagrasses (1.19 ha) which are necessary to construct the proposed port facilities, reserve limestone stockpile area and conveyor corridor. It should be noted that this revised plan is the first step in the progression to implementing mangrove and seagrass restoration to compensate for the proposed impacts from development. However, the Applicant believes that the conceptual plan presented in this document demonstrates that adequate compensatory mitigation can be provided for the proposed impacts and the Applicant acknowledges that once the permit is received further detailed data collection, restoration design, and implementation will need to commence.

The Applicant welcomes and encourages NEPA and C-CAM to work cooperatively with them to implement the significant restoration plan that will not only compensate for the proposed impacts but will also provide a net ecological benefit to the Portland Bight Protection Area. Additionally, due to his recognized expertise in the field of ecological restoration and his relevant knowledge of local marine/estuarine habitats, Mr. Roy R. Lewis III of Lewis Environmental Services, Inc. (LES) has been retained as a member of the project team by WilsonMiller, Inc. to provide assistance in the development and review of the mitigation opportunities proposed by this plan.

As presented to NEPA during the meeting held at their offices on December 8, 2008, the Applicant has completed a thorough redesign of the proposed facility to minimize impacts to ecological communities. This was accomplished by moving the aggregate stockpile areas to existing uplands south of the mining site and designing the port facility to be located within deeper water to further reduce impacts to submerged aquatic resources. Please refer to Exhibits 1 and 2 which depict the overall site plan for the proposed aggregate transfer facility and the layout of the port facility.

6.2 Proposed Seagrass and Mangrove Impact Assessment

As necessitated by the re-alignment of the proposed facility and to more accurately calculate the proposed impacts to seagrass and mangroves within the project site a seagrass and mangrove impact assessment was completed. WilsonMiller and CD&A conducted field assessments of both resources and potential mitigation opportunities associated with the proposed project on January 6-8, 2009.

6.2.1 *Seagrass*

6.2.1.1 Seagrass Impact Assessment Methods

Due to the varying conditions observed during the site inspection and nature of the proposed impacts, two methodologies (Method A and B) were utilized to map the seagrass occurring within the project limits. Method A was utilized to map the seagrasses located west of the existing groin where the seagrass limits were more visually defined relative to depth. The landward-most limits of the seagrasses were digitized based on the clearly visible and well defined aerial signature identified along the coastline. Verification of this signature was accomplished by ground-truthing during the field observations. The waterward-most limits were mapped utilizing a Trimble™ ProXT DGPS unit. To attain the limits, divers marked the seagrass limits with buoys which were then located with the DGPS unit. From these points, a line was drawn between the collected points to create a polygon from which impacts can be calculated.

The limits of seagrasses north of the proposed impacts were mapped based on aerial photo-interpretation. Method B was utilized to assess the presence and quantify the coverage by seagrasses within the proposed project impact area associated with the port facility and dredge channel. The waterward-most limits of the seagrasses located eastward of the groin have been mapped based on aerial photo-interpretation; however, the limits of seagrasses in this area are not clearly definitive and therefore required a different method to quantify the coverage. To accomplish this, weighted buoys were placed at four locations approximately ten (10) meters outside of the limits of the proposed port facility. Five (5), 300-foot (approximately 91.44 meter) transects oriented north-south were marked along the southern line created by the southern-most two buoys. The 300-foot transects extended from the “buoy line” to beyond the limits of the seagrass.

Transects 1 and 2 were located west of the groin and Transects 3-5 were located east of the groin. Along each transect divers quantified seagrass coverage using ¼ meter quadrats centered on the transect at 10-foot intervals. This was accomplished by counting the number of individual 5 cm by 5 cm cells occupied by seagrass. In addition, the dominant seagrass species were identified and a Braun-Blanquet coverage abundance scale (shown below) was applied within each of the quadrats. The photograph below shows a quadrat positioned on the transect for assessment.

Braun-Blanquet Coverage Abundance Scale

- 0 = no coverage by seagrass
- R = solitary to few shoots with small cover
- 1 = numerous shoots but less than 5% cover
- 2 = any number of shoots but with 5-25% cover
- 3 = any number of shoots but with 25-50% cover
- 4 = any number of shoots but with 50-75% cover
- 5 = any number of shoots but with > 75% cover

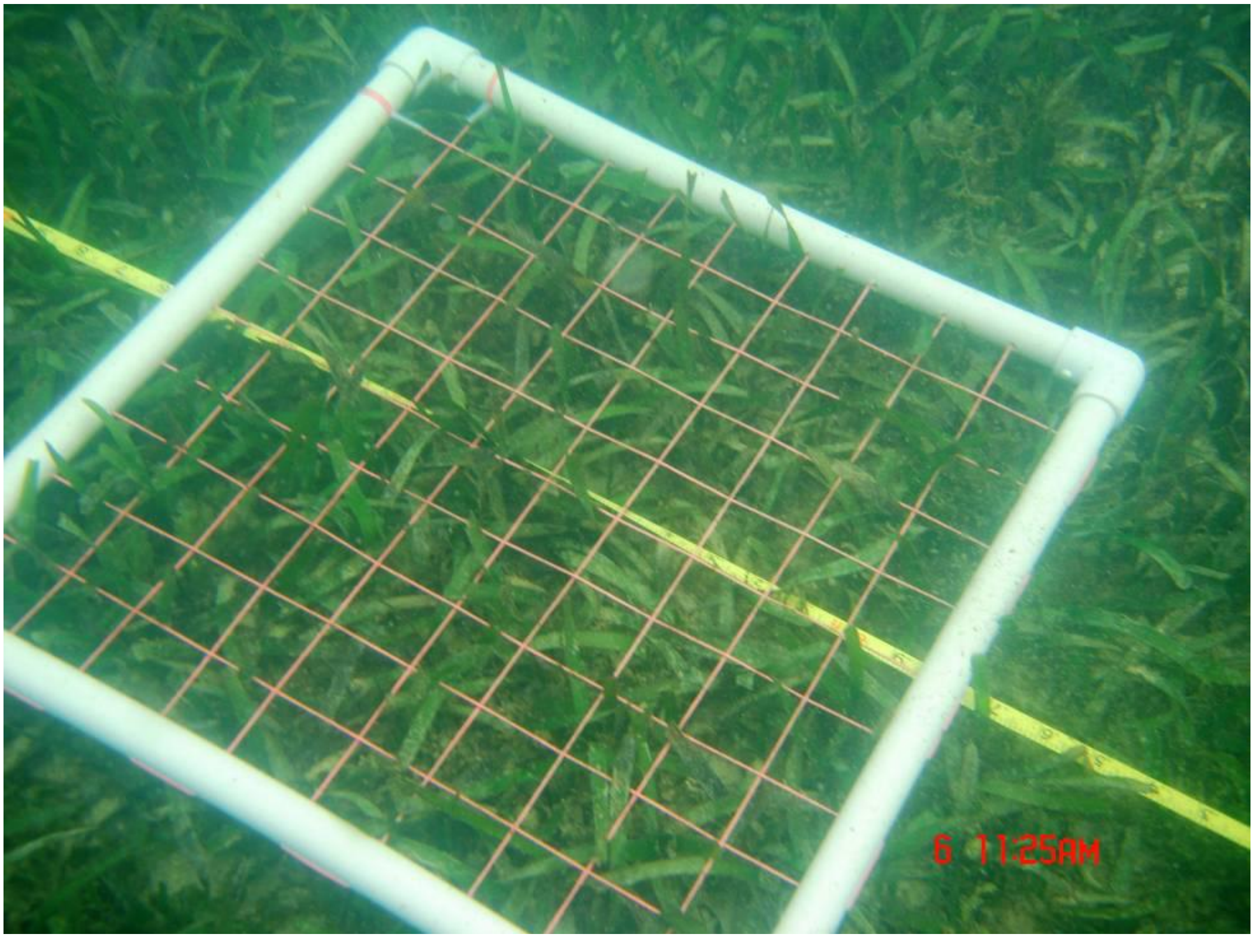


Plate 6-1: Seagrass Assessment Transect with ¼-Meter Square Quadrat

6.2.1.2 Seagrass Impact Assessment Findings

Based on the aerial interpretation and field data, the total area of seagrass located within the project site west of the groin and to the eastern tip of Burial Point is approximately 30 hectares. This area has a well-defined seaward limit that appears to be depth dependent. The depth limitation, approximately 4.5 meters to 6.0 meters (15 to 20 feet), is likely a result of the previous dredging of the area for fill material utilized for the construction of the JAMALCO facility. The seagrass within this area is dominated by turtlegrass (*Thalassia testudinum*) with scattered manatee grass (*Syringodium filiforme*) nearer the shore and shoalgrass (*Halodule wrightii*) at the highest elevations along the shoreline. Other submerged aquatic vegetative species observed (SAV) at lesser densities scattered within the subject area were the ephemeral species of seagrass paddle grass (*Halophila decipiens*) and rooted green algae (*Caulerpa sertularioides*). The Braun-Blanquet coverage abundance scores within this area appeared to transition with increasing water depth from five (5) to zero (0).

The photographs below show typical seagrasses mapped within this portion of the seagrass impact area.

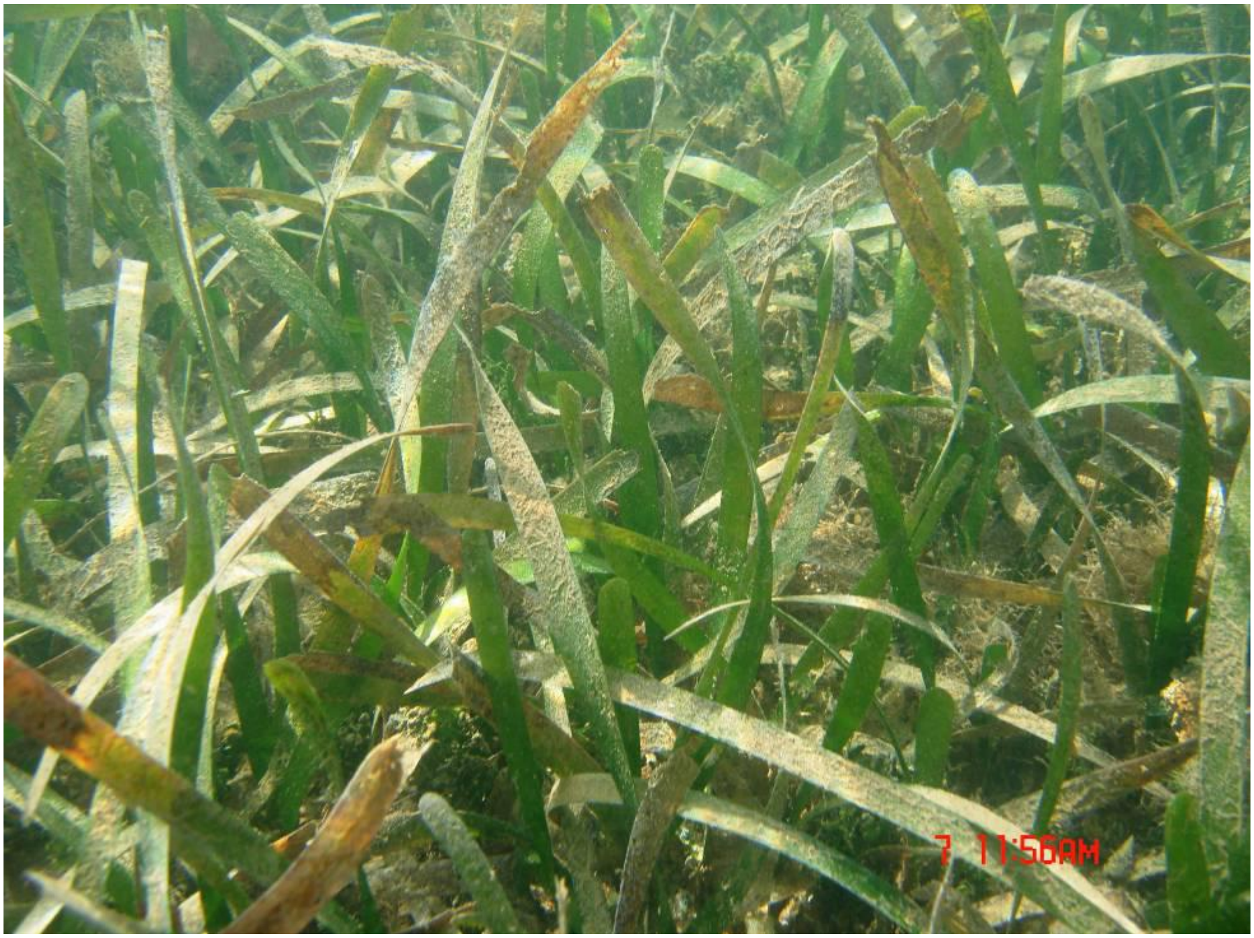


Plate 6-2: Near Shore Area of Dense Turtlegrass (*T. testudinum*)

Plate 6-3: Deeper Water Area of Less Dense Turtlegrass (*T. testudinum*)

Plate 6-4: Seaward Limits of Turtlegrass (*T. testudinum*)

Following the digitizing of the approximate seagrass limits west of the groin, a seagrass impact area was calculated for the proposed impact associated with the elevated piling supported conveyor corridor. The impacts to seagrasses are therefore limited to the minimal area necessary for the installation of the individual support pilings. A total of 36, 1 m (42 in.) diameter piles result in an estimated impact of approximately 0.0032 hectares. Shading impacts are not anticipated since the 5 m (16 ft.) wide conveyor will be elevated approximately 6 m (20 ft) above the water surface. A detail of the typical elevated conveyor is shown below (**Figure 6-1**).

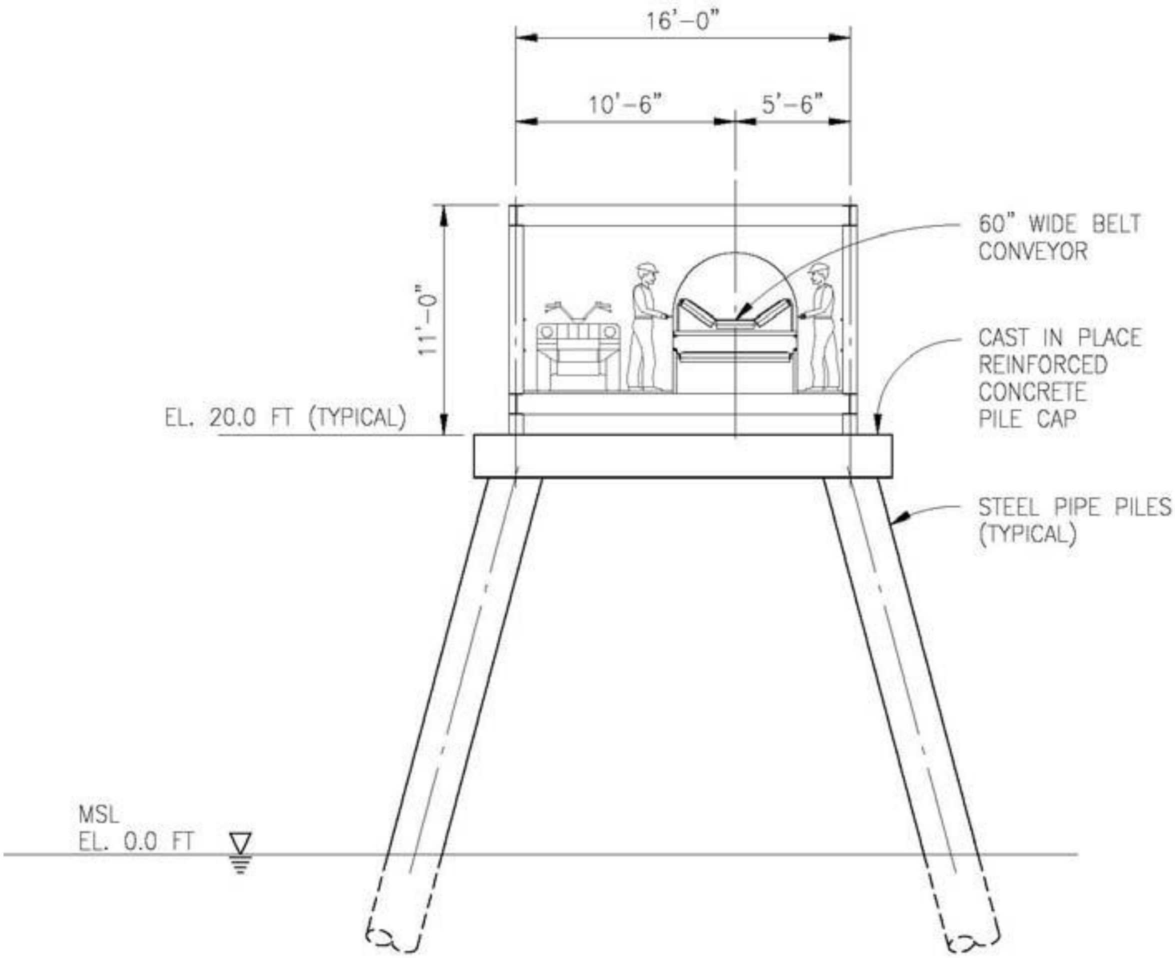


Figure 6-1: Typical Elevated Conveyor Detail

Based on initial field reconnaissance, the seagrass located within and adjacent to the proposed port facility at and east of the groin does not have a distinct visual limit. As a result, Method B (discussed above) was utilized to collect quadrat data along the transects (Transects 3-5 - **Table 6-1** below) beginning south of the proposed impact area and extending past the seaward limits of seagrass. Following a thorough field reconnaissance by ecologists from WilsonMiller and CDA of the subject area, the seaward limit of seagrasses was observed to be increasingly patchy and less defined in this region of the project site. The patchy distribution of seagrasses observed is likely attributable to the apparent variable depths and scouring due to the exposure to current velocities and excessive wave energy. Similar to the region of the project site west of the groin, the seagrasses in this area are dominated by dense shoalgrass and turtlegrass nearer to the shore line. Minimal paddle-grass (*Halophila decipiens*) was observed in deeper areas located near the groin where the seafloor appears disturbed (potential erosion from wave energy/current velocities associated with significant storm events) and other seagrass does not exist. The areas exhibiting coverage by paddle grass have a Braun-Blanquet score of "R" indicating the low density distribution of this species within the subject site. The photographs below are representative of this area.

Plate 6-5: Near Shore Area of Dense Turtlegrass (*T. testudinum*)

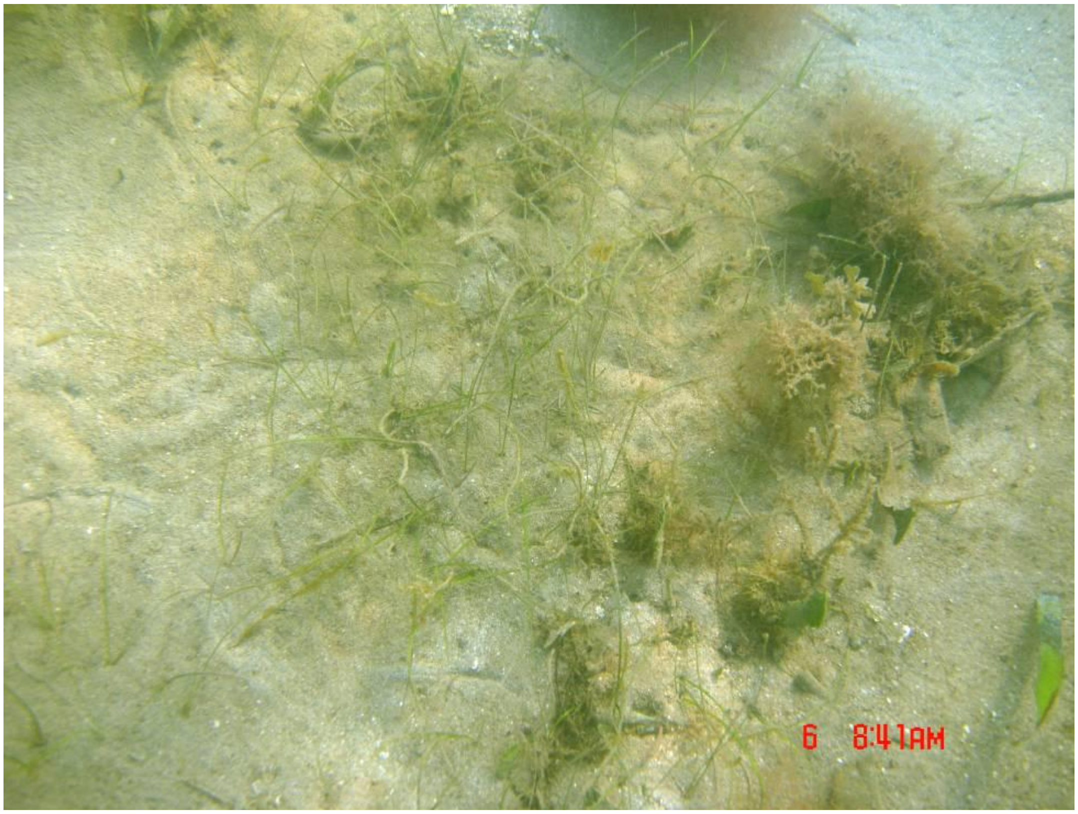


Plate 6-6: Low Density Near-Shore Area of Shoalgrass (*H. wrightii*)

Plate 6-7: Low Density Loosely-Scattered Paddle Grass (*H. decipiens*)

To calculate the seagrass impact area associated with the proposed port facility at the groin, the collected quadrat data (**Table 6-1**) was utilized to calculate a percent coverage within the area of the proposed impact that contain seagrasses. Utilizing the data collected for Transects 3-5, the percent coverage (87.13%) was then applied to the impact area to calculate the areal coverage of seagrasses. The proposed seagrass impact east of the proposed port facility is approximately 1.07 hectares based on measured and calculated 87.13 percent coverage of seagrasses within the 1.23 hectares. The proposed seagrass impact west of the proposed port facility is approximately 0.12 hectares based on 100 percent coverage of seagrasses. The proposed seagrass impact from the piles associated with the elevated conveyor is approximately 0.003 hectares based on 100 percent cover of seagrass. The total seagrass impact, as shown on **Plate 6-8** and **Plate 6-9**, resulting from the construction of the proposed conveyor and port facility is approximately 1.19 hectares. Therefore, the proposed seagrass impact is less than approximately five (5) percent of the total seagrass mapped within the project limits.

Table 6-1: Rocky Point Seagrass Impact Area Analysis Transect Data

Transect ID	Point Distance (Linear Feet)	Data Point Number	Braun-Blanquet Scale	Areal Coverage (%)	Seagrass Species Present
T3	0	1	5	100	*T. testudinum*
T3	10	2	5	100	*T. testudinum*
T3	20	3	5	100	*T. testudinum*
T3	30	4	5	100	*T. testudinum*
T3	40	5	5	100	*T. testudinum*
T3	50	6	5	100	*T. testudinum*
T3	60	7	5	100	*T. testudinum*
T3	70	8	5	100	*T. testudinum*
T3	80	9	5	100	*T. testudinum*
T3	90	10	5	100	*T. testudinum*
T3	100	11	5	100	*T. testudinum*
T3	110	12	5	100	*T. testudinum*
T3	120	13	5	100	*T. testudinum*
T3	130	14	5	100	*T. testudinum*
T3	140	15	5	100	*T. testudinum*
T3	150	16	95	100	*T. testudinum*
T3	160	17	5	100	*T. testudinum*
T3	170	18	5	100	*T. testudinum*
T3	180	19	5	100	*T. testudinum*
T3	190	20	0	0	
T3	200	21	0	0	
T3	210	22	5	95	*T. testudinum*
T3	220	23	5	100	*T. testudinum*
T3	230	24	5	100	*T. testudinum*
T3	240	25	5	100	*T. testudinum*
T3	250	26	5	100	*T. testudinum*
T3	260	27	5	100	*T. testudinum*

Transect ID	Point Distance (Linear Feet)	Data Point Number	Braun-Blanquet Scale	Areal Coverage (%)	Seagrass Species Present
T3	270	28	5	90	*T. testudinum*
T3	280	29	1	12	*T. testudinum*
T3	290	30	0	--*	
T3	300	31	0	--*	
T4	0	1	5	100	*T. testudinum*
T4	10	2	5	100	*T. testudinum*
T4	20	3	5	100	*T. testudinum*
T4	30	4	5	100	*T. testudinum*
T4	40	5	5	100	*T. testudinum*
T4	50	6	5	98	*T. testudinum*
T4	60	7	5	100	*T. testudinum*
T4	70	8	5	100	*T. testudinum*
T4	80	9	5	100	*T. testudinum*
T4	90	10	5	100	*T. testudinum*
T4	100	11	5	100	*T. testudinum*
T4	110	12	5	100	*T. testudinum*
T4	120	13	5	98	*T. testudinum*
T4	130	14	5	100	*T. testudinum*
T4	140	15	5	100	*T. testudinum*
T4	150	16	5	100	*T. testudinum*
T4	160	17	5	94	*T. testudinum*
T4	170	18	5	100	*T. testudinum*
T4	180	19	5	100	*T. testudinum*
T4	190	20	5	100	*T. testudinum*
T4	200	21	5	100	*T. testudinum*
T4	210	22	5	98	*T. testudinum*
T4	220	23	3	60	*T. testudinum*
T4	230	24	4	90	*T. testudinum*
T4	240	25	4	81	*T. testudinum*
T4	250	26	2	18	*T. testudinum*
T4	260	27	3	42	*T. testudinum*
T4	270	28	R	4	*T. testudinum*
T4	280	29	R	5	*T. testudinum*
T4	290	30	R	7	*T. testudinum*
T4	300	31	0	--*	
T5	0	1	5	100	*T. testudinum*
T5	10	2	5	100	*T. testudinum*
T5	20	3	5	100	*T. testudinum*
T5	30	4	5	100	*T. testudinum*
T5	40	5	5	100	*T. testudinum*
T5	50	6	5	100	*T. testudinum*
T5	60	7	5	80	*T. testudinum*
T5	70	8	5	100	*T. testudinum*
T5	80	9	5	100	*T. testudinum*
T5	90	10	5	98	*T. testudinum*
T5	100	11	5	98	*T. testudinum*

Transect ID	Point Distance (Linear Feet)	Data Point Number	Braun-Blanquet Scale	Areal Coverage (%)	Seagrass Species Present
T5	110	12	5	98	*T. testudinum*
T5	120	13	5	98	*T. testudinum*
T5	130	14	5	98	*T. testudinum*
T5	140	15	5	99	*T. testudinum*
T5	150	16	4	70	*T. testudinum*
T5	160	17	5	100	*T. testudinum*
T5	170	18	5	98	*T. testudinum*
T5	180	19	5	98	*T. testudinum*
T5	190	20	5	87	*T. testudinum*
T5	200	21	5	100	*T. testudinum*
T5	210	22	5	100	*T. testudinum*
T5	220	23	4	80	*T. testudinum*
T5	230	24	5	97	*T. testudinum*
T5	240	25	5	96	*T. testudinum*
T5	250	26	5	100	*T. testudinum*
T5	260	27	4	77	*T. testudinum*
T5	270	28	5	87	*T. testudinum*
T5	280	29	3	60	*T. testudinum*
T5	290	30	2	15	*T. testudinum*
T5	300	31	2	16	*T. testudinum*

Transects 3-5 Percentage Cover 87.13

**** Quadrat locations beyond the limits of seagrasses, data were not utilized to calculate percent cover.***

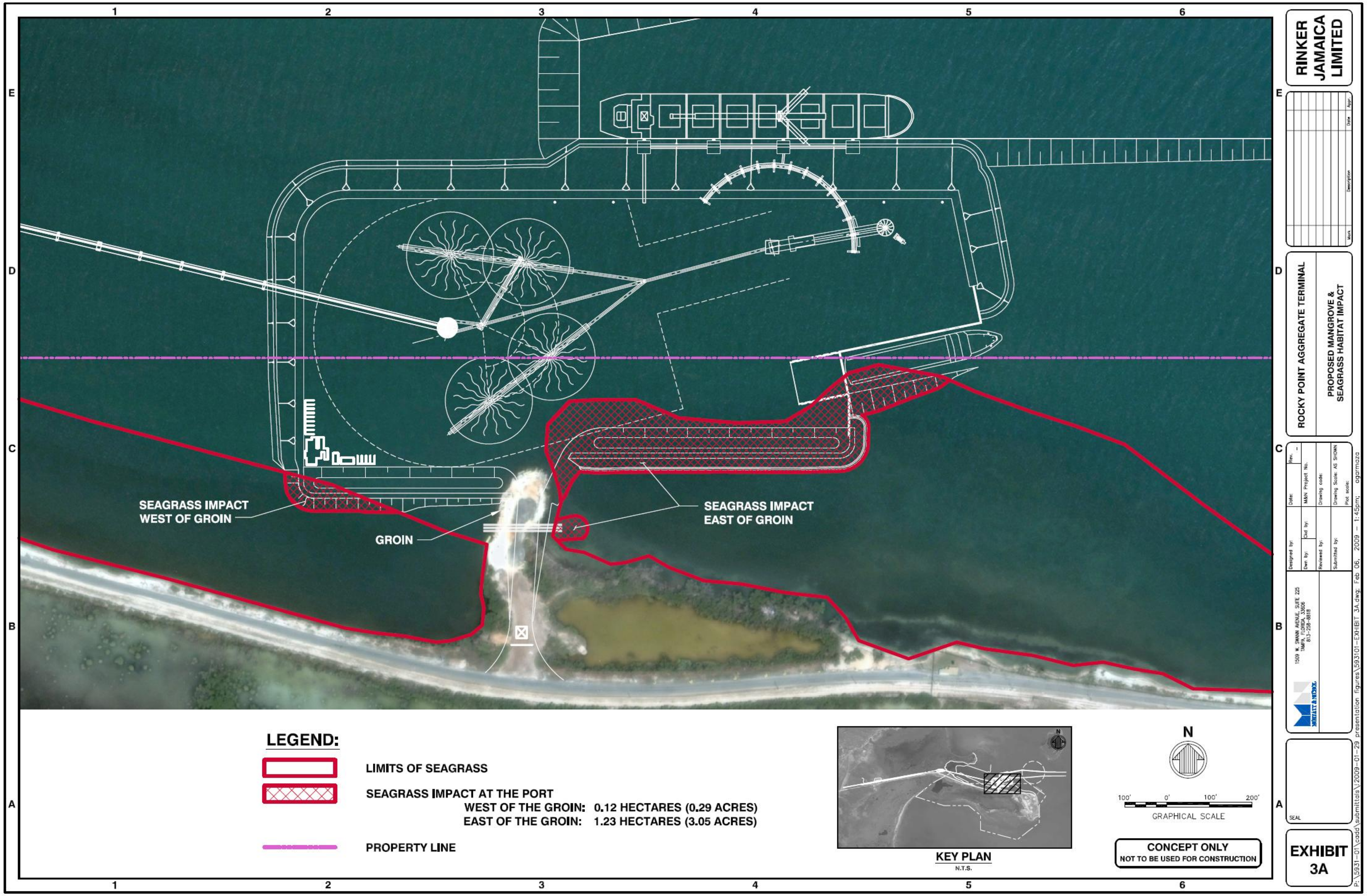


Plate 6-8: Total Seagrass Impact – Immediate Vicinity of Proposed Port

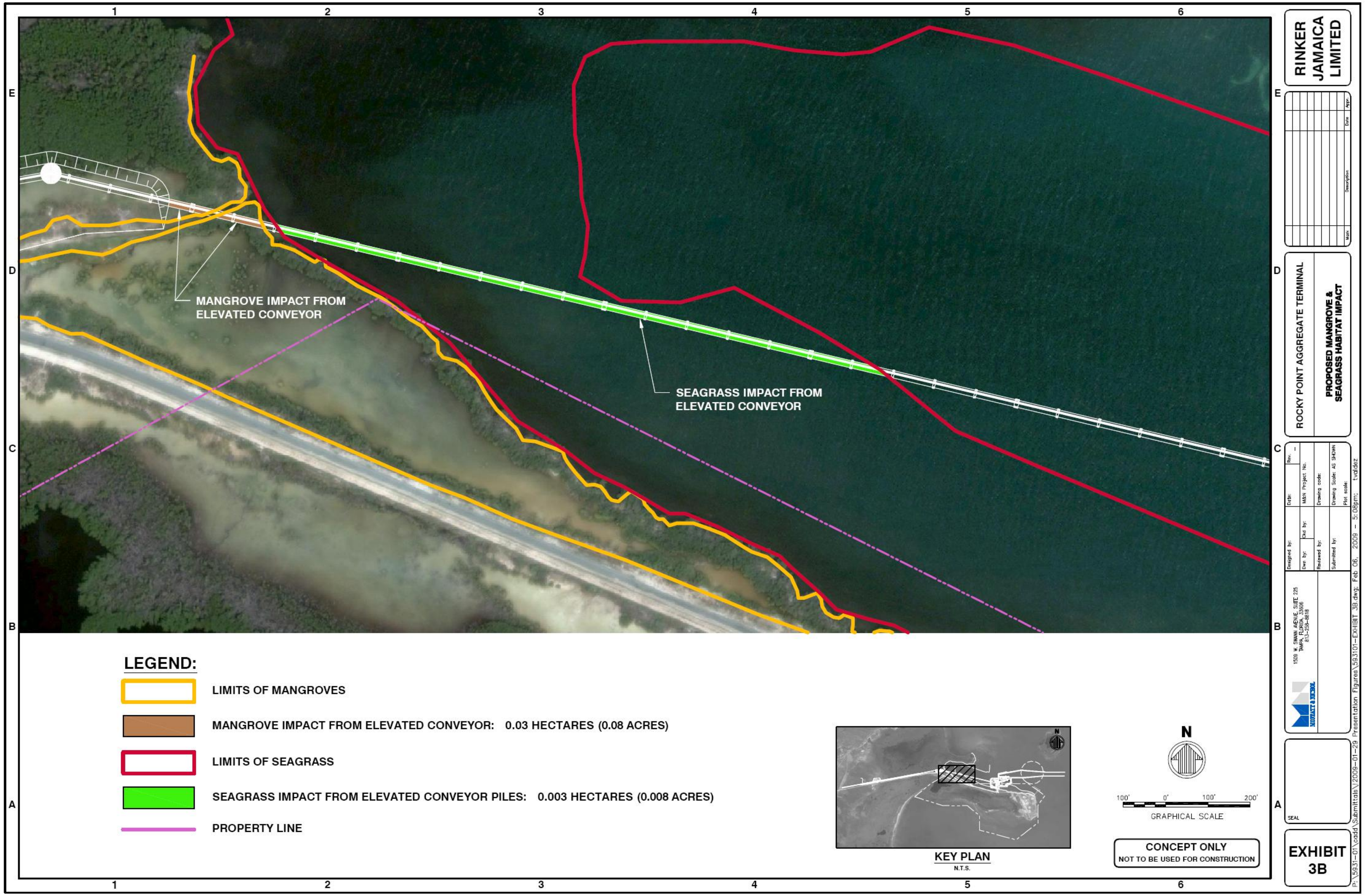


Plate 6-9: Total Seagrass Impact – Conveyor Corridor adjacent Proposed Port

6.2.2 *Mangrove*

6.2.2.1 Mangrove Impact Assessment Methods

Mangrove areas were mapped and characterized by traversing the proposed route of the conveyor and noting the presence and coverage by mangroves and/or other dominant vegetation as well as hydrology. In addition, digital photographs were taken at several photo points along the proposed conveyor route. Based on the field survey of the conveyor route and the aerial interpretation/verification of the habitat signatures, polygons depicting the limits of mangroves, Salinas and tidal flat areas were digitized.

6.2.2.2 Mangrove Impact Assessment Results

Plate 6-10 shows the mangrove, open tidal flats, and salt flats or Salina areas present within the vicinity of and adjacent to the proposed project impacts based on the field review and aerial interpretation. The western edge of the mangrove limit is located at the terminus of the mangrove system and the beginning of uplands dominated by acacia (*Acacia tortuosa and A. macracantha*) trees. A fringe of mixed herbaceous vegetation occurs along the northern edge of the causeway with frequent occurrence of acacia trees and buttonwood (*Conocarpus erectus*). Along a portion of the conveyor route a linear strip of open areas characterized as tidal and salt flats or Salinas occurs.

These open areas are situated to the north of the roadside vegetation and south of the dense mangrove fringe dominated by red mangrove (*Rhizophora mangle*). Some of the areas are likely remnants of impacts resulting from the construction of the causeway as identified on the March 3, 1968 historical aerial photograph (see **Appendix VIII**). The deeper tidal flats situated at the eastern limits of the overland conveyor route also have scattered patches of shoalgrass (*H. wrightii*). However, due to the limited tidal regime within these areas the shoalgrass exhibited relatively short blade lengths and low shortshoot densities. Photos from stations 1 (**Plate 6-11**) and 2 (**Plate 6-13**) below are representative of these habitats. Please refer to **Plate 6-10** below showing the location of the photo stations referenced by the photographs below. The remaining overland portion of the conveyor route is characterized by red mangroves located in the areas of regular tidal flushing, black mangroves (*Avicennia germinans*) in areas subject to tidal inundation at high tide, white mangroves (*Laguncularia racemosa*) at the upper limit of high tides, and buttonwoods at the highest elevations adjacent to the roadway, as visible at photo stations 3 (**Plate 6-14**) and 4 (**Plate 6-15**) below. The representative photo from station 5 (**Plate 6-16**) below shows the characteristic Salina habitat to be impacted.

Plate 6-10: Representative Photographic Stations for Mangrove Impact Zone

Plate 6-11: Photo Station 1: Shallow Tidal Flat Area (View Orientation – West)

Plate 6-12: Photo Station 1: Shallow Tidal Flat Area (Shoalgrass)

Plate 6-13: Photo Station 2: Mangrove/Tidal Flat Area (View Orientation – East)

Plate 6-14: Photo Station 3: Mangrove/Tidal Flat Area (View Orientation – East)

Plate 6-15: Photo Station 4: Mangrove Area (View Orientation – West)

Plate 6-16: Photo Station 5: Salt Flat or Salina Area (View Orientation – West)

The impacts to mangroves are associated with the construction of the aggregate transfer conveyor from the inland stockpile to the ship-loading facility. As shown on **Plate 6-8** and **Plate 6-9** above and **Plate 6-17** below, there are three separate Impact Areas (identified as numbers 1, 2, and 3) associated with the conveyor where it will impact the mangroves/tidal flats/Salina. Impact Area 1 is the portion of the proposed conveyor from the beginning of mangroves to the west up to the point where the conveyor is elevated on piles. In this area the conveyor is placed on fill to the approximate elevation of +10 feet. The applicant would have preferred to locate the proposed conveyor in this area immediately north of the existing causeway; however, Jamaica Public Service (JPS) is requiring the applicant to maintain a 15-meter setback from the existing utility corridor (power transmission line). The area between the conveyor and the utility corridor will be utilized for stormwater retention and will be at least minimally impacted during the construction of the conveyor. Therefore, approximately 2.13 hectares of mangrove/tidal flat/Salina impacts are associated with the fill area and approximately 2.24 hectares of the impacts are associated with the stormwater retention area within Impact Area 1. Impact Area 2 consists of the fill island created for the conveyor transfer facility. Approximately 0.95 hectares of impact are associated with Impact Area 2.

Please note that the transfer island has been located to take advantage, to the greatest extent possible, of the existing impacted area from the trail road. Impact Area 3 is the elevated portion of the conveyor which will be supported by piles at a minimum of +12 feet and will have minimal impact on the habitats located beneath. However, mitigation will be proposed for all of the approximately 0.27 hectares of mangrove/tidal flat impacts that are associated with the elevated conveyor east and west of the transfer facility. The total proposed permanent impact to mangroves/tidal flats/Salinas is approximately 5.59 hectares. As apparent from the exhibits and considering the previously proposed site layouts, the applicant has taken multiple practicable steps to minimize impacts to the greatest extent considering the added constraint associated with the utility pole setback.

Temporary impacts to mangroves/tidal flats may occur as a result of the construction of the overland conveyor. These areas are not quantified in the impact areas as the extent of these impacts will be determined at the time of construction based on construction methods and site conditions. Any areas temporarily impacted by construction will be regarded to the original grade and, in areas where significant mangroves are disturbed; mangroves will be replanted to supplement natural regeneration.

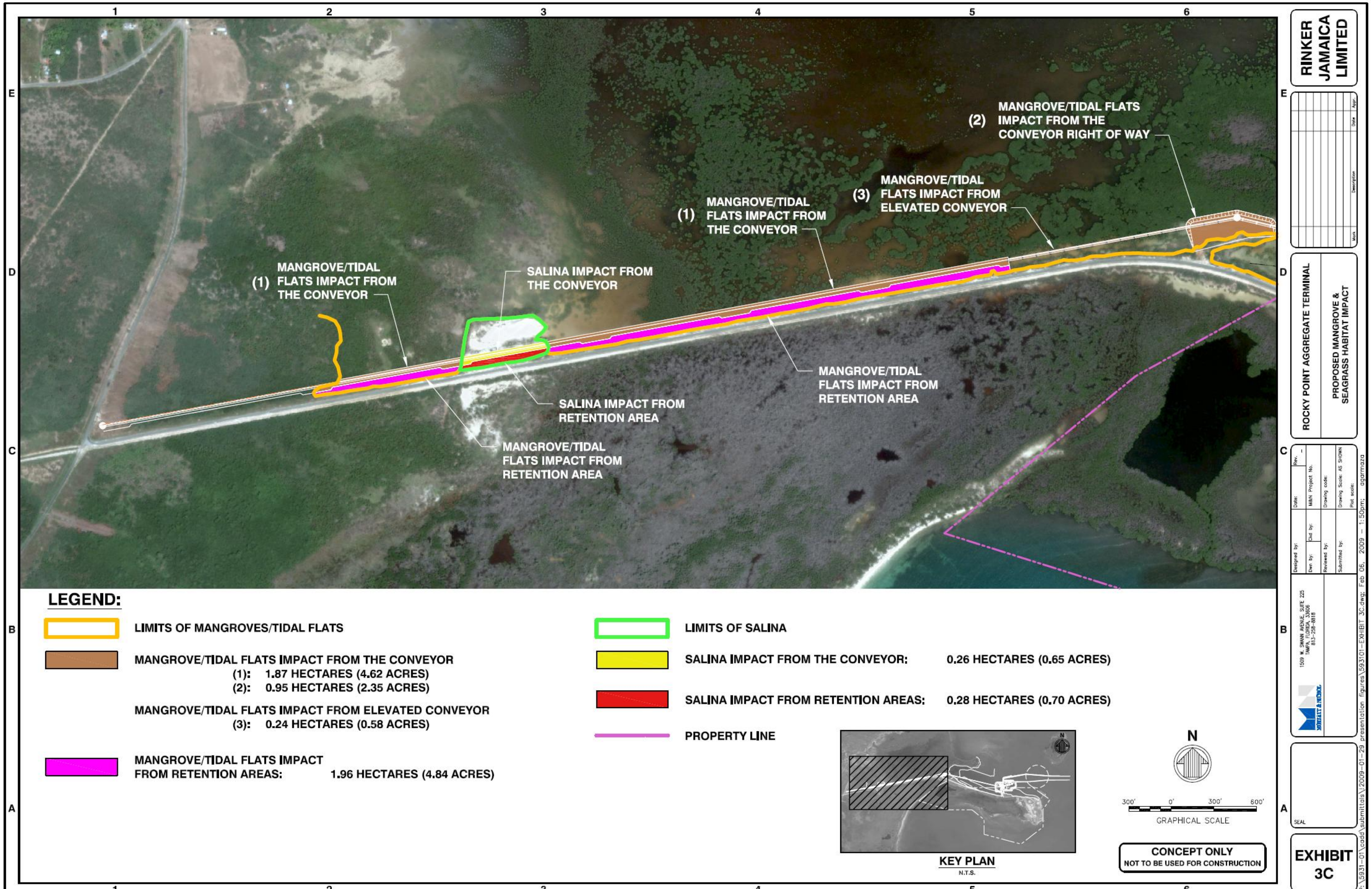


Plate 6-17: Total Mangrove Impact – Conveyor Corridor adjacent Peninsula Road west of Proposed Port

6.3 Proposed Seagrass and Mangrove Compensatory Mitigation Options

The previously submitted Revised Mangrove and Seagrass Rehabilitation Plan (dated November 12, 2008) contained descriptions and potential restoration options for mangrove and seagrass mitigation. Five (5) mangrove restoration areas (Areas B, C, E, F, and G), labelled on **Plate 6-10** above, were presented as possible areas which could be evaluated for mangrove restoration. One (1) primary seagrass mitigation (Area I) was identified for seagrass restoration and four (4) secondary seagrass mitigation areas were identified (Areas C, D, E, and F). To facilitate the preparation of this revised plan, ecologists from WilsonMiller and Conrad Douglas and Associates completed a field review (January 6 – 8, 2009) of the previously identified mitigation areas and additional mitigation areas identified in the field. The goal of this field review was to gather qualitative data to further refine and/or eliminate previously proposed mitigation areas with the goal of identifying feasible mitigation options and restoration methods.

The following paragraph summarizes the reasons why some of the previously proposed mitigative options are no longer considered viable options based on the data gathered during the January 6th through 8th field reviews. Area C, which was identified as a possible mangrove or seagrass mitigation area, currently supports a tidal flat with scattered mangroves. Therefore, there is no mitigative credit to be gained by completing restoration activities in this area as it is currently a functioning habitat. Area F, which was previously identified as a potential mangrove or seagrass mitigation area, is an unvegetated flat that appears to occur at an elevation prohibiting regular tidal inundation. However, mechanical grading and/or excavating of meandering channels could be performed to facilitate/improve tidal flushing with the lagoon to the west thus encouraging mangrove recruitment and establishment. We do not believe that this is a preferred restoration option and will only be explored further if additional mangrove mitigation is required in excess of the preferred options detailed below. Area G, which was previously identified as a potential mangrove mitigation area, is a largely unvegetated area that has been disturbed by activities related to the JAMALCO facility.

Based on visual inspection of this area it appears that this area was bermed and used for water/wastewater storage. Additionally, this area exhibits signs that bauxite or similar residue is accumulated within the upper sediments rendering this area not suitable for connection to adjacent waters. Area H, which was previously identified as potential seagrass mitigation area, will be partially impacted by the construction of the proposed port facility. It was surmised in the previous plan that this area contained patchy distribution of seagrasses as result of either natural or man-induced activities.

Following the site inspection of this area, the apparent patchy seagrass distribution was confirmed and is likely attributable to excessive wave energy and varying bathymetry. Therefore, due to the extreme measures that would be necessary to reduce wave energy, Area H is no longer considered a feasible/preferable mitigation option for the restoration of seagrasses. Area I, which was previously identified as a potential seagrass mitigation area, was also investigated during the recent field review. The previous plans suggested that this area contained "blow-holes" that were a product of scouring from wave energy (storm events) and also caused by coalesced prop scarring. While the field review appeared to corroborate these findings, the continued exposure to wave energy, particularly during storm events, would substantially increase the risk of potential failure of any seagrass restoration efforts.

The mangrove and seagrass restoration options proposed herein form a conceptual mitigation plan that will provide sufficient compensation to offset the loss of 5.59 hectares of proposed mangrove habitat impacts and 1.19 hectares of proposed seagrass habitat impacts. Although it is acknowledged that this plan is conceptual, it has been developed utilizing qualitative and quantitative assessments of the on-site habitats in conjunction with well documented principles and methods of successful seagrass meadow, mangrove forest and coral reef ecological restoration (Bosire et al. 2008; Clark 2002; Erftemeijer and Lewis 2000; 2006; Fonseca et al. 1998; 2002; Lewis 1982; 1987; 1990a: 1990b; 1994; 2000; 2005; Lewis et al. 1994; 1998; 2005; 2006; Lewis and Gilmore 2007; Treat and Lewis 2006, Turner and Lewis 1998). As the plan is conceptual, additional quantitative data will need to be gathered prior to the actual construction design. The conclusions drawn from the on-site analyses and imagery review performed demonstrate that a sufficient quantity of appropriate mangrove and seagrass mitigation potential is available. Additionally, this plan represents a collaborative effort between CDA, WM, and LES to determine the most appropriate and feasible approaches to compensatory mitigation by employing successfully documented ecological restoration techniques and principles. The necessary data to be collected and reviewed prior to final design may likely include detailed location specific bathymetry/topography, tidal data, and current field conditions assessed immediately prior to final design and implementation. Once the necessary information is collected, the final restoration design specifications will be determined to provide the required 130 percent of mangrove and seagrass mitigation. Note as these mitigation options have been conceptualized based on limited topographical/bathymetrical datum, the design specific details such as the locations, sizes, depths, orientation, and/or number of any hydrologic connections (ditches, channels, or flow-ways) or planting areas will be provided immediately prior to implementation.

6.3.1 *Proposed Seagrass Mitigation Options*

As mitigation for the excavation or fill of 1.19 hectares of seagrass habitat, NEPA has noted that the previously submitted CD&A methodology, which proposed not to transplant any of the seagrasses to be impacted, but attempting instead to repair "blowouts" in an existing area of seagrasses (15 ha) situated north of the Rocky Point and just northeast of Burial Ground Point was not an appropriate approach for mitigation.

The methodology for seagrass restoration that was initially proposed by CD&A is a method for repair of man-made prop scars in seagrass beds using carbonate gravel that did not work (Kruer 2001). Kruer (2001) experimentally filled a 231 m^2 prop scar in the Florida Keys, USA, with 1" to 1.25 " (2.5 – 3.1 cm) carbonate rock in July and August of 1999, and monitoring was undertaken. No planting of seagrass occurred as part of that project. The work of Kruer (2001) did not show any recovery within the filled prop scar through one year of monitoring. Dr. Penny Hall (Florida Wildlife Research Institute, personal communication, September 30, 2004) indicates that no success was observed during subsequent years of monitoring, and that this site has now been overlain with sediment tubes filled with finer grained carbonate sand material (0.002" – 0.033 ", 0.005 – 0.084 cm) than the original carbonate rock fill. Anecdotally, greater success with both planting and volunteer colonization by shoal grass only has been observed, as no written report is yet available on this effort.

Since the original paper by Zieman (1976) on motor boat damage to turtle grass meadows there has been little actual published work on the issue of repair to man-made damage to seagrasses and any form of successful seagrass mitigation. Lewis et al. (1994) describe one of the few successful efforts at seagrass mitigation with 54.33 ha of successful restoration as part of a program to mitigate for 37.79 ha of impact to seagrasses during the replacement of 37 bridges in the Florida Keys. Thus the mitigation program resulted in a net of 16.54 ha of restored seagrass. This is more than that needed for no-net-loss to occur. Lewis et al. (1994) also demonstrated for the first time the successful transplanting by plugs of turtle grass and manatee grass (*Syringodium filiforme*). Durako et al. (1992) reported on the differential rates of recovery of shoal grass versus turtle grass in intentionally made prop-scars, but no actual restoration was attempted. Kenworthy et al (2000) reported that undisturbed prop-scars in turtlegrass beds would take 6.9 years for the damaged areas to fully recover.

This slow recovery of turtlegrass meadows when scarred, the potential for erosion within a prop-scars, and the potential loss of larger areas of seagrass with boat groundings or repeated damage from both man-made and natural events (i.e., hurricanes) has led to efforts to restore damaged seagrass areas, and development of management techniques to prevent further damage such as the placement of additional navigational channel markers and informational markers (Fonseca et al. 1998; 2002; Lewis et al. 2006).

The bottom line is that successful seagrass mitigation is possible, but more failures than successes have occurred. The key to success is: (1) to choose a site for restoration, or for receipt of transplanted seagrass, for which you have a good site history; (2) know for sure why there are no seagrasses or limited seagrass cover at the site (i.e., degraded water quality, too much wave energy, recent hurricane damage, recent boat prop scaring or boat groundings, etc.); and (3) have a reasonable plan to remove these historic stressors prior to attempting restoration.

The initially proposed 15 ha seagrass mitigation area (Area I, **Plate 6-10**) referenced above (CD&A 2008) has been re-examined utilizing the available aerial imagery from Google, Inc. and the April 2008 oblique photography. As noted by NEPA and in the discussion above, the proposed plan did not meet the basic criteria for successful seagrass restoration. "Blow-outs" are natural features which indicate high wave and/or tidal energy at a site. They are not man-made features that need repair. The re-examination of admittedly poor aerial photography of the site does; however, apparently indicate that there may be coalesced prop-scarring and boat grounding damage. If the area has received recurring boat damage, repair may be possible through both a closure of the area to boat traffic (Shallow Water Caution Signage), potential stabilization by installation of fill, and the transplanting of seagrasses from the proposed impact areas. It is noted that keeping boats out of the area to minimize further impacts would have to be a necessary component of any seagrass mitigation program, otherwise even if initial repairs were successful, the restored seagrasses would simply be destroyed again. The on-site field review conducted in January by WM and CD&A was inconclusive as to the primary (natural or man-made) cause of the unvegetated portions within Area I. Thus there may be some potential for seagrass restoration in Area I; however, due to proximity of this potential mitigation area to surrounding waters, exposure to tidal/current velocities and wave energy, and the necessity for permanent protection measures (Shallow Water Caution Signage and Enforcement Measures) from further boating related injuries this area (Area I) would have a reduced potential for mitigation success when compared to the other seagrass mitigation option proposed. Due to the circumstances contributing to the presence or absence of seagrasses, the selection of a potential planting site is one of the most critical and difficult components of a successful mitigation plan (Fonseca et al., 1998). Typically there are few potential locations for mitigation sites that can support/sustain seagrass growth and do not involve habitat substitution. One well documented method of seagrass restoration that meets this criterion is the filling of historically dredged areas to match the grade elevation of the surrounding seagrasses. If the elevations surrounding seagrasses can be effectively matched, these previously vegetated areas have a strong potential for natural revegetation (Fonseca 1998). Following the review of the available aerial imagery and bathymetry within the vicinity of the subject project site, a relatively large area was identified south of Burial Point, east of Area A, and north of Area C that appears to have been historically dredged (see **Appendix VIII**). This area (Area K – see **Plate 6-18** below) is approximately 4.5 to 6.0 deep (15 to 20 feet) and is apparently surrounded (north, south, and west) by dense *T. testudinum* at shallower depths between 2 to 3.5 meters (approximately 6 to 10 feet). The limits of the seagrasses were identified, characterized and mapped to the south of Area K during the recent site inspection in order to quantify the proposed seagrass impacts related to the conveyor corridor. As referenced in the impact analysis section above, the seagrasses within this area appear to be limited by depth and begin to become patchy and less dense at water depths below 3.5 meters or 10 feet.

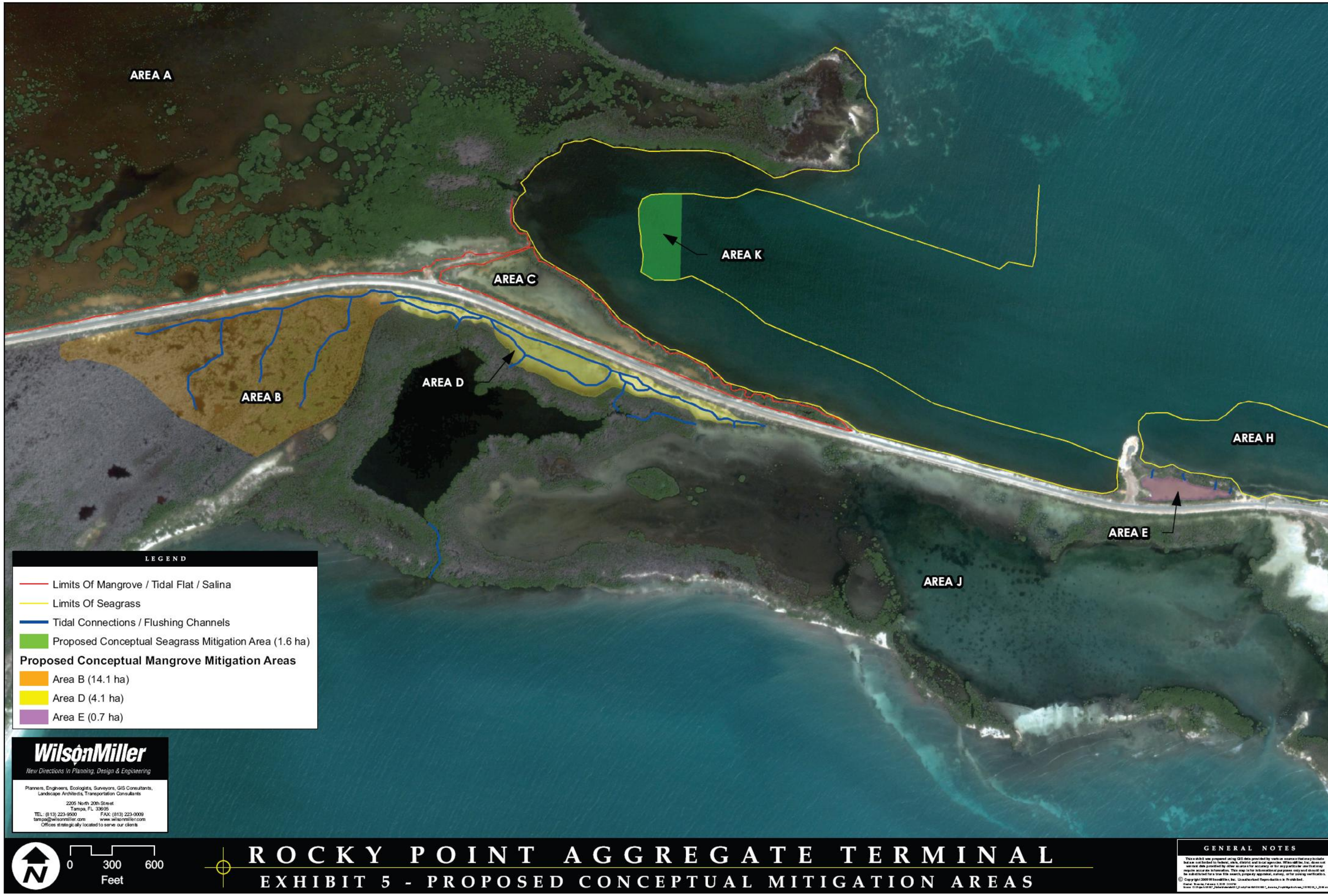


Plate 6-18: Proposed Mitigation Areas (Mangrove & Seagrass)

The proposed mitigation option is to utilize the suitable spoil material generated during the channel dredging and facility construction activities to fill Area K (approximately 1.6 hectares) to the appropriate elevations in order to allow the natural recovery of the seagrasses. In addition to the expansion or encroachment of the adjacent seagrasses and natural recruitment, supplemental transplanting is also proposed as part of this mitigation plan. Due to the need for a significant amount of suitable fill material and the typical order of construction sequences it is not feasible to move or transplant the seagrasses from within the impact area (Port Facility) prior to construction. Another factor precluding some of the impacted seagrasses from being utilized as donor material is the relatively low densities observed during the impact analysis. In order to further reduce the amount of impacts, the applicant has revised port facility design by shifting the construction footprint to the north over slightly deeper waters characterized with less dense seagrasses. Successful transplanting of seagrasses, particularly *T. testudinum,* requires that a minimum number of short shoots per rhizome segment are collected intact (preferable with apical meristems) (Tomasko et al., 1991). Given the current methods for transplanting seagrasses, the transplanting of the less dense seagrasses occurring within the impact site would be impractical and would not likely result in a successful restoration project. Additionally, transplanted seagrasses have significantly higher chances of survival when collected and replanted from similar depths. If seagrasses suitable for transplanting are identified from the impact area associated with the conveyor corridor, the applicant will utilize the seagrasses as donor material. The applicant recognizes that this approach to seagrass restoration may be atypical from NEPA's regulatory policy practices, whereby seagrasses within impact areas are required to be moved prior to construction, this unique mitigation opportunity has a greater chance of success over the other option (Area I) referenced by the previous plan. However, this option also does not involve habitat conversion (mangrove/tidal flat to shallow lagoon) which would be required for the other areas (associated Areas C, D, E, and F) if implemented.

The size of the mitigation area will be adjusted to 1.3 times the area of seagrass impact (1.19 hectares) plus the additional area of fill associated with the transitional or less dense, patchy distribution of seagrasses adjacent to the targeted restoration density. As referenced above, in order to successfully transplant seagrasses the donor material must be relatively dense and must be replanted at similar depths to provide the best chance of survival. Therefore, the final design size of the mitigation area will be based on detailed bathymetry and field analysis of the targeted densities prior to implementation. The limits of the proposed restoration area will be field located and surveyed for the final calculation of the overall size and location (1.3 times the seagrass impact area plus overfill area). Please refer to Exhibit 5 for the approximate location of the proposed mitigation Area K.

Upon confirmation and approval by NEPA (bathymetric survey) that the targeted design size and depth has been achieved following the filling activities and the area has stabilized (3 to 6 months) the supplemental transplanting will begin. In contrast to the method of transplanting large sods or plugs as referenced by Lewis et al. 1994 and Lewis et al. 2006, the applicant proposes the implementation of a smaller plug or core method (Fonseca et al. 1998). This method relies on significantly smaller individual planting units (0.06 m^2 or less). Although the total transplanting of all the seagrasses within the proposed impact area could not be accomplished feasibly for a project of this scale, particularly considering the size of the individual planting unit and deeply rooted species to be impacted (*T. testudinum*), this approach has been used successfully to transplant substantial mitigation/restoration areas in Tampa Bay, Florida (Port Manatee) and Florida Keys. By installing the planting units on specified planting centers, such as approximately 1,200 to 4,000 planting unit per acre, relatively large areas can be transplanted using less donor material and completed within a reasonable time frame.

Additionally, this method has been adapted to allow the use of donor beds not associated with the impact areas (*T. testudinum*, *S. filiforme*, *H. wrightii*) that have recovered within a single growing season (1-year). Therefore subsequent supplemental transplanting of the mitigation areas, as needed and/or required, could be accomplished following completion without relying on poor quality salvage material or damaging adjacent donor areas.

Recently, core transplanting methods have been refined and improved to allow for greater economic feasibility. An example of one of these revisions to the plug or core method referenced by Fonseca et al. (1998), was developed by WilsonMiller in 2006-2007 and implemented at Port Manatee (referenced above). Monitoring and statistical analysis of the 1,001-0.03 m^2 planting units revealed a survival rate of 83.8 percent over a period of one-year following the completion of the transplanting activities. These results were similar to those published by Tomasko et al. (1991) in a study regarding the "Effects of the Number of Short Shoots and Presence of Rhizome Apical Meristem on the Survival and Growth of Transplanted Seagrass *Thalassia testudinum*". Additionally, the donor beds showed no evidence of disturbance following the same one-year period.

Due to the monopodal growth pattern exhibited by rhizomes of *T. testudinum*, coupled with the importance of the collection of multiple short shoots during the harvesting process high-density beds will be identified by the applicant as donor material within specific areas for approval by NEPA immediately prior to transplanting activities. Using the newly developed coring device, the applicant will collect 0.03 m^2 transplanting units at a maximum density of one (1) unit per 2.3 m^2 within the pre-selected donor areas. The relatively small size of the seagrass plugs and the conservative spacing between the collected units will minimize any potential adverse impacts and reduce the time period for the recovery of the donor beds. In order to further accelerate recovery of the donor areas, the open holes will be simultaneously back-filled with unvegetated sediment collected using the same coring device from within the recipient sites. No seagrass donor material will be destroyed during the transplanting activities. Planting units will be installed into a hexagonal cluster pattern consisting of 7-individual units equidistantly spaced 1-meter apart. The clusters will be installed every 4-meters along field demarcated transects established during the transplanting activities. The positions of the donor beds and planting transects within the recipient site will be field located using survey equipment or sub-meter DGPS for future monitoring purposes. The individual cluster locations will be located for planting and monitoring purposes by placing a measuring tape along the fixed transects.

The proposed planting density within the recipient site (Area K) will require up to a total of approximately 1,000 clusters or 4,375 seagrass units per hectare transplanted. Thus the total amount of donor material that would be required per hectare is approximately 131 m^2 or approximately one (1) percent of the seagrasses within a hectare. As referenced above, the final size and location of the recipient and donor areas, and approximate number of transplanted units will be provided by the applicant for NEPA approval prior to plan implementation. For purposes of this seagrass restoration plan, the targeted goal within the subject recipient site is defined as 65 percent survival of the planting units and/or 65% areal coverage of SAV (sources: planting unit expansion, natural recruitment, or adjacent seagrass encroachment) within five (5) years. If the transplanted restoration area is determined, based on the monitoring results, to not meet or exceed the targeted goal after five (5) years following the initial transplanting event then the restoration area shall be subject to remedial actions. Additionally, if the applicant determines that based on monitoring results the restoration area would benefit from remedial supplementary planting any time during the monitoring period the applicant may propose supplementary planting to NEPA for approval. Remedial actions, following the five-year monitoring period, may include continued monitoring efforts, supplemental planting, or alternative measures proposed by the applicant subject to NEPA approval.

6.3.2 *Proposed Mangrove Mitigation Options*

Mangrove communities in the vicinity of the project site were investigated during the field reviews conducted on January 6th through 8th, 2009. Extensive mangrove communities occur west (Area A and B) and south (Area J) of the project site (**Plate 6-10**). These systems include old-growth red mangrove communities with individual trees exceeding 20-feet in height, shallow black mangrove swamps, and fringe communities dominated by white mangrove and buttonwood. In the current condition, two major disconnected mangrove systems (Area A and B) occur west of the project site. Prior to the construction of the causeway and railroad leading to JAMALCO's facility, a continuous coastal mangrove community existed. The construction of the causeway/railroad severed the hydrologic connection between the mangrove systems north (Area A) and south (Area B) of the causeway as no culverts or pipes were installed to maintain tidal exchange. Aerial imagery through 2002 shows limited mangrove mortality in Area B, primarily in the northeast corner and southern end.

It is likely that this mortality is related to changes in hydrology resulting from the construction of the causeway. The majority of mangroves in Area B did not show mortality prior to the 2002 aerial imagery; however, nearly the entire mangrove community within Area B has experienced mortality since. The photo below shows the dead mangrove debris and standing dead trees within Area B. As a result, it is anticipated that the extreme mortality visible was caused by wind and wave energy associated with recent hurricane activity. It is hypothesized that while construction of the causeway did not cause the large-scale mangrove mortality, the hydrologic changes resulting from the causeway construction has altered the hydrologic regime such that mangrove recruitment and regeneration following the hurricane impacts is severely limited. As shown on the photo below, very few mangroves have recruited within Area B and the limited recruitment is only at lower elevations where water ponds for extended periods of time. Based on the field review and aerial photography, it appears that portions of Area B are apparently inundated during the higher tidal events but do not adequately flush once the waters recede. This causes stagnant water conditions with high salinities and an irregular hydrologic regime.

Plate 6-19: Area B – Red Mangrove Die-Off Area

The primary mangrove mitigation option is to restore hydrology to portions of Area B to facilitate regeneration of the mangrove community. The focus of the restoration will be to improve hydrology in the northwest corner of the area and facilitate tidal flushing. **Plate 6-18** shows the components of the proposed mangrove restoration within and east of Area B. Area D, located east of Area B, was historically a black mangrove community but is currently open water habitat dominated by dead black mangroves (see **Plate 6-20** below). Based on aerial photography and the field reviews, Area D does not experience regular tidal exchange thus severely limiting mangrove regeneration. Specifically, Area D holds standing water following rain and high tide events at elevations that prohibit mangrove recruitment.

Plate 6-20: Area D – Located East of Area B – Black Mangrove Die-Off Area

The proposed mangrove restoration of Area B and Area D focuses on the establishment of a regular tidal exchange regime to facilitate mangrove recruitment leading to regeneration of the mangrove community. Prior to the construction of the causeway, it is likely that Area B would have exchanged tidal flushing with Area A to the north. While restoration of the hydrologic connection between Area A and Area B would be the preferred restoration option, this option may result in minor hydrologic changes in Area A. Comments by C-CAM during the meeting held at NEPA's office on November 17, 2008 expressed concerns that any hydrologic alterations in Area A may adversely affect American crocodile and West Indian whistling duck habitat within that area. It is unlikely that a minor hydrologic alteration in Area A would adversely impact those species' habitats. However, due to the issues involved with installing culverts under the existing roadway and railroad and the likely impact to JAMALCO's rail operations during construction this restoration option is not the preferred option. Therefore, the proposed option is to provide flushing within Area B by excavating flushing channels to the east adjacent to the existing roadway. The meandering flushing channels shown on **Plate 6-18** will be constructed at a suitable elevation to insure frequent tidal exchange within the northwestern portion of Area B and throughout Area D. The flushing channels will be broad (to prevent closure), meandering channels which will support mangrove recruitment within the channels themselves. Site-specific topography and tide elevation data will be collected and utilized for the final design of the channels to insure that adequate water elevations are attained within the restoration areas during the appropriate tide events and that the water within the restoration areas flushes frequently. The flushing channels will hydrologically connect the northwestern portion of Area B, Area D, adjacent tidal flats and Salinas, and the open water lagoons to the south and east. It should be noted that the Salinas located south of the causeway in the vicinity of Area D show signs of sediment and corral rubble deposition associated with the destruction of the railroad bed by hurricanes. Therefore, current elevations within these areas are likely higher than they were historically. The use of flushing channels through the tidal flats and Salinas allows tidal exchange between mangrove areas, increases mangrove community extent, and preserves the Salinas. The restoration of Area B, Area D, and the construction of flushing channels between these areas will result in the restoration of a minimum of 18.2 hectares. While the restoration s focused on natural recruitment, mangroves will be planted in strategically identified areas to hasten mangrove community development. Mangrove propagules will be planted at a density of one (1) per ten (10) square meters.

One additional mangrove restoration option is proposed to provide additional compensation for the proposed mangrove impacts. Area E shown in the photos below, which was previously proposed for mangrove or seagrass mitigation, is proposed in this plan for mangrove mitigation. As shown on **Plate 6-18**, two existing tidal connections between Area E and the bay will be improved to allow regular tidal inundation of the area. If necessary based on surveyed elevations, additional tidal connections and flushing channels will be excavated within Area E to improve flushing. The target restoration goal for this area will be to create a habitat similar to Area C, as shown in the photos above. The target community will be scattered red and black mangroves within a tidal flat. While seagrass mitigation is not proposed within this area, it is likely that shoalgrass will recruit within this area if the appropriate elevations exist. Representative photographs of Area E and Area C are shown below (**Plate 6-21** to **Plate 6-24**).

Plate 6-21: Area E – Proposed Mangrove Mitigation Area

Plate 6-22: Area E – Existing Tidal Connection Proposed For Improvement

Plate 6-23: Area C – Mangrove/Tidal Flat Area (View Orientation – West)

Plate 6-24: Area C/East Dirt Road – Mangrove/Tidal Flat Area (View Orientation – East)

The three proposed mangrove mitigation options above will result in approximately 18.9 hectares of mangrove mitigation to offset the proposed impacts to mangroves, tidal flats, and Salinas. The mangrove mitigation proposed in Areas B and D consists of approximately 18.2 hectares of mangrove forest restoration. The mangrove mitigation proposed in Area E is approximately 0.7 hectares of mangrove and tidal flat community creation. As this is a conceptual plan, the final design will be based on site-specific data to be collected prior to implementation thus accounting for any physical habitat changes that may occur between now and the time of implementation. The goal of these mangrove mitigation options is to provide assurance of the following: 1) suitable mangrove mitigation area exists, 2) factors leading to decline have been identified, 3) restoration techniques can eliminate those factors, and 4) successful mangrove mitigation can be completed to offset the mangrove impacts associated with the proposed project. It should be acknowledged that the final design may vary from that proposed herein; however, the final design will include a mangrove mitigation area(s) of at least equal area to that proposed in this conceptual plan and will be of similar habitat value.

CONCLUSION

This revised mangrove and seagrass rehabilitation plan has been prepared to address the concerns of the National Environment and Planning Agency (NEPA), as referenced in their letter dated October 29, 2008, following the discussions during the meetings with NEPA on November 17, 2008 and December 8, 2008 regarding the proposed Rocky Point Project.

The applicant contracted the services of WilsonMiller and CD&A to conduct field reviews of the natural resources and mitigation options associated with the proposed project. Field reviews of the project site were conducted by WilsonMiller and CD&A on January 6 – 8, 2009. The primary tasks completed were the assessment of seagrass habitats, mangrove habitats, and compensatory mitigation opportunities. All assessments and calculations were performed in relation to the revised layout of the port facility and conveyor corridor as presented to NEPA on December 8, 2008.

Based on the data gathered during the field review and aerial photo-interpretation, 1.19 hectares of seagrass impacts and 5.59 hectares of mangrove-tidal flat-Salina habitat impacts are proposed. Given the nature of the facility and the difficult logistics associated with this type of development, the impacts on natural resources are unavoidable. In contrast to the previous site layout proposed by the applicant, the site layout proposed herein significantly reduces ecological impacts, especially impacts to seagrasses (7.49 ha to 1.19 ha). This is not the optimal design for the aggregate facility's operational efficiency, but the applicant has committed to reducing impacts to the greatest extent possible.

A conceptual compensatory mitigation plan has been prepared to offset the loss of seagrass and mangrove habitat resulting from the proposed project. The bulleted list below summarizes the mitigation options of this conceptual plan.

- Mangrove Mitigation
    - Proposed Mitigation Areas
        - Area B = 14.1 ha
        - Area D = 4.1 ha
        - Area E = 0.7 ha
    - Proposed Mitigation Methods
        - Establishment of tidal connections/flushing channels to provide tidal flushing within previously impacted areas
        - Excavation/re-grading/filling to establish appropriate mangrove elevations
        - Planting of mangroves/buttonwoods
    - Potential Pre-Implementation Data Collection
        - Detailed, design-specific topographic/bathymetric data
        - Hydrologic analysis (data collection and modeling)
        - Tidal data
        - Current (pre-implementation) habitat characteristic review
- Seagrass Mitigation
    - Proposed Mitigation Areas
        - Area K = 1.6 ha
    - Proposed Mitigation Methods
        - Filling of historical dredge hole to appropriate depth
        - Transplanting of seagrass (predominantly *T. testudinum*) within a cluster arrangement on specified centres
    - Potential Necessary Data
        - Detailed, site-specific topographic/bathymetric data
        - Field survey of current (pre-implementation) seagrass limits within mitigation area
        - Mapping of seagrass donor area containing high-quality seagrass

The conceptual mitigation options within this plan are capable of providing the necessary compensation to offset the loss of habitats proposed by the project. The additional data gathered prior to implementation will be utilized to finalize the mitigation plan with specific design details. The applicant acknowledges that this is not a final rehabilitation plan that can be immediately implemented, but rather a conceptual plan that outlines the steps necessary to progress from the conceptual stage to final implementation and, subsequently, monitoring. Once the applicant receives approval of this conceptual plan and, more specifically, the preferred compensatory mitigation options contained herein, further development of the final restoration plan may commence. It is very important to note that the proposed project impacts are not likely to take place for a minimum of two (2) years; therefore, the collection of additional data and the finalization of the compensatory mitigation plan should be completed at a date nearer the time of implementation. The ecological communities present within the project area are dynamic systems that are located in an area subject to extreme weather conditions and it is possible that significant changes, positive or negative, to the ecological communities may occur prior to implementation.

SOCIO-CULTURAL & SOCIO-ECONOMIC ENVIRONMENT

7 Socio-Cultural & Socio-Economic Environment

7.1 Introduction

Rocky Point has one of the largest fishing beaches on the island and a large alumina port. The Rocky Point area, in the vicinity of the alumina port, has large and diverse wetlands, which is an important habitat for marine organisms, birds and reptiles. It also has large patches of mangrove, dry scrubland, ponds and mudflats.

The location at which the proposed limestone export facility will adjoin lands established by the construction of the JAMALCO Marine Terminal over 35 years ago. This area can be described as a Mangrove inhabited peninsula at Colon Bay in the Clarendon area of Portland Bight **(Plate 7-1 below).**

Plate 7-1: RINKER Proposed Limestone Port Development Concept Location

The facility, once constructed, will join the JAMALCO Marine terminal and WINDALCO's Port Esquivel facility to the north as existing port facilities in the Bight. The proposed facility will also share maritime accesses with three power generation facilities, namely the Jamaica Public Service Company Ltd's Old Harbour Bay Power Station and the two power barges operated at the Jamaica Energy Partners Power facility. Finally, a number of communities ring the Portland Bight area, including Mitchell Town, Portland Cottage, Salt River, Longville, Kelly's Pen and Old Harbour Bay **(Plate 7-2 below)**.

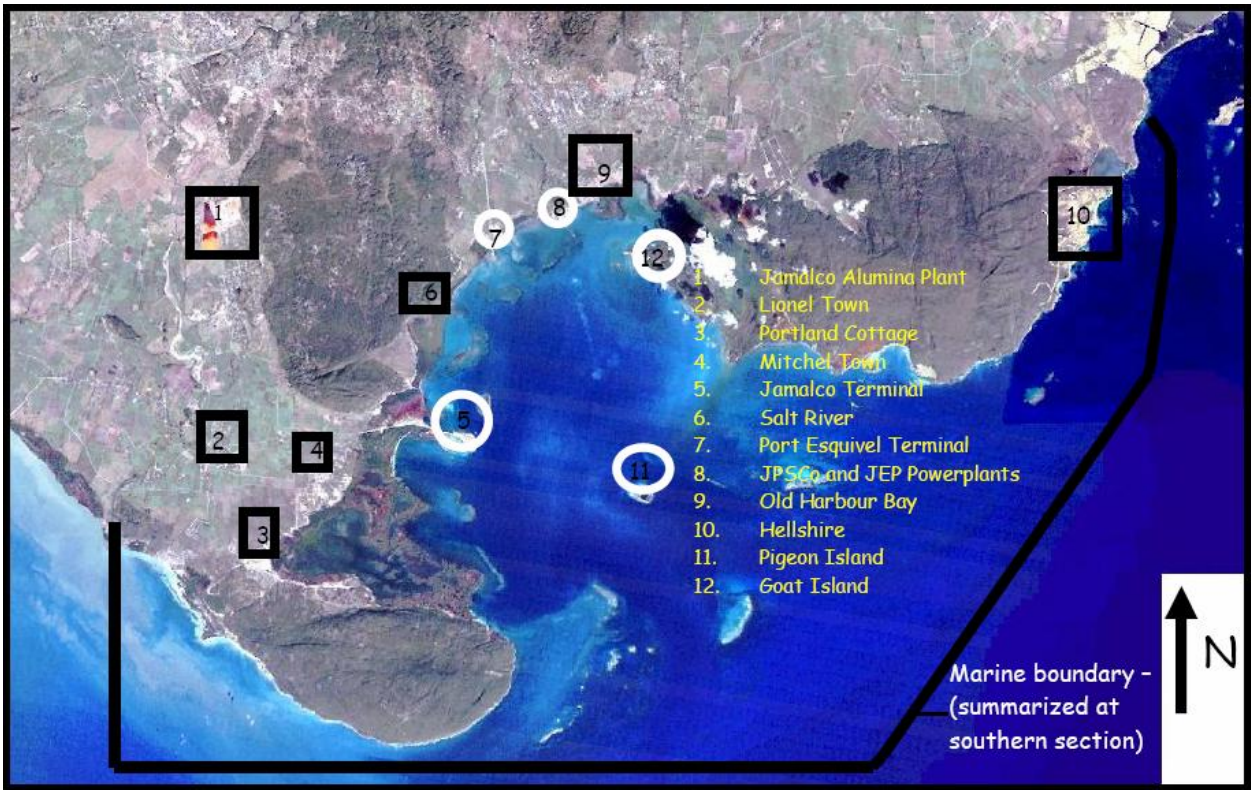


Plate 7-2: Facilities & Communities Bordering the Development Location

The site of the proposed limestone export facility falls within the Portland Bight Protected area, which extends from the Hellshire Hills area to the east, to the Rio Minho River estuary in the west **(Plate 7-2).** The Natural Resources Conservation Authority (NRCA) declared the protected area in April 22, 1999. The NRCA ultimately delegated responsibility for the protected area to two management entities. The Caribbean Coastal Area Management Foundation, a non-governmental organization with environmental interests, is currently seeking management responsibility for areas extending from the Old Harbour Bay, west and south to the Portland Cottage area and including the cays and marine environment contained therein.

The Urban Development Corporation will oversee the management of the Hellshire Hills area and the Goat Island region[24] **(Plate 7-2).**

7.2 Land-Use

7.2.1 *Approach and Methodology*

An accurate and thorough account of past and current land uses in the study area demanded a multi-faceted approach for collating land use information for the area. These included:

1. The use of the Land Cover/Use Classification Map produced by the Ministry of Agriculture (MOA, 1986)
2. Aerial Photographs of the area which provide images for the years 1998 and 2001.
3. Satellite Imagery of the area dating 2006 (Google Earth)
4. The use of field surveys to incorporate regional observations and documentation of existing land use, while providing verification of land use patterns depicted on the maps.

Land use was examined from both a historical and regional perspective. In order to accommodate regional (8 km radius) and site specific (3 km radius) analysis of the proposed development site was seen as an appropriate extent for the area of interest. Relevant land uses immediately adjacent to the outer limits of the selected buffer was also taken into account.

7.2.2 *Historical Overview*

The parish of Clarendon is covered by a land use zoning under a Development Order (1982) and falls under the aegis of the Town and Country Planning Act. The Development Order has zoned specific areas of southern Clarendon for agricultural uses, forest, residential and conservation, which constitutes the major land uses in the region. Conservation covers the entire area and is currently within the area designated as the Portland Bight Protected Area, which hosts the various land uses including the Portland Ridge, the Brazilletto Mountains, the extensive West Harbour mangals and several residential areas such as Mitchell Town, Salt River, Lionel Town and Rocky Point.

According to MOA (1986), the study area was historically dominated by forest and brush vegetation which accounted for approximately 50% of the land cover at the time. Sugar cane cultivation was the second most dominant land use in the study area covering approximately 21% of the total land cover. This is to be expected as the Clarendon developed as a major sugar production parish during the British Plantocracy with the Vere Plains providing the most ideal topography for sugar cane cultivation in the parish.

[24] NEPA Portland Bight Protected Area file reference 17/35 Vol I-III

Residential land use in the study area existed in the form of small pockets of scattered settlements developed in linear pattern along major roadways in proximity to the Monymusk Sugar Factory and the JAMALCO Alumina Plant.

Industrial land use in the area was miniscule in comparison to now, but existed with the presence of the Monymusk Sugar Factory in Lionel Town and the development of the JAMALCO Alumina Plant located in Hayes. With the growth of the alumina operations at JAMALCO and in Jamaica, industrial activity gained momentum in the area with the development of port facilities at Port Esquivel (WINDALCO) and Rocky Point (JAMALCO). An Industrial Estate/Park has also been established at Tarentum and accommodates a Coffee Factory and the Chemical Lime Quarry.

Areas along the Salt River Bay including Welcome Beach and the Gun, Rod and Tiller Club have accommodated recreational uses such as fishing, swimming and bird shooting.

7.2.3 *Present Land Use*

The area of interest is mostly undeveloped and predominantly rural with minimal commercial activity supporting the sparse settlements affiliated with the area. The general land use in the area can be classified as, but not limited to the following:

- Rural Residential
- Mixed Residential/Commercial
- Sugar Cane Cultivation
- Industrial
- Recreational
- Wetlands
- Grassland
- Forest/Brush

Rural Residential

Generally, the land use in the area is rural with unplanned settlements developing in a linear pattern. These dispersed settlements include Tarentum, Salt River and Cockpit which span the major roadways and comprises mainly of ‘squatters’ who have occupied the area for decades. Commercial activity in these areas is relatively non-existent.

Mixed Residential/Commercial

Areas under mixed residential and commercial use entail the larger settlements in the study area designated as villages and sub-regional centres. It includes the major towns such as Hayes, Lionel Town and Mitchell Town where residential activity is well developed to the point where commercial and institutional services have emerged to support the increase in size and population of these areas. In some instances, there are lots that display the two land uses where residential units are also used as shops. Commercial and institutional uses are interspersed with residential development along major roadways in the form of banks, grocery shops/supermarkets, police station, schools and post office.

Sugar Cane

An extensive area within the sphere of influence (8 km radius) is currently designated to sugar cane cultivation. It provides the bulk of the raw materials for the Monymusk Sugar Factory in Lionel Town. No such practices exist within the site specific sphere of influence. However, lands within this region are owned by WISCO.

Industrial

Large scale industries constitute the various industrial activities in the region. The industries that currently exist within the area include:

- The JAMALCO Alumina Plant in Hayes
- The JAMALCO Alumina Port at Rocky Point
- The Monymusk Sugar Factory
- The Tarentum Industrial Estate – Coffee Processing Plant and Chemical Lime Quarry
- WINDALCO Alumina Port at Port Esquivel

Though some of these industries are located outside the established extent of the area of interest, they provide the insights into the types and scale of industrial activity within a regional context for a more robust and in-depth analysis.

Recreational

Recreational activities in the study area exist in several forms. The Gun, Rod and Tiller Club in the Salt River community provides bird shooting and fishing for its members while people from outside and within the community use the Salt River for swimming, bathing and fishing. Welcome Beach provides another major recreational use as it is the major fishing and swimming beach in the area. Other recreational uses in the area are evident in the presence of playing fields.

Wetlands

Both coastal and non-coastal wetlands are present within the study area. The coastal areas comprise mangal forest (red and black mangroves) and swamps. Fresh water marshes that are not directly connected to the sea exist in the non-coastal areas.

Grassland/Brush

These areas exist on less steep slopes on the fringe of the Brazilletto Mountains where the land was cleared but is now covered with grass and shrubs. Brush cover is present mainly in the form of cashew and cacti

Forests

The large expanse of the Brazilletto Mountains accounts for forest cover being the most dominant land use in the area and provides a source of income for many residents in the area as the vegetation is used for charcoal production and lumber.

7.2.4 *Potential Land Use Conflicts*

Potential land use conflicts were identified in the context of noting conflict of interests that are likely to result from the location, scale and nature of the proposed development and its interaction with the various land uses in the study area.

Conflicts were analyzed in relation to the activities involved in the construction and operation of the proposed development and their effect on residential areas, resort and recreational facilities and forest interests. Noise and dust nuisance and the intrusion of space are the most common land use conflicts identified. The type and nature of potential land use conflicts arising are summarized in Table below.

Table 7-1: Type and Nature of Potential Land-Use Conflicts

Phases of Operations	Affected Land Use/Area		Nature of Potential Conflicts
Transportation Corridor (Construction Area)	Residential	Salt River Community	○ Intrusion of space
	Wetlands	Salt River Bay	○ Potential for loss of mangrove cover
	Forest	Brazilletto Mountain	○ The removal of vegetation which provides livelihood for charcoal producers and bird hunters in the

Phases of Operations	Affected Land Use/Area		Nature of Potential Conflicts
			area
Transportation Corridor (Operation)	Residential	Salt River Community	○ Visual Intrusion and conflict for space
	Recreational	Playing Field	○ Intrusion of space
Port Facility (Construction)	Residential	Salt River Community	○ Noise nuisance due to the movement of trucks and other vehicular traffic related to on-site construction operations.
		Tarentum	○ Noise nuisance due to the movement of trucks and other vehicular traffic related to on-site construction operations.
	Recreational	Welcome Beach	○ The removal of mangroves and increased turbidity from dredging may impact fisheries
	Security Post	Rocky Point	○ Potential site conflict
Port Facility (Operation)	Resort	Proposed Heritage Bay Hotel and Marina	○ Potential Increased turbidity of water and decreased water quality negatively affects the aesthetics and marketability of the hotel as a marine resort (During Dredging)
	Security Post	Rocky Point	○ Potential marine vehicular traffic

7.2.5 *Potential Proposed Land-Use*

The area is scheduled to house posts for both the Jamaica Defence Force and the Jamaica Constabulary Force. This is a move to reduce the illicit activities of drug and gun trafficking that have been occurring along this section of the south coast. This is still in proposal stage and no concrete location has been put forward except the general location of Rocky Point, utilising lands possibly owned by JAMALCO. Similarly, JAMALCO's proposed nature tour utilising the rail and port area could be impacted by this project; largely in respect to aesthetics.

7.3 Synopsis of Major Stakeholder Consultations

7.3.1 *Community Consultations*

The views and opinions of residents of the surrounding communities were solicited through two public meetings held in Salt River on the 5th and the 20th of February, 2008. The residents in attendance came predominantly from the communities of Salt River, Tarentum and Mitchell Town, while several individuals came from Brats Hill, Hayes and Lionel Town. Some members of the Clarendon Parish Council, and the Minister of Health and Environment were also in attendance.

The residents were comprehensively informed of the proposal to construct a port and conveyor corridor in the area, who is the proponent, what the operations would entail and an overview of the environmental impact assessment process.

In discussion with the residents several issues were raised. These include:

- ***The extent of blasting and noise nuisance***.

The issue of compensation was prevalent as many residents claimed to have experienced damage to property as a result of blasting associated with existing operations at the Brazilletto Quarry without compensation. Consequently, the residents were curious as to what kind of arrangement would exist as part of the proposed project to compensate residents for such damage. This was a concern primarily for the residents of Tarentum. In addition the extent of mining and its impact on the aesthetics of the area was also a concern. The conditions for blasting were outlined to residents during consultations.

- ***The impacts on water resources***.

The availability of *potable water* was consistently highlighted as a critical deficiency in all communities. Some residents went further to suggest that the provision of potable water to the community would be an appropriate compensation for any development in the area.

Concerns were also expressed about the potential impact on the *groundwater* regime in the area. Emphasis was placed on the potential impact on the Salt River mineral spa, which is a major recreational facility in the community. It was asked that these issues be taken into consideration.

- ***Impacts on vulnerability to Hurricanes and Storm Surge.***

The residents were also concerned about the possibility of increased vulnerability to hurricanes and storm surge as a result of the removal of mangroves and the reduction in the height of the Brazilletto Mountains, which provide a buffer for some communities such as Hayes.

- ***How will the community benefit?***

Most of the residents in attendance were curious to find out how they would benefit from the project, highlighting water and employment as critical community needs. It was suggested that community members should be given priority as far as employment was concerned.

- ***Impact on Fisheries and Nursing Grounds***

One resident encouraged the development on the basis that the site is a brown field site with the baseline environmental impacts already established over several decades and employment opportunities are needed in the community, concerns were aired regarding the dredging and removal of mangroves and the effect it would have on fisheries and nurseries in the area.

- ***Location and Routing of Conveyor Corridor***

In addition, there was the issue of whether relocation was necessary or not depending on the routing and location of the conveyor corridor.

7.3.2 *Clarendon Parish Council*

Consultations with the Clarendon Parish Council took place on two occasions as well. The first was a meeting held on the 30th of January, 2008. The members of the Clarendon Parish Council involved in this meeting were:

- Mr. Rohan Blake – Planning Director,
- Ms. Adassa Morgan – Secretary Manager,
- Mr. Stafel Thomas – Planning Technologist
- Ms. Grandlin Fearon – Director of Administration

A presentation was made providing detailed information on the project, the proponents of the project and the strategies in place to successfully implement the project in an environmentally sustainable manner.

The concerns raised were similar to that expressed by the residents in the public meetings. Issues were related to the socio-cultural impacts from the project, the impacts on the physical environment and protected zones and heritage sites which are important to the people and the area.

Socio-cultural concerns that emerged related to the level of employment that would be generated by the project as well as identifying the communities in close proximity to the operation and how they will be affected.

The concerns regarding the physical environment include the impacts on the aesthetics of the area, considerations to the vulnerability of the area to hurricane, rehabilitation and the measures to be put in place to withstand any changes in climate and drainage. It was also raised that consideration must be given to the fact that the area is protected and the project should be undertaken within that context.

A major concern raised was whether the legislation and regulations were enforceable.

7.3.3 *Conclusions*

The consultation process is intended to garner the views of the major stakeholders on the project and any concerns that may have so that due consideration is given to them in the Environmental Impact Assessment and the project development process.

The major issues highlighted included concerns for the bio-physical environment such as the mangroves, fisheries and water resources. Other concerns were socio-cultural in nature as they related to property damage, noise nuisance, employment and provision of water. These were the primary concerns of the residents.

All concerns of the residents of the communities and the other stakeholders were given major consideration in the undertaking of the environmental and socio-cultural impact of the project.

Table 7-2: Summary of Stakeholder Concerns

STAKEHOLDER	DATE	ISSUES/CONCERNS RAISED
COMMUNITIES CONSULTATION (Communities represented) • **Salt River,** • **Tarentum,** • **Brats Hill,** • **Mitchell Town,** • **Hayes**	Feb. 5, 2008	The extent of blasting and noise nuisance.
		Impact on Fisheries and Nursing Grounds.
		Impacts on vulnerability to Hurricanes and Storm Surge
		How will the community benefit?
	Feb. 20, 2008	The impacts on water resources
		Impacts on vulnerability to Hurricanes and Storm Surge
		Scale of employment to be afforded community members
		Location and routing of Conveyor Corridor.
		Impact on aesthetics of the area

7.4 Survey Population

In order to accommodate a thorough analysis of the impacts associated with the proposed development an assessment of the socio-economic and cultural characteristics of the communities and residents within the sphere of influence of the project was necessary. In addition, RINKER Jamaica Limited has a special interest in the opinions, attitudes and views of the communities in which it does business. As such, within the context of the nature of the proposed development, affected communities were identified and surveyed. This was done to facilitate detailed analysis of potential impacts, to determine the level of knowledge among the local population of the existing and proposed operations and to solicit their views on the perceived or known impacts of the operations. This report presents the demographic and social profile of the affected communities and the findings of a survey that was conducted in February 2008.

The nature and scale of the proposed development requires a systematic approach to identifying the areas that will be affected. As such, areas within and in close proximity to a 2.5 mile radius of the proposed operation was used for determining the affected communities. The named communities that fall within this sphere of influence include Salt River, Tarentum, Cockpit, Bratts Hill, Mitchell Town, Hayes, Savanna, and Raymonds.

The selection of the areas for interviewing was based on Enumeration Districts (ED) as defined by the Statistical Institute of Jamaica (STATIN) which make up the affected communities. However, it must be noted that it is possible for some communities to cross ED boundaries. As a result, the communities as presented in this report were also defined in the field by the interviewer and the respondent

The survey population was devised from a 5% sample of the total population of the area in the 2001 Population Census. A total of 155 surveys were conducted in the EDs as outlined by STATIN, which were in a 2.5 mile radius of the project site (**Table 7-3**). These statistics were obtained from the ***Population Census 2001***, at the Statistical Institute of Jamaica.

Table 7-3: Enumeration Districts Surveyed

Enumeration District Code	Total Population	5% Sample Value
Rural	**1345**	**67**
South East 068	390	20
South East 069	588	29
South East 071	367	18
Mitchell Town	**1753**	**88**
South East 072	297	15
South East 073	474	24
South East 074	374	19
South East 075	608	30
TOTAL	**3098**	**155**

The map following shows the locations of the Enumeration Districts in which socio-economic surveys were issued concerning the development (**Figure 7-1**). A copy of the Survey Instrument is attached as **Appendix II** for.

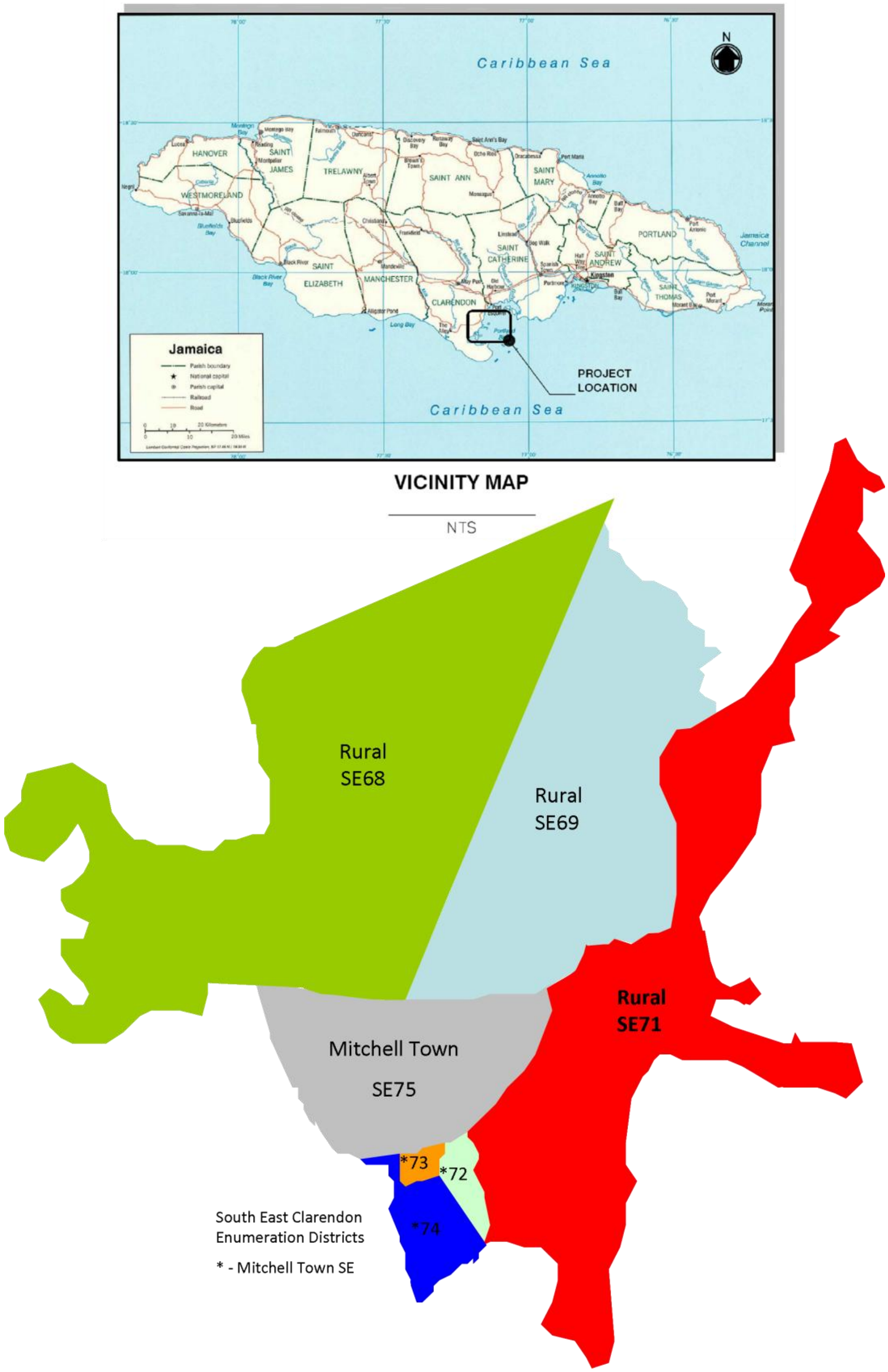


Figure 7-1: Location and Name of Enumeration Districts Surveyed

7.4.1 *Demographics & Social Profile*

The affected communities together comprise a population of 3098 individuals and represents only 1.3% of the total population of Clarendon. The age-sex pyramid depicted in **Figure 7-2** shows a population structure typical of rural areas in Jamaica with a predominantly youthful population of 1396 persons accounting for approximately 45% of the population is under the age of 20 years.

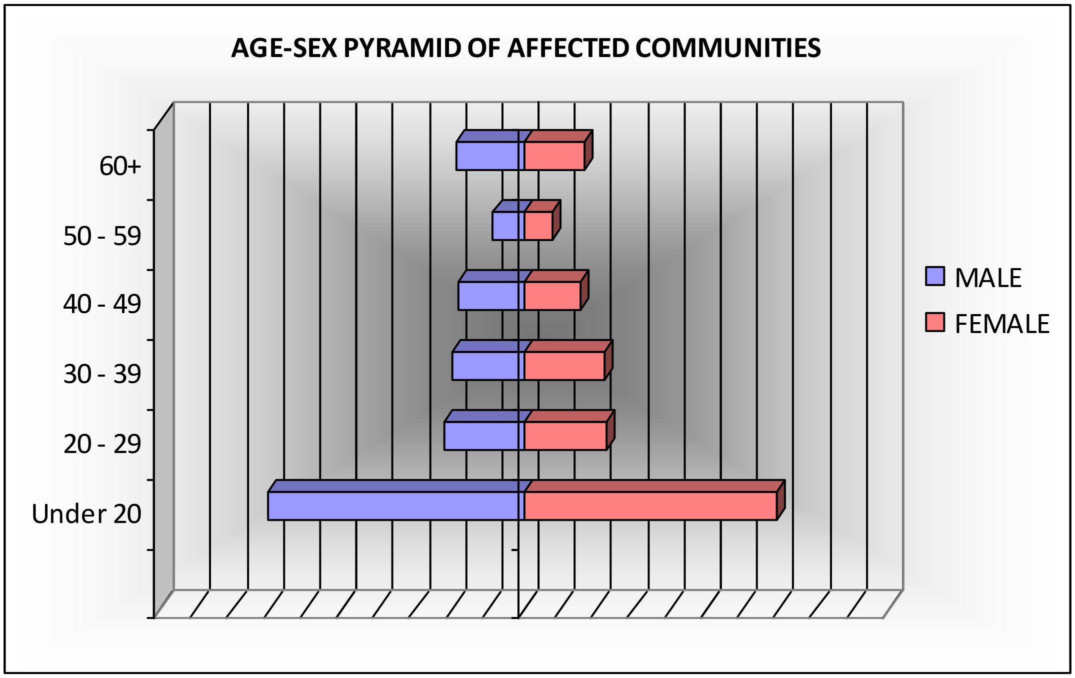


Figure 7-2: Age-Sex Pyramid of Affected Communities

The area has a large dependent population of approximately 1749 individuals, which represents 56.5% of the total population. It must also be noted that there is a relatively even distribution between the male and female population in the area. Male and female population represents 50.7 % and 49.3 % of the total population respectively.

There are 864 housing units in the area. These are predominantly separate detached houses that account for 91.8% (793) of the total number of housing units.

7.4.2 *Findings*

7.4.2.1 The Survey Population Characteristics

In total, 154 respondents were covered in the survey. The number of male to female respondents was relatively equal amounting to 80 and 74 individuals respectively. The majority of the respondents, approximately 85.1%, has been living in the community for more that twenty (20) years and is mostly between the ages 20 to 39 years of age. The table below illustrates the age and years of residency of the community respondents.

Table 7-4: Age and Years of Residency of Respondents within each Community/ED

Community ► / Parameter ▼	SE68 Hayes, Savannah, Raymonds	SE 069 Salt River	SE 069 Tarentum & Brats Hill	SE 069 Breadnut Valley	SE 071*	SE 072 –0 75 Mitchell Town	TOTAL
AGE RANGE							
Under 20	1	0	0	0	0	1	**3**
20-39	7	2	6	2	7	28	**80**
40-49	1	1	2	1	9	32	**78**
50-59	3	5	2	1	1	16	**44**
60-Over	4	7	0	1	3	10	**35**
NR	0	0	0	0	0	1	**2**
Total	**16**	**15**	**10**	**5**	**20**	**88**	**154**
YEARS OF RESIDENCY							
0-5 Yrs	0	0	0	0	3	0	**3**
6-10 Yrs	2	0	0	0	1	2	**7**
11-20 Yrs	2	4	1	0	5	3	**18**
20+ Yrs	12	11	9	5	11	83	**214**
No Response	0	0	0	0	0	0	**0**
Total	**16**	**15**	**10**	**5**	**20**	**88**	**154**

***A combination of communities (Tarentum, Salt River, Mitchell Town)**

In addition, about 65% of the survey population attended secondary school. Self-employment and unemployment is common among the communities, while retirees and pensioners are also prevalent. The communities are relatively poor areas with only 4.6% of the respondents having an annual income exceeding J$500,000.

7.4.2.2 Opinions of the Community

The most favoured feature of the community as expressed by the respondents is the quietness (35%), followed by the lack of crime and violence (26%) and the friendliness of the people (24%). Quiet environment is most liked trait the communities of Salt River and Mitchell Town as indicated by 75% and 31% of the respondents in these respective communities. Some respondents also highlighted the Mineral Spa in Salt River as what they liked most about the community. The availability of farmland was least favoured trait in all the communities. **Figure 7-3** shows what the respondents like most about their community.

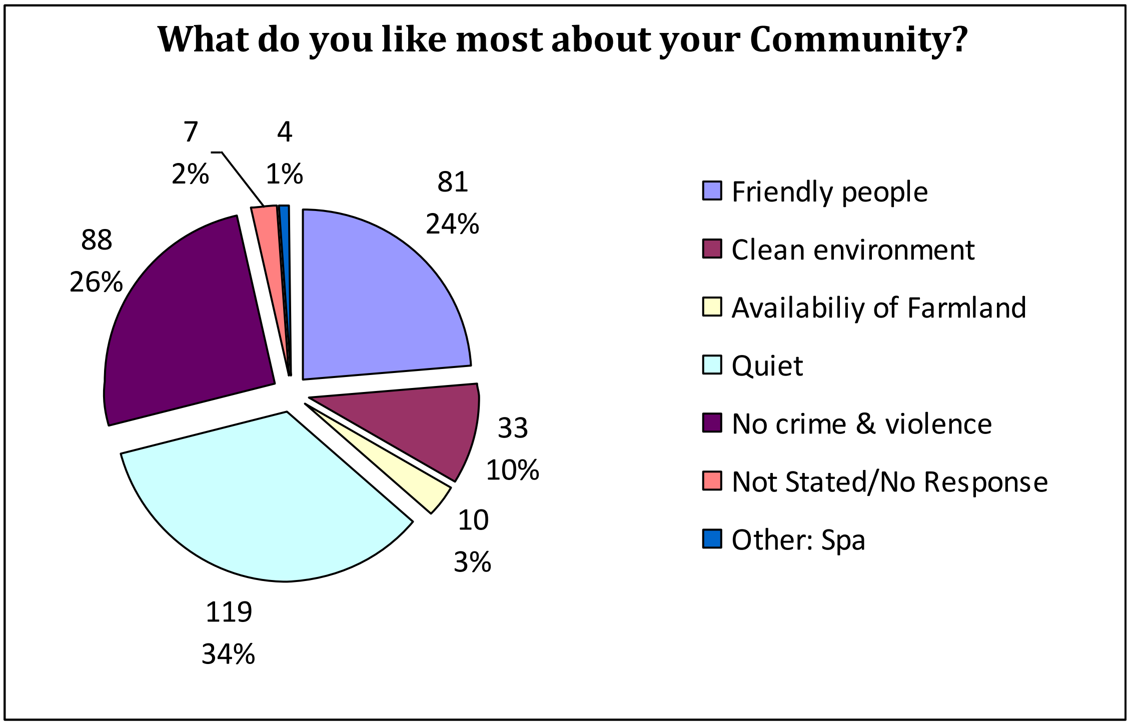


Figure 7-3: What do you like most about your community?

On the other hand, as indicated in **Figure 7-4** the most disliked characteristic of the community was unemployment which accounted for 35% of the respondents. This sentiment was particularly high in Salt River where approximately 74% of the respondents highlighted it as the major dislike. Poor roads and a lack of utilities were also major concerns of the residents as indicated by 27% and 20% of the respondents. This was consistent in all the communities especially Salt River, Mitchell Town, Tarentum and Brats Hill. Crime and violence or a dirty environment were rarely expressed as concerns in the communities except in Mitchell Town, which accounted for 96% of the total number of persons highlighting a dirty environment as a major dislike.

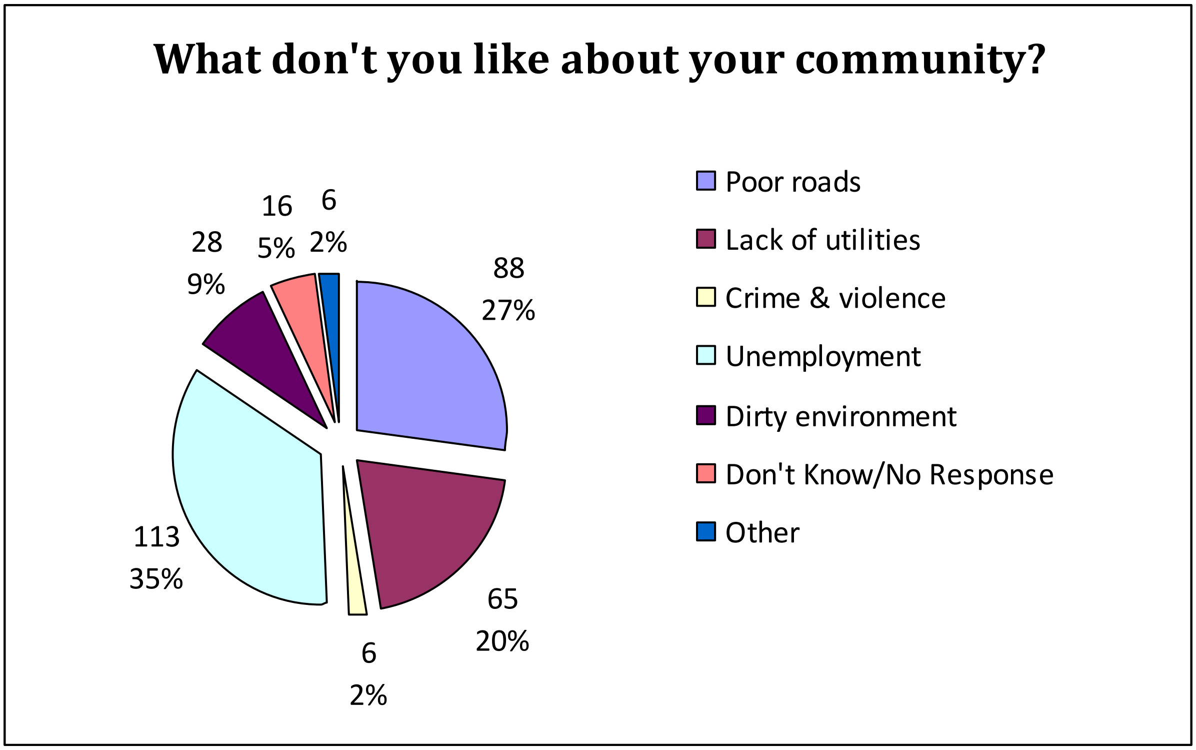


Figure 7-4: What don't you like about your community?

The availability of drinking water is a sore subject for the residents within the communities, as the main sources of water indicated by respondents are the water truck (28%) and rain water (16%). Of the one hundred and fifty-four persons surveyed, only 32% felt they had access to safe water, while 63% felt the water was unsafe.

7.4.2.3 Awareness and Experiences with Current Mining Operations

Awareness of limestone mining operations in the area is high in the communities as approximately 66% of respondents expressed knowledge of existing mining activities in the area. It appeared to be highest in the community of Salt River where about 88% of the respondents knew of mining operations currently in the area.

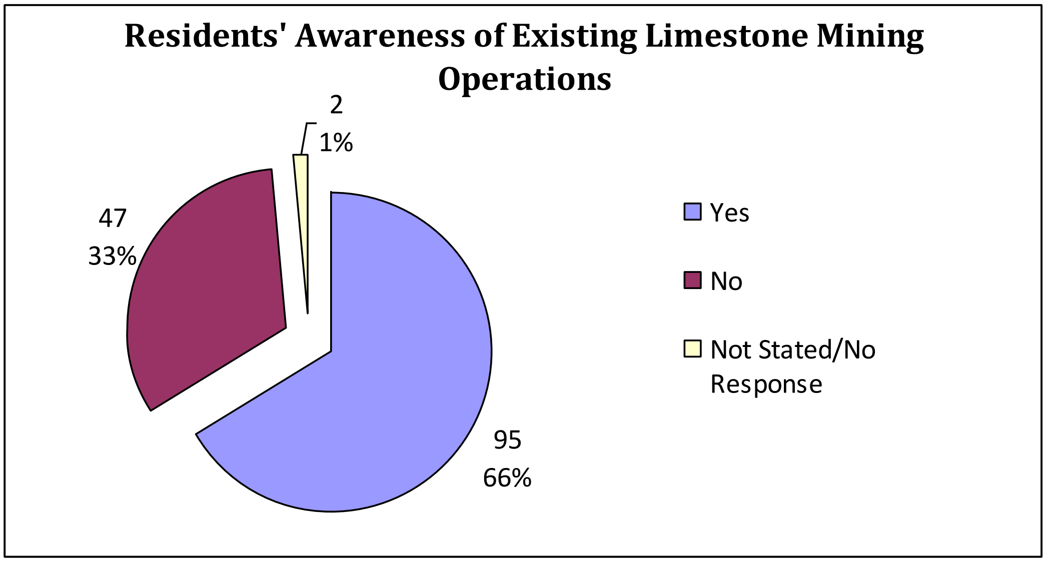


Figure 7-5: Residents' Awareness of Existing Limestone Mining Operations

The experience of the residents with limestone mining operations in the area is one of mixed sentiments. Most respondents (44%) commented that their experience was negative but it must be noted that 22% have had positive experiences, while 34% of respondents highlighted they experienced no impact. Most of these respondents who experience no impact came from the communities of Mitchell Town, Hayes, Raymonds and Savannah.

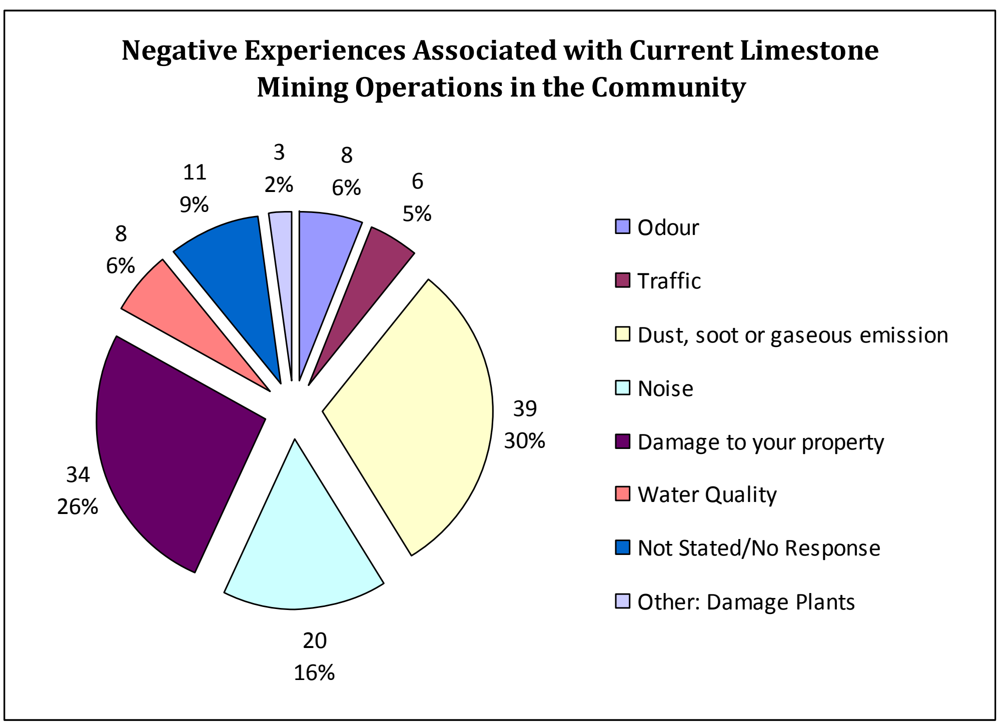


Figure 7-6: Negative Experiences Associated with Current Limestone Mining Operations in the Community

Since most of the residents noted negative experiences with mining in the area, it is necessary to highlight those experiences. Dust nuisance was the most common negative impact as pointed out by the majority of the respondents (30%). Damage to property and noise are the next most popular impacts experienced by residents in the accounting for 26% and 16% respectively.

It must be noted that the abundance of these impacts varied according to the community. Dust was most common in the community of Mitchell Town while the respondents of Salt River were more affected by property damage. The communities of Tarentum, Brats Hill, Hayes, and Savannah reflected no dominant experience but represented a more even mixture of experiences.

With respect to the Brazilletto Quarry in Tarentum, 78% of the respondents stated that they were not experiencing any negative impact from its quarrying operations. Of the 23% that are experiencing negative impacts, the majority came from the communities of Tarentum, Brats Hill, Breadnut Gully and Salt River.

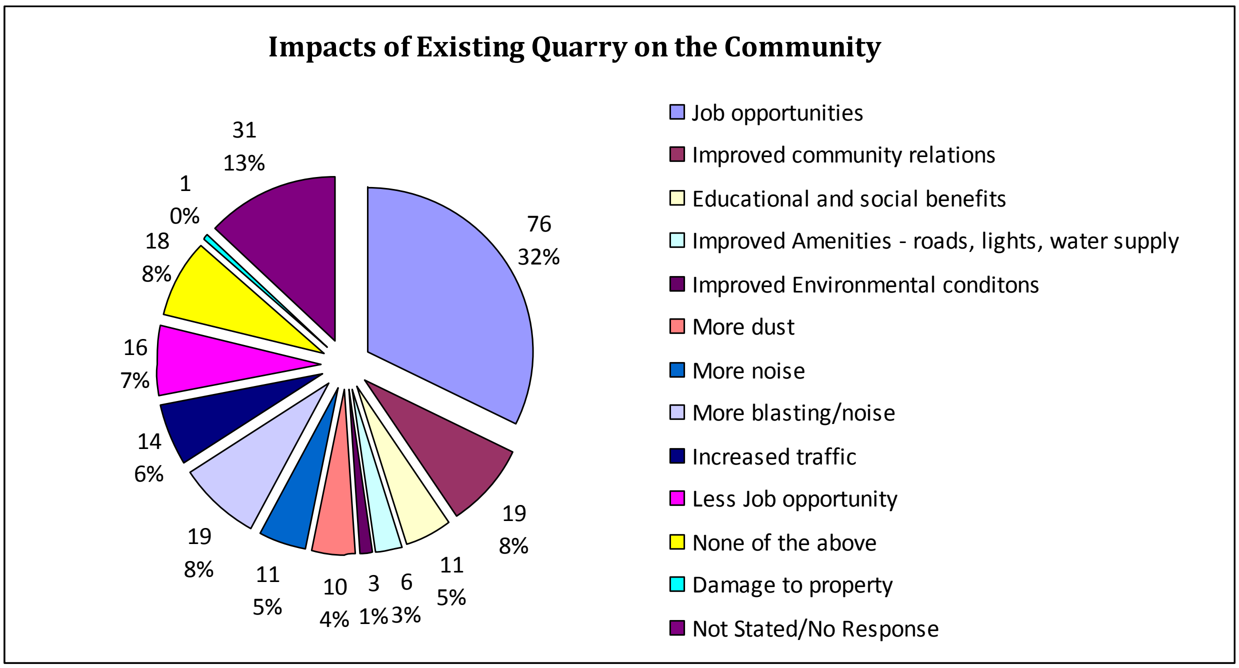


Figure 7-7: Impacts of Existing Quarry on the Community

In response to the overall impacts of the Brazilletto Quarry on the community, most respondents (32%) highlighted job opportunities as an impact that the quarry has had on the community. This was constant in the communities of Tarentum, Brats Hill, Salt River and Mitchell Town. Another positive impact was indicated by 8% who highlighted improved community relations as an impact. On the other hand a similar percentage of the respondents indicated that noise and blasting was a problem. Respondents from the communities that make up the ED of SE071 dominated the population that pointed out noise and dust impacts.

7.4.2.4 Knowledge and Views of Upgrade Plans and Port Facilities

Sixty-one per cent (61%) of the respondents were aware of the proposal to construct a Port at Rocky Point and a conveyor system connecting the port to the Brazilletto Quarry. Knowledge of the upgrade and construction plans was highest in the communities of ED SE071 (82%), Tarentum (80%), Salt River (79%) and Breadnut Valley (60%).

The respondents who were aware of the plans were informed mainly via word of mouth (40%) and community representation (19%), while 21% pointed out that the survey was the first knowledge of the project. The former was the most common information channel in all communities except Hayes, Savannah and Raymond, where the majority of the respondents (87%) suggested that the survey was the first knowledge of the project. Flyers and fact sheets were most common in Salt River and Tarentum areas, while most of the respondents, who heard about the project from a consultant, came from the communities within ED SE071.

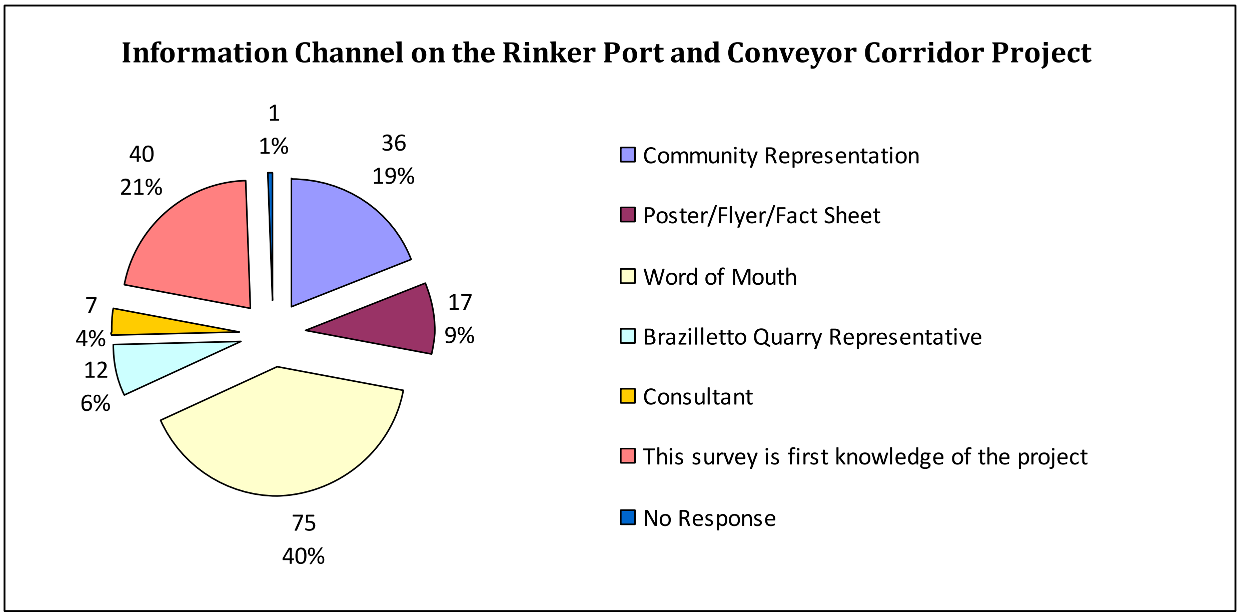


Figure 7-8: Information Channel on the RINKER Proposed Port and Conveyor Corridor Project

In seeking the perceptions of the community members regarding the effect that the proposed project will have on the community, only 43% of the respondents, mostly from Mitchell Town and Tarentum, felt that the project would affect them personally. Most respondents (57%) indicated uncertainty as to whether the project would affect them or not.

The opinions of the residents were sought regarding the effect of the port and conveyor corridor on the following aspects of the community (**Figure 7-9**):

- Income/economic value

- Job Opportunities
- Pollution

One hundred and fifteen (115) respondents (77%) agreed that the port and conveyor corridor will have a positive effect on job opportunities in the community, while only eight (8), which accounted for 5% had a negative view. A positive outlook was expressed mainly from respondents from Mitchell Town and the areas within SE071. The respondents from the communities of Salt River, Tarentum and Brats Hill mostly commented they were unsure and accounted for 16%.

The effect on income and the economic value of the community was viewed in a positive light by one hundred and six (106) respondents (68%), while only thirteen (13) respondents (8%) had a negative opinion. The respondents who felt the project would have a positive effect and those who felt the effects would be negative were distributed similarly to those who commented on the effects on job opportunities.

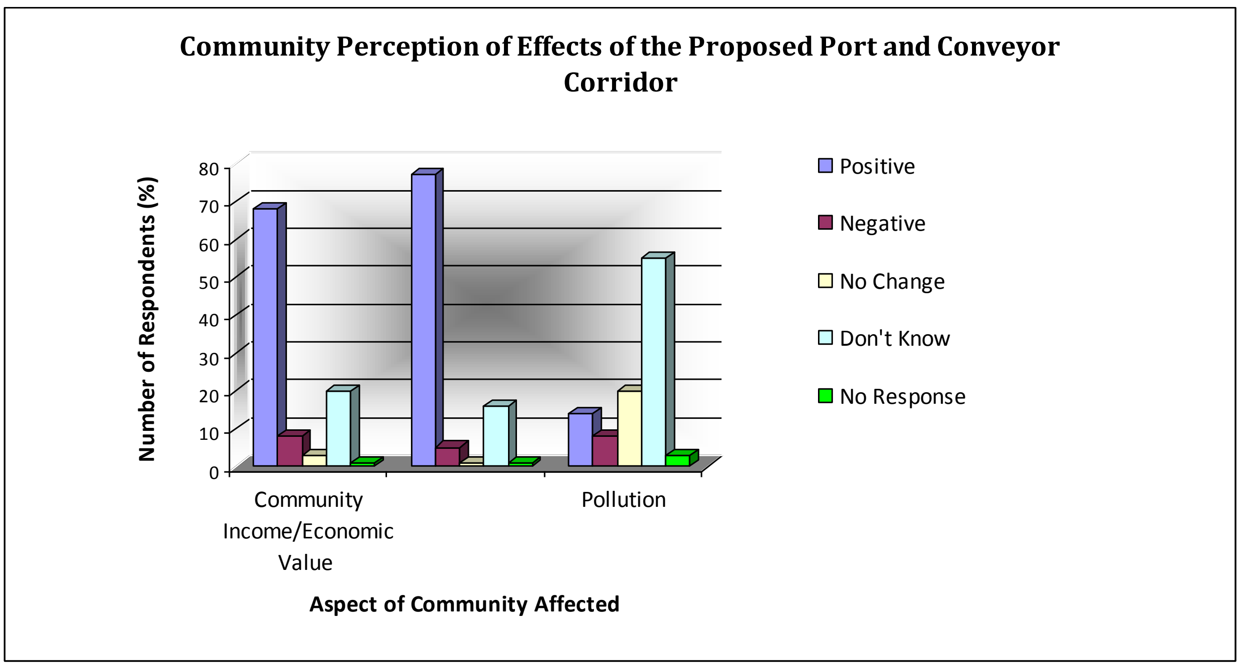


Figure 7-9: Community Perception of the Effects of the Proposed Port and Conveyor Corridor

The number of respondents who were unsure (86) increased dramatically when asked of their views of the effect of the port and conveyor corridor on pollution in the community. Fifty-five per cent (55%) of the respondents said that they did not know if the proposed project would have an effect on pollution in the area, and mostly came from Salt River and areas within ED SE071. Twenty-six respondents (20%) held the view that the project would effect no change in pollution while an even smaller number (12) thought it would have a negative effect. The majority of these respondents came from Mitchell Town.

7.4.2.5 Interests and Use for Community Areas

Of the 154 individuals surveyed, only 15% stated that they relied on areas close to the quarry for livelihood. Firewood, bird shooting and farming were the most popular means of livelihood within areas close to the quarry among the respondents from Salt River and Mitchell Town. A large number of respondents (53%) stated other means of livelihood which included fishing, mineral spa and job opportunities.

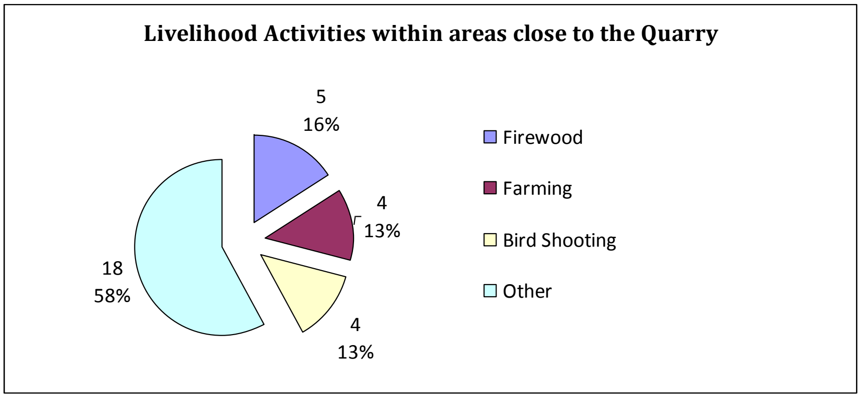


Figure 7-10: Livelihood and Activities within areas close to the quarry

Thirty-six per cent (36%) of the respondents stated that they used the area for recreational purposes, with the majority stating that they used the area once per week predominantly on weekends. The most popular areas used include the mineral spa in Salt River and Welcome Beach. This was deduced from the fact that 53% of the respondents use the mineral spa and 42% stated that they used Welcome Beach. Other areas used include the Mangroves and the hills of the Brazilletto Mountains.

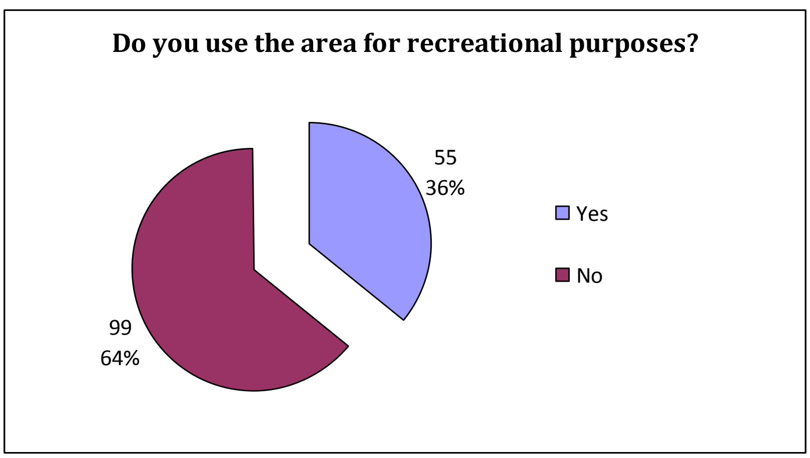


Figure 7-11: Area used for Recreational Purposes

7.5 Conclusion

The survey has revealed that the individuals who could be most affected by the project are the residents of Mitchell Town, Salt River, Tarentum and Brats Hill. Limited employment opportunities, poor roads and a lack of utilities, especially water, appear to be the major dislike among the residents of these communities. With a majority of the respondents obtaining water from water trucks and collecting rainwater in tanks, as much as sixty-three per cent (63%) had the opinion that they did not have access to safe water. On the other hand most residents appreciated the quietness of the community and the lack of crime and violence and they accounted for the majority of the respondents (34% and 26% respectively).

The knowledge of existing mining operations in the area is relatively high as 66% of the respondents expressed awareness of such activities. However, a majority also expressed negative experiences associated with those activities with 26% stating that damage to their property was prevalent and 16% having problems with noise. Employment was the major positive experience expressed by the respondents.

Word of mouth, this survey and community representatives were the most popular means through which information about the proposed port and conveyor corridor passed through these communities. As a result as much as (61%) of the respondents were aware of the plans, and mostly came from the communities of Tarentum and Salt River. The project was perceived by most of the respondents to have a positive effect on job opportunities and the economic value of the community. A reasonable number of respondents indicated that they did not know what the effect would be. This was particularly the case for the perceived effect on pollution. Only a very small number of respondents (8%) felt the project would have a negative effect, while others thought it would have no impact. In essence, a majority of the respondents had a positive outlook on the project.

However, consideration has to be given to Welcome Beach and the mineral spa in Salt River because together, these areas provide recreational uses for approximately 95% of the respondents. Areas in proximity to the quarry are also critical to bird hunters, farmers and charcoal producers who use these areas for their livelihood.

DETERMINATION OF THE POTENTIAL IMPACTS OF THE PROPOSED PROJECT

8 Determination of the Potential Impacts of the Proposed Project

8.1 Introduction

This proposed development has the potential to create a variety of impacts if it is permitted for implementation. These potential impacts can be either positive or negative depending on the receptors involved and other parameters such as magnitude, duration, project management and monitoring. Since this report is geared primarily towards identification of potential environmental impacts their definitions and significance are presented in greater detail in the appendix, especially to assist the public review process (See **Appendix VI**).

8.2 Impact Identification & Mitigation

This project will provide employment opportunities during all phases of the project (pre-construction, construction and operation). Additionally, RINKER will utilise existing contractors and engineers where available in the immediate area, who may seek to employ residents of the surrounding communities due to their proximity to the project site, and their knowledge of the area and operations there.

Foreign Exchange Earnings/Benefit to Economy – The proposed development represents an investment of at least US$300 million to the Jamaica economy in new investment. The Island should see increased revenues from Income, Royalties and General Consumption Taxes resulting from the future use of the Port and Quarry. This is a significant positive, both direct and indirect, long-term impact on the economy of the communities and the country.

The following tables provide a clear indication of potential environmental impacts associated with this project, and provide information on potential receptors, duration, magnitude, and mitigation measures. Since these are potential impacts, there is no certainty that they will materialize. However, the developers will be prepared to address any adverse impacts should they arise during any phase of this project.

Mitigation costs associated with this project have been incorporated into the overall project cost.

8.2.1 *Impacts to Physical Resources*

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Aesthetics							
Pre-Construction, Construction, Operation	Humans	***Item A1*** – The clearance and removal of vegetation from various areas will result in a visually negative impact as it represents a change from what is customary. Similarly, the construction site. All activities on the site will be carefully examined to ensure as little impact on the surrounding community as possible	Low & Short-term	Limited & Minor Negative	High & Direct	Proper upkeep and maintenance of the site will be done. Vegetation cover will be maintained along the conveyor corridor to reduce the visual impact. Where necessary, hoarding of not less than 2.4 m above ground level should be provided along the entire length of that portion of the site boundary except for any site entrances or exits. Other measures include: minimizing height of temporary structures, replanting of disturbed vegetation, and the re-use of topsoil stripped during site clearance.	Minor
		Item A2 – The minimal clearance and removal of mangrove and seagrass from various areas will result in a visually and ecologically negative impact as it represents a change from what is customary. All activities on the site will be carefully examined to ensure as little impact on the surrounding community as possible	Low & Long-term	Regional & Major Negative	High & Direct (Cumulative)	Mangrove and Seagrass replanting will be done on a scale not exceeding 3:1, and be monitored externally by NEPA and any other required agency. This will follow the impact assessment and mitigation measures outlined in Section 6. On completion of the proposed project, the mangrove parallel the proposed conveyor will be protected and monitored regularly to ensure it continues to perform a key role in the development of the region. The scarification through timber felling, squatting and illegal solid waste dumping will be eliminated and wetland flora and fauna will be maintained or improved upon. A management and operation plan will be implemented so that the development can be properly maintained. Effective monitoring and solid waste storage and disposal must be put in place so that the cleanliness of the facility and its environs is maintained.	Positive
Geological and Geotechnical							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item GG1*** – In a few areas, slope reinforcement and stabilization may be required to eliminate the potential for erosion. If the overall width of the conveyor route is kept at a minimum and within prescribed contour elevations the potential for erosion to occur should be reduced.	Moderate & Long- term	Local & Minor Negative	Low & Indirect	Construction planning and monitoring should ensure that all agreed slope reinforcement and stabilization designs are properly implemented.	Minor
		Item GG2 – The inclusion of existing drainage features (which will be upgraded, where necessary) into the project's overall drainage design will allow for better control and management of stormwater which will reduce or eliminate erosion and limit associated impacts of silting and sedimentation on coastal waters.	Moderate & Long- term	Local & Minor Negative	Low & Direct	A properly designed drainage system will be a feature of the proposed development. Once implemented along with other protective measures such as silt screens, as necessary, will provide adequate protection for land stabilization. All effort will be made to ensure that this aspect of the project is implemented. Vegetated areas outside the design footprint must be maintained to reduce the risk of erosion. Stockpile material near drainage corridors must be bermed.	Minor

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Water Quality, Surface Water Hydrology and Groundwater							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item WQ1*** – The impact on water quality is confined to groundwater infiltration on Colon & Peake Bays. The impacts on groundwater of this project will be negligible as there are no chemicals, waste streams or disposal activities associated with the development that stands to affect groundwater with the exception of sedimentation. The coastal waters may be impacted if significant erosion takes place primarily during the pre-construction and construction phase. The coastal area may be impacted negatively by siltation and sedimentation if a problem with soil erosion is realised.	Low & Long -term	Local & Minor Negative	Low & Indirect	The water quality of these systems will be evaluated on a periodic or event basis to determine if negative impacts are being realised. The project monitoring phase will play a major role in this activity. The mangrove will provide natural filtering systems, and will enhance any measures put in place by the developers such as silt/sediment screens and landscaping to offset the possibility, primarily during construction. Stockpiles should be kept at least 25m from the coastal waters edge and be properly bermed. A wastewater treatment facility should be put in place to handle all effluent streams prior to any discharge into the coastal waters. It is recommended that portable chemical toilets be used at the Port area and a fully functional tertiary treatment system to be put in place at the quarry. Effluent quality must meet or exceed NEPA's Trade Effluent and/or Irrigation Standards All drainage features to be designed must meet a minimum 1:25 year return period.	Minor
Air Quality							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item AQ1*** – During site clearance and construction activities, there is a possibility that stockpiles of various materials associated with the proposed project may have to be maintained in the project area. These stockpiles, without proper management and monitoring can dry out and result in fugitive dust formation which can be dispersed in the wind affecting air quality. This is a short term, reversible and mitigable impact.	Moderate & Short -term	Local & Minor Negative	Low & Indirect	All stockpiles of construction material should be kept onsite for a minimum amount of time. This will limit the potential for stockpiles drying out and becoming airborne. If unavoidable, the stockpiles should be wetted or in the worst case covered to limit dispersion of dust. Stockpile material that may generate fugitive dust should be totally covered during transportation on land (truck). Proper personal protection equipment (PPE) devices such as face mask should be provided to workers where necessary.	Minor
		Item AQ2 – Various mechanical equipment and vehicles are expected to be used at the project site. The heavy duty vehicles are expected to be primarily diesel fuel vehicles. When properly maintained heavy duty vehicles can operate without causing a significant decrease in air quality. However, if maintenance is poor, excessive fugitive emissions may result.	Low & Short-term	Local & Minor Negative	Low & Indirect	Heavy duty equipment and vehicles using diesel fuel must be properly maintained and inspected at regular intervals. As much as possible, all vehicular maintenance should be done at an approved off-site maintenance location such as a garage. Vehicles causing excessive fugitive emissions should be removed from service.	Minor
		Item AQ3 – The removal of vegetation from the site during site clearance activities may increase the potential for particulate matter to get into the atmosphere. This is as a result of exposed soil that may dry out.	Low & Short-term	Local & Minor Negative	Low & Indirect	During site clearance activities, the area must be monitored and dust suppression techniques put in place as needed.	Minor

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Noise							
Pre-Construction, Construction, Operation	Humans and Fauna	***Item N1*** –Vehicles and site activities, and various mechanical equipment, can generate noise that may exceed acceptable levels.	low & Long-term	Local & Minor Negative	Medium & Direct	Silencers or mufflers on construction equipment should be properly fitted and maintained. If site activities are known to be noisy, they should be scheduled at times least likely to impact those in hearing distance.	Minor
		Item N1 – The conveyor to be installed will result in noise being generated over long hours. The use of this conveyor has the potential to be a nuisance to residents	Moderate & Long-term	Local & Major Negative	Medium & Direct	The rollers, belts and all other components of the conveyor should be properly insulated and housed in covered corridors in the immediate vicinity of residential communities. Operating schedules should be maintained at times least likely to impact those in hearing distance, as much as possible. PPE devices such as ear muffs should be provided to workers where necessary. Noise reduction should be addressed under the occupational, health and safety standards to be implemented by RINKER.	Minor

8.2.2 *Impacts to Biological Resources*

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Marine Resources							
Pre-Construction, Construction, Operation	Marine Fauna	***Item MR1*** – The marine community may be affected mainly during the pre-construction and construction phases due to the possibility for increases in turbidity through increased sedimentation and/or siltation within the drainage corridor. This potential impact is particularly in the form of a loss of biodiversity.	Moderate & Long-term	Local & Major Negative	High & Direct	Conditions that can lead to soil erosion should be avoided. Drainage channels should be routed through the mangrove area to allow for entrained sediments to fall out. If deemed necessary, silt/sedimentation screens should be installed prior to discharge into Colon Bay. It is not envisioned that the project will have a negative impact on Colon Bay if these mitigation measures are implemented.	Moderate
	Marine Flora	***Item MR1*** – Seagrasses will be affected mainly during the pre-construction and construction phases due to the proposed dredging and land reclamation activities. This potential impact is particularly in the form of a loss of biodiversity.	Moderate & Long-term	Local & Major Negative	High & Direct	A seagrass rehabilitation and/or relocation exercise must be conducted. This should follow the measures put forward in Section 6. This plan must address areas within the immediate region where seagrass loss has been experienced and seagrass relocation would be considered ideal. A monitoring plan should be formulated.	Moderate
Terrestrial Wildlife Resources							
Pre-Construction, Construction, Operation	Fauna	***Item WR1*** – The potential for the loss of wildlife resources exists within the immediate area. This loss is temporary since any resident wildlife will temporarily relocate to surrounding areas that are not affected. No region-specific wildlife resource occupies the area that will be endangered should this project be permitted. The proposed protection of the mangrove will maintain the conditions for the existing wildlife resources, particularly the avifauna.	Low & Long-term	Local & Minor Negative	High & Direct	The removal of wildlife resources and their ecological habitats is unavoidable notwithstanding the fact that the area is disturbed through the various charcoal burners, bee-keeping and squatting. Wildlife is mobile in nature and will more than likely relocate to other areas in the vicinity where they are less likely to be in danger. Those deemed important will be tagged, relocated or otherwise placed in a nursery during site clearance and construction to be restored in the immediate vicinity. Special effort must be made to protect wildlife such as crocodiles, manatees and sea turtles that may be in the area, as well as worker safety. Sitings should be recorded in a log book specifically designed for that purpose. NEPA should be contacted immediately to handle any necessary relocation should crocodiles venture onto the property and pose a problem to worker safety.	Minor
Terrestrial Vegetative Resources							
Pre-Construction, Construction, Operation	Flora	***Item VR1*** – In order to construct this development some aspects of the existing vegetation will be removed. This presents a loss of biodiversity within the immediate area. Established ecosystems will be lost. No region-specific endemic plant species were found in the area.	Major & Long term	Local & Major Negative	High & Direct	The removal of vegetation and ecological habitats is unavoidable and is the main trade-off to be made against the benefits to be derived from project implementation. Vegetation should only be removed within the design footprints. Any landscaping measures to be put in place must incorporate plants that are growing in the area only.	Minor
	Mangrove	***Item MR1*** – The mangrove will be affected mainly during the pre-construction and construction phases due to the installation of footprints for the elevated conveyor corridor. This potential impact is particularly in the form of a loss of biodiversity.	Moderate & Short-term	Local & Minor Negative	Low & Direct	A mangrove transplanting project must be conducted preferably within the immediate region where mangrove loss has been experienced. A monitoring plan should be formulated.	Moderate

8.2.3 *Impacts on Socio-Economic and Socio-Cultural Resources*

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Employment & Worker Health & Safety							
Pre-Construction, Construction, Operation	Humans	***Item E&HS1*** – This project will provide employment opportunities during all phases of project implementation, which will include residents of the surrounding communities due to their proximity to the project site, and their knowledge of the area and operations there.	Major & Long-term	Regional & Major Positive	High & Direct	No mitigation required, though re-training may be essential for certain class of operations	Positive
		Item E&HS2 –Occupational Safety Risk are associated with any working condition. This is primarily important where workers interact with moving and heavy equipment.	Moderate & Long-term	Local & Major Negative	Low & Indirect	Proper PPE should be issued to workers depending on the area they work in. This should include boots, ear muffs, goggles, gloves and hard hats at a minimum. Management should strictly implement a standard annual health and safety retraining exercise for all categories of workers. Compliance audits and accident/injury records must be done on a periodic basis.	Positive
Relocation/Compensation							
Pre-Construction, Construction, Operation	Humans	***Item H1*** – depending on the routing of the conveyor corridor, the potential exist for consideration of relocation	Minor & Short-term	Local & Minor Negative	Low & Indirect	No mitigation required. The preferred design alternative does not impact on any existing houses. No relocation and/or compensation required	Positive
Recreation & Heritage Sites							
Operation	Human	***Item CH1*** – The Salt River area is known to have areas that can be considered heritage sites and recreation areas.	Major & Long-term	Regional & Minor Positive	Medium & Indirect	The inclusion of a proposed protection and management status for the mangrove area will increase the importance of the area. No "heritage sites" will be affected by this development. No recreational facility will be affected by this development. Aspects of some recreational areas may be enhanced through proposed redesign and improvement works. The JNHT and the Police should be contacted immediately and all work stopped should human remains be found anywhere within the project boundaries. A similar protocol is recommended for the unearthing of historical artefacts.	Positive
Traffic [Land and Marine]							
Pre-Construction, Construction, Operation	Humans	***Item T1*** – The existing main roads will be used to deliver and remove any materials, and equipment to and from the proposed site location that cannot be barged in. The added vehicles and the frequency of their movement have the potential to add to the existing volume on the roads during peak usage periods.	Moderate & Short-term	Regional & Minor Negative	Medium & Direct	At a minimum, proper ingress and egress must be designed into the development plans to accommodate the smooth flow of traffic in and out of the port development through all phases of the project. Heavy duty vehicles such as trucks should be scheduled to deliver and/or remove construction waste during off-peak times. During operation there will be limited impact on the existing traffic in the area. The project does not propose to add to the existing traffic volumes and may reduce current truck traffic associated with current contract deliverables. This will eventually be realised	Minor

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
						through rail usage. Hence truck traffic will be eliminated over time.	
	Humans, Flora and Fauna	***Item T2*** – The existing shipping channel may be used to deliver and remove materials and equipment to and from the proposed site location. The added marine vessels and the frequency of their movement have the potential to add to the existing volume within the shipping channel during peak usage periods.	Low & Short-term	Regional & Minor Negative	Low & Indirect	At a minimum, the developers will engage JAMALCO and other marine interest to educate them on the proposed development plans. This will facilitate good communication and reduce likely impacts. Proper scheduling on the part of the developers will also ensure there are no incidents during peak travel periods, particularly as it relates to the JAMALCO port. During operation there will be a new shipping channel and this will mitigate any incidents with other marine interest.	Minor
Solid Waste							
Pre-Construction, Construction, Operation	Humans/Marine	***Item SW1*** – Site clearance activities during the pre-construction phase and other waste from packaging and materials in the other phases will generate solid waste. If these waste streams are not properly managed then the potential exists for a negative impact. A properly implemented and executed solid waste management plan can remove this negative potential.	Low & Short-term	Limited & Minor Negative	Low & Indirect	All solid waste generated during all phases will be collected, handled and disposed of appropriately. Centralized storage areas (dumpsters, compactors, etc.) will be located within the development for proper solid waste handling and storage. Solid waste removal will be facilitated by using approved licensed haulage contractors. A comprehensive on-site waste management plan will be prepared for the construction period. Such a management plan will incorporate site specific factors, such as the designated areas for the temporary storage of solid waste.	Minor
Sewage Waste							
Pre-Construction, Construction, Operation	Humans and Fauna	***Item SeW1*** – The potential for sewage waste pollution during site clearance and construction activities exist though remote.	Low & Short-term	Limited & Minor Negative	Low & Indirect	The use of regularly serviced portable chemical toilets will negate this potential negative impact. Sewage handling and disposal will be effectively managed as part of the project management and monitoring plans.	Minor
Storm Water Management							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item SWM1*** – The potential for storm surge inundation/damage during site clearance and construction activities exist during adverse weather conditions such as hurricanes and tropical storms.	Moderate & Long-term	Regional & Major Negative	High & Direct	A storm surge disaster plan should be drafted if the project is advanced. This should be designed with the assistance of ODPEM, the Jamaica Fire Brigade and participation of JAMALCO.	Minor
Oil Spill Contingency							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item OSC1*** – The potential for oil spill damage during site clearance and construction activities exist during adverse weather conditions such as hurricanes and tropical storms as well as vessel mishaps	Low & Long-term	Regional & Major Negative	High & Direct	An oil spill contingency plan will be drafted if the project is advanced. This will be designed with the collaboration of NEPA, ODPEM, Marine Police, and participation of JAMALCO.	Minor

8.3 Cumulative Impact Assessment

The potential cumulative impacts as a result of this development are as follows:

- Impacts to Biological Resources
- Impacts to Physical Resources
- Impacts on Socio-Economic and Socio-Cultural Resources

8.3.1 *Impacts to Physical Resources*

The surrounding economic zone comprises; bauxite-alumina ports, energy generation facilities, commercial boatyards, piers, various land-based commercial shops, and a recreational firing range.

Water demands for the proposed development have been considered in conjunction with present usage patterns and known capacities. In terms of potable water demand, the proponents will be considering commissioning groundwater well development to adequately supply the proposed project and the Salt River community, based on water quality. The cumulative impact of water supply to the development would not be to the detriment of other users presently being supplied by well water in the area.

Sewerage demands for the proposed development have been considered in conjunction with present usage patterns and known capacities. No centralised sewage network exists in the area. As a result, RINKER will be seeking to construct a tertiary level sewage treatment plant to process all sewage and drainage waters that will be generated from the construction stage through the operational stage of the overall development (including proposed quarry expansion) at the plant west of the Salt River community. Additionally, the treated effluent will be regularly analysed to ensure it meets existing standards. With this system implemented, the development will not add any new stresses on the existing environment.

The proposed project area is not known to be prone to land-slippage though coastal erosion is known to occur during periods of significant storm surge and hurricane activity. It is not to the benefit of RINKER to construct this development in a manner that will result in erosion or land slippage; in fact any area(s) deemed to be susceptible will be reinforced. The proposed development is not expected to affect the stability of soils in the area. No measurable cumulative impact.

A post-hurricane assessment showed that physical damage to port facilities and power plants in the Salt River – Old Harbour Bay region was significant[25]. The most significant destruction (75%) occurred at JAMALCO's port at Rocky Point, which required temporary logistical support from WINDALCO. The damage done by Hurricane Ivan in 2004 was primarily to the conveyor belt that leads to the ship loader. Shoreside damage also included the roofs for the administrative and shop areas, along with the electrical poles and lines.[26] The peninsula roadway was also flooded due to the storm surge which also affected the railway. The design for the port has taken into consideration winds and waves consistent with such natural phenomenon.

The armoured revetment on the dockside will reduce shoreline erosion and be a positive contribution to the peninsula stability. The proposed port will also be in a more sheltered area of the bay. No negative impacts are expected from the proposed development as it relates to JAMALCO's operations.

Cumulatively, there will be a change in land use in the immediate area of the port and transportation corridor.

8.3.2 *Impacts to Biological Resources*

Biological resources of the area are being impacted at present from illegal charcoal burning, hunting and squatting. The aquatic and/or marine environment is already potentially impacted by the existing JAMALCO port and from energy generators, fishing beach to other bauxite-alumina port.

If properly implemented and managed, discharges from the development (storm water, treated effluent) will meet or exceed discharge standards in the bay.

It is not anticipated that the development will significantly add to any existing impacts resulting in worsening of the cumulative impact. To the contrary, the reduction of squatting, illegal solid waste disposal and illegal removal of mangrove for charcoal and the associated chemicals may result in an improvement in the quality of runoff and drainage into Colon Bay.

The loss of vegetated land is not a major impact (since the area shows signs of previous disturbance) and will not add significantly to any cumulative impact.

Impacts to groundwater should not be realized from this development. There is no real source of groundwater contamination associated with this development. There is possibly seepage from

[25] JBI – An overview of Jamaica's Bauxite Industry.
http://www.bunting.org.jm/pdfs/JBI_An%20Overview_of_Jamaica's_Bauxite_Industry.pdf
[26] Jamalco 2004 Sustainability Report. http://www.alcoa.com/jamaica/en/pdf/jamalco_sustain_04.pdf

long established septic systems and improperly treated sewage from residential areas (faecal coliform), and any unknown sources will not be increased significantly.

Where biological resources could be lost, the proponent – RINKER, is willing to assist in addressing mitigation through an environmental fund designed to manage the Portland Bight area and the Salt River wetlands in particular, through the management effort of the mandated agency – CCAM.

The impacts to seagrass and mangroves and proposed mitigations are collectively dealt with in Section 6.

The seagrass meadows in the region may also support the protected sea turtles that may nest within the region. There are no known turtle nesting in the immediate area slated for the project. Additionally, not much in the way of beaches exists within this area. Salt Island and Welcome Beach to the east and north-east respectively are more likely turtle nesting grounds. Sea turtles are not known to nest within mangroves.

However, despite this claim, the developer will ensure the following to mitigate any likelihood of impact to sea turtles. The proponents will develop materials that will enable workers and visitors to distinguish sea turtle species on the basis of nesting crawls, nest sites, eggs, hatchlings, etc. with the assistance of the relevant organisations such as NEPA and C-CAM.

1) *Artificial lighting*: Sea turtles, especially hatchlings, are profoundly influenced by light. Baby sea turtles, freshly emerged from the nest, depend largely on a visual response to natural seaward light to guide them to the ocean. In zones of coastal development, sources of artificial light distract hatchlings so that they turn away from the sea and crawl landward. It is essential that artificial light sources be positioned so that the source of light does not present a negative impact on sea turtles in the area, while providing the security that is required of an international port. Low pressure sodium lights should be used to the maximum extent possible. Low intensity, ground-level lighting is encouraged. Night time and security lighting should be mounted not more than 5 m above the ground and should not directly illuminate areas seaward of the line of permanent vegetation. Window shading is recommended.

   Natural or artificial structures rising above the ground should be used to the maximum extent possible to prevent lighting from directly illuminating the area and to buffer noise and conceal human activity. Planting native or ornamental vegetation, or using hedges and/or privacy fences is recommended.

2) *Shoreline stabilization structures*: Security lighting in the area at night will be closely evaluated in light of the ecological requirements of endangered turtles.
3) *Vegetation cover*: All attempts will be made to preserve vegetation in the area. Creeping and standing vegetation stabilizes the area and offers protection against destructive erosion by wind and waves.
4) *Physical destruction of coral and sea grass*: As much as possible, seagrass removal will be limited to the extent of the proposed design. No coral will be destroyed in the construction of the port. All possible mitigation measures, such as the use of silt screens, must be incorporated during the construction of the port facility.

Fauna such as crabs, birds and crocodiles are migratory and will not be significantly impacted by the proposed development. Workers will be educated on the protected status of crocodiles and all mitigation measures outlined in the EIA will be adhered to.

Special effort must be made to protect wildlife such as crocodiles, manatees and sea turtles that may be in the area, as well as worker safety. Sitings should be recorded in a log book specifically designed for that purpose. NEPA should be contacted immediately to handle any necessary relocation should crocodiles venture onto the property and pose a problem to worker safety.

The loss of mangrove and seagrass habitat proposed to facilitate this project, represents less than one (1) percent of the existing mangrove habitat and less than five (5) percent of seagrass habitat.

While RINKER is committed to implementing the best available environmental practices in this project, there is the potential for other indirect impacts unless appropriate mitigation measures are implemented, particularly during any near-shore works. Such mitigation measures mainly relate to controlling the potential for impacts to water quality.

As with all other projects occurring at the land-water interface, the control of erosion, sedimentation and other water quality impacts is a key issue. Given the existing level of disturbance in the vicinity of the proposed project area and the fact that any activities associated with the dredging works would incorporate implementation of appropriate environmental management and impact mitigation measures, the potential impacts are unlikely to be substantial or significant with regard to the marine and aquatic communities.

It should be noted, however, that the Rocky Point Peninsula is in fact a built environment. The region was modified to build the JAMALCO Port. It was constructed using coral material in the late 1960s-early 1970s. The wetlands on either side of the peninsula road can thus be considered secondary and not primary as they grew in relation to the newly created land; similarly, the extent of seagrass meadows on the north of the peninsula.

Despite this, all efforts must be made to ensure the continued presence of both the mangroves and seagrass meadows and by extension the wetland ecosystem. Every effort has been made to avoid impacts to the struggling coral heads, such as building the new port at least 100m west of the western most coral head.

Dredge and fill activities have been widely recognized as a major anthropogenic disturbance contributing to the destruction of seagrass meadows. The direct and immediate effect of dredging on seagrass communities is mortality due to removal and/or burial. In addition, there are indirect losses resulting from the disturbance of sediments during dredging operations. Sediment disturbance results in increased turbidity, and decreased light availability. Seagrasses have high light requirements and the decreased light availability associated with sediment re-suspension has been closely associated with seagrass loss (Texas Parks and Wildlife, 1999).[27] It must be noted that the survivability of replanted seagrass is exceedingly low. Seagrass will naturally colonize the ocean floor where conditions suitable for their growth and development exist.

8.3.3 *Impacts on Socio-Economic and Socio-Cultural Resources*

The region has an existing commercial and industrial zone. The introduction of another port will have a positive impact on the socio-economics of the area. Residents will have new job solutions in closer proximity to their place of living. From a cumulative perspective, this project would be a benefit since employment solutions are in high demand in the area. However, there are other aspects that cumulatively, will be impacted by this project, primarily to JAMALCO's port operations[28] as follows:

1) JAMALCO Port

   The project will not impact the existing port operations. As detailed in the Project Description section, a separate shipping channel will be utilized.

2) Proposed JDF Coast Guard Base

   There are proposed plans to install a base of operations for the JDF Coast Guard and also the JCF. The proposed location may be in conflict with the proposed RINKER Port. RINKER currently has an agreement with JAMALCO regarding the proposed port location; therefore, any impacts to this proposal will be largely land-use. The area has sufficient land to facilitate all three possible operations.

The project will not impact the proposed JDF/JCF base.

3) Proposed Nature Reserves & Proposed Eco-Tourism Initiatives – Clarendon Express

[27] http://www.epa.gov/gmpo/habitat/seagrassmanagementplan.pdf
[28] Jamalco 2004 Sustainability Report, http://www.alcoa.com/jamaica/en/pdf/jamalco_sustain_04.pdf

The "Clarendon Express," a JAMALCO sustainable project to boost tourism on Jamaica's south coast was launched. The project is designed to integrate government, industry, community groups, and individuals by linking Jamalco properties— Halse Hall and Whitney Estate, rehabilitated mine sites, and the Rocky Point Port—by rail line.

The project will not impact this venture, provided any schedule constraints can be agreed. The main negative impacts are the port facilities, which if managed properly will be minor.

However, it should be reiterated that Rinker Jamaica and JAMALCO have entered into a joint management approach of the entire Rocky Point Peninsula. This to ensure no piecemeal development of the peninsula and major elements for environmental sustainability as well as crime prevention and protection are in place.

8.4 Impact Matrices

Table 8-1: Impact Identification of the Proposed Development

	EIA Activities																
	Site Preparation				Construction								Operation				
	Site Surveying	Site Clearance	Site Access	Solid Waste Disposal	Materials Sourcing	Materials Transport	Materials Storage	Construction Works	Solid Waste Disposal	Sewage Treatment	Surfacing/Paving	Landscaping	Traffic	Solid Waste Disposal	Water Supply	Electricity Generation	Increased Marine Traffic
Physical Parameters																	
TOPOGRAPHY																	
GEOLOGY & GEOTECHNICAL																	
AMBIENT NOISE & VIBRATION																	
WINDS																	
RAINFALL																	
NOISE AND DUST																	
DRAINAGE																	
WATER QUALITY																	
TEMPERATURE																	
NATURAL HAZARD VULNERABILITY																	
Ecological Parameters:-																	
TERRESTRIAL ECOSYSTEMS																	
TERRESTRIAL VEGETATION																	
AVIFAUNA																	
OTHER FAUNA																	
MARINE ECOSYSTEMS																	
MARINE VEGETATION																	
MARINE FAUNA																	
SENSITIVE HABITATS																	
Socio-Economic Parameters:-																	
AESTHETICS																	
LAND USE COMPATIBILITY																	
EMPLOYMENT																	
STRUCTURES/ROADS																	
WASTE MANAGEMENT																	

	EIA Activities																
	Site Preparation				Construction								Operation				
	Site Surveying	Site Clearance	Site Access	Solid Waste Disposal	Materials Sourcing	Materials Transport	Materials Storage	Construction Works	Solid Waste Disposal	Sewage Treatment	Surfacing/Paving	Landscaping	Traffic	Solid Waste Disposal	Water Supply	Electricity Generation	Increased Marine Traffic
TRAFFIC ON THE ACCESS ROAD																	
INCREASED CRIME POTENTIAL																	
HAZARD VULNERABILITY																	
SEWAGE DISPOSAL																	
OCCUPATIONAL HEALTH & SAFETY																	

KEY

No Impact

Minor Negative

Major Negative

Minor Positive

Major Positive

Table 8-2: Impact Mitigation Matrix - Residual Effect (Pre-Construction Phase)

	Proposed Mitigation Measures													
	Detailed Topographic Surveys	Effective Site Management	Scheduling of Construction Activities	Waste Management Plan	Regular Solid waste collection	Placing of Solid waste Receptacles	Road Paving and Surfacing	Dust Management Techniques	Proper Vehicle Maintenance	Installation of Sediment Traps	Security & Fencing	Positive Impact No Mitigation	Community Relations	Flora & Fauna Relocation
Impacts – Pre-construction Phase														
Clearing of Site Vegetation														
Levelling of Site														
Transportation of Construction Material														
Increase in Noise														
Increase in Dust														
Disturbance of flora and fauna														
Aesthetics														
Increased Traffic														
Increased Employment														
Road Wear														
Increased Sedimentation of Coastal Waters														
Change in the Natural Drainage Patterns														
Solid Waste Generation														
Disturbance of Sensitive Habitats														
Increased Earning Potential for Community														
Trespassers into Conservation Area														
Traffic Inconveniences														
Seagrass Relocation & Monitoring														
Mangrove Replanting & Monitoring														

Table 8-3: Impact Mitigation Matrix - Residual Effect (Construction Phase)

	Proposed Mitigation Measures															
	Detailed Topographic Surveys	Phasing of Building Plans	Scheduling of Construction Activities	Waste Management Plan	Regular Solid waste collection	Placing of Solid waste Receptacles	Road Paving and Surfacing	Dust Management Techniques	Proper Vehicle Maintenance	Landscaping Measures	Effective Site Management	Security & Fencing	Installation of Sediment Traps	Scheduling of Heavy Vehicles	Positive Impact No Mitigation	Community Relations
Impacts - Construction Phase																
Increased Employment																
Preparation of Site																
Transportation of Construction Material																
Increase in Noise																
Increase in Dust																
Occupational Health & Safety Concerns																
Aesthetics																
Increased Earning Potential for Community																
Increased Traffic																
Road Wear																
Increased Sedimentation of Coastal Waters																
Change in the Natural Drainage Patterns																
Solid Waste Generation																
Sewage Disposal																
Trespassers into Conservation Area																
Disturbance of Wetland Communities																

Table 8-4: Impact Mitigation Matrix - Residual Effect (Operational Phase)

	Proposed Mitigation Measures							
	Community Wide Plan	Operation & Maintenance Plan	Regulatory Monitoring	Waste Management Plan	Regular Solid waste collection	Placing of Solid Waste Receptacles	Security & Fencing	Landscaping Measures
Impacts - Operational Phase								
Increased Employment opportunities	Positive			Negligible				
Sewage Treatment System Management		Negligible	Negligible	Negligible				
Drainage Patterns	Negligible		Negligible	Negligible		Negligible		Positive
Solid Waste Management		Negligible	Negligible	Negligible	Positive	Positive		
Water Conservation		Negligible		Negligible				
Energy Conservation		Negligible						
Aesthetics		Negligible		Negligible	Positive	Negligible	Negligible	Positive
Regulatory Compliance			Positive	Negligible		Negligible		
Trespassers in Conservation Area	Positive	Negligible					Positive	
Fugitive Dust	Negligible		Negligible	Negligible				Positive
Increased Earning Potential for Community	Negligible	Negligible						
Seagrass Relocation & Monitoring	Negligible	Negligible	Major					
Mangrove Replanting & Monitoring	Negligible	Negligible	Major					

KEY (Appendix VI)

- Major
- Moderate
- Minor
- Negligible
- Positive

ENVIRONMENTAL MANAGEMENT PLAN

9 Environmental Management Plan

9.1 Introduction

An Environmental Management Plan (EMP) is necessary for this project, particularly during the operational phase of the project. The primary objective of the EMP is to ensure that the project complies with the terms and conditions of NEPA and other applicable and relevant authorities. The plan will provide guidance in the following areas:

1. Training of managers and staff
2. Solid waste handling and disposal
3. Hazardous material storage and disposal
4. Sewage treatment and disposal
5. Natural Hazards Management

As required or as necessary, active environmental monitoring will be undertaken to provide quantitative information on the state of the environment as it relates to the phases of the project.

Areas of concern are:

- Water quality
- Air quality
- Noise levels
- Land rehabilitation
- Creative conservation

9.2 Emergencies: Response, Preventative Measures & Contingency Plans

9.2.1 *Natural Hazard Management*

It is necessary to develop a hazard response plan to offset the worst effects of hurricanes on the project area. This plan will be prepared as a separate document on the advice from the Office of Disaster Preparedness and Emergency Management (ODPEM).

Losses due to hurricanes can be reduced through an effective response plan. The principal features of such a plan are:

- Comprehensive risk assessment based on historical precedent and vulnerability of the site. Distribution of occurrences, frequencies of wind strengths and direction, and frequencies of storm surges.

- Appropriate preventative design and engineering (e.g. structures built to withstand hurricane force winds etc.)
- Public awareness and staff training in disaster response
- An effective national warning system

9.2.2 *Operational Hazard Management & Safety*

A clearly defined emergency response and preparedness policy will be developed and brought to the proposed project. An effective response is seen as the direct outcome of quality environmental management and comprehensive training and awareness of safety procedures. The principal objective of emergency preparedness is to localize accidents, and if possible contain and minimize them.

9.2.2.1 Response Plan

The defined emergency response plan is necessary for training and implementation purposes at the work site should the project be approved.

The proposed development should have an Emergency Response Plan, which will provide guidelines to allow for flexible response to a range of potential circumstances. The plan would include:

- Chain of command and coordination procedures
- Lines of communication
- Means of obtaining needed information and assistance

Copies of the plan or relevant portions will be strategically located at vantage points across the property to allow for immediate access.

All employees should receive safety and emergency response training as a part of the initiation process.

9.2.2.2 Fire Safety

Considerations will be made for fire safety, especially during the dry season when forest fires are a possibility. All water stored on site for both domestic and potable should be made available for alternative emergency use for fire safety.

9.2.2.3 Severe Windstorm/Hurricanes

9.2.2.3.1 Pre-Planning

Terminals need to develop an actual plan that focuses on all stages of preparation throughout the year. This will include:

- Pre-season (hurricane season) site inspection for real property deterioration, repairs, cleaning, and so forth.
- Actual checklist to prepare personnel, site, and customers for each stage of storm development
- Develop a communications roster that delineates required notifications by office (or function), site personnel, and customer base.
- Roster designed for logical contact flow; i.e., terminal manager, terminal operators, region management, customer(s) point of contact, and public safety or emergency services
- Roster includes backup methods for establishing/maintaining contact Logistics Management must pre-determine if RINKER Jamaica facilities will be manned or evacuated during storms. If both requirements are possible, checklists to address site manning must be prepared. Critical records need to be identified by management so that terminal personnel can plan for protection by the various recommended methods. Possible candidates would be all permits, one-of-a-kind drawings, charts, or support data required for audits.

9.2.2.3.2 Elements of the Plan

The terminal needs to identify the critical areas and establish vulnerabilities—knowing what they are helps to identify the best loss prevention application.

Specify a specific month that each plan gets a thorough review for accuracy. Telephone numbers, personnel changes, reorganizations, operational changes since the prior year are examples of areas susceptible to frequent change.

Emergency generators, if planned for use, must have a designated purpose and training for special applications must be attained and documented. Generator tie-in to facility electrical service systems must be cleared by Logistics Management and performed by licensed electricians.

Procedures for “All Clear” announcements need to be obtained from the county emergency services department need to be established prior to storm arrival and understood by all personnel.

Situation reports (SITREP) pertaining to impact areas where RINKER Jamaica facilities are located requires predetermined report intervals up the chain of command. Minimum data elements should include a report of personnel and status of facilities, and to whom/where the data is sent.

Ordering emergency supplies: determine what constitutes emergency supplies—a minimum list should be developed for each site.

All sites require evaluation for flooding and damage potential to operations. Objective is to minimize equipment damage and return to full operational capability as soon as possible after the storm passes.

- Identify the problem areas (including storage areas)
- Determine the best prevention application (sand bags, berms, channels, covers, etc.) to minimize impact
- Plan for water removal.
- Pumps, hoses, and generators to run pumps
- Replacement parts susceptible to water damage on hand before the storm

9.2.2.3.3 Impending Windstorm

Each terminal would have a requirement to evaluate storm path and estimated arrival and compare to current terminal operations.

- Once the storm arrives, transportation routes could be degraded to severely impact the supply chain. Getting material before the storm could be instrumental in resuming and maintaining operations after the storm.
- Port facilities should coordinate with the nearest Coast Guard unit and get an evaluation of the storm effect to the waterway at the terminal. Will storm surge be an issue or not, are there other concerns that normally would not be a factor but is with this storm?

9.2.2.4 Water Hazards

The following are procedures to be used when working on or near bodies of water:

9.2.2.4.1 General

- Life vests approved for use by the Jamaican Coast Guard will be worn by employees working on or near bodies of water when the water depth is 1 m (~3 feet) or greater.
- Employees working on elevated surfaces (e.g., platform) greater than 1.2 m (4 feet) above water bodies should wear a 5-point harness and a lanyard of appropriate length in addition to the life vest.
- Water bodies should be posted with hazard information. When possible, water bodies that are accessible by the public should be fenced or barricaded

9.2.2.4.2 Dock Operations

- Written and diagrammed tie-off/mooring procedures shall be developed and implemented for RINKER Jamaica docks. Employees shall receive training in these procedures.
- Personnel assigned to work at the dock shall wear PPE appropriate for the duties performed
- Visitors to the dock must be authorized and shall be required to use appropriate safety equipment
- Unsafe conditions shall be reported to the site manager upon discovery. Repairs or other mitigation shall be completed as soon as possible after discovery
- Dock personnel shall not participate in towboat or switching activities unless trained to do so and directed to do so by the site manager
- Barge loading systems shall have “kill” or “idle” switches clearly marked. Barge and dock personnel shall be familiar with the switch operation and location
- Mooring lines and pipelines shall be adjusted as needed during loading and unloading to maintain control and to avoid hazardous strain and failure
- Hoses and attachments connected to barges shall be tied off during operations to minimize the potential for injury or damage should the hoses burst or accidentally disconnect
- Tools used during dock operations shall be inspected and repaired or replaced if damaged
- Barge electrical cables shall be disconnected and locked/tagged out before beginning electrical repairs
- Floatation compartments shall be vented at least 20 minutes before entering. In addition, confined space entry procedures shall be followed if entry into the compartment is required. Compartment air shall be monitored for % oxygen, presence of potentially explosive gas, and presence of volatile organic compounds before entry and while an entrant is inside the compartment.

9.2.2.4.3 Dock Communications

- If applicable, the dock shall be equipped with a properly licensed and operational VHF marine radio. Employees shall be trained to use and maintain the radio.
- Docks and captive barges shall be equipped with a telephone or a radio service capable of summoning emergency assistance
- Employees must use the “buddy system” (visual and/or verbal contact with a co-worker) when travelling from dock to ship/barge and the reverse.
- Barge and dock equipment operators must be in full visual contact with other personnel in the area when operating this equipment
- Barge operators and dock personnel shall maintain radio, visual, and/or voice contact during docking operations

9.2.2.4.4 Dock Night Operations

- Barges shall not be hooked up overnight if unattended
- Dock lighting shall be adequate for the performance of night work
- Employees shall use personal lights as needed
- Docks and barges must be equipped with navigation warning lights in accordance any Jamaican Coast Guard requirements. Warning lights shall be maintained in operational condition.
- Cleats, fittings, accessories, or other mounted items on docks that may pose a trip hazard shall be painted yellow

9.2.2.4.5 Dock Emergency Response Plan

- A written emergency response plan shall be located at the dock. Information required to be included in the plan is as follows:
- RINKER Jamaica emergency contact names and telephone numbers
- Telephone numbers for local emergency response organizations
- Written emergency response procedures specific to the site
- Location of emergency response equipment available for use at the dock
- Local agency contact names and numbers for reporting required by regulation
- The following emergency and rescue equipment shall be available for use at the site and shall be clearly identified and designated for emergency use:
- Portable lighting
- Rope
- Jamaican Coast Guard approved throw able flotation device with line attachment.
- Stretcher
- Oxygen and first aid supplies
- Emergency response procedures shall be included in employee training
- A mock drill of the emergency response plan shall be performed at least annually The emergency response plan shall be reviewed and updated as needed

9.2.2.5 Temperature Extremes

The procedures presented below shall be followed to limit the potential for heat or cold related illnesses.

<u>Heat Stress</u>

Be conscious of situations that can create heat stress, i.e., high temperatures, humidity and confined spaces.

- Have a cool water or carbohydrate electrolyte replenishment solution available. Drink small amounts of the water or the solution frequently to limit the potential for dehydration.
- Count the pulse rate for 30 seconds at the beginning of the break. If the pulse rate exceeds 110 beats per minute, shorten the next work period by one-third.
- Do not continue working if you become disoriented, feel nauseous, or become lightheaded. If these symptoms occur, take a break and drink cool water or a carbohydrate electrolyte replenishment solution. If the symptoms persist, seek medical assistance.
- Include salt in your food intake; salt tablets are not recommended.

9.2.3 *CEMEX Commitment to the Environment*

A century-long commitment to the environment

For almost a century, we've worked to operate our business with care for our people, our communities, and our environment. Our responsibility-as well as the effort and resources we've invested in environmental protection and promotion-have grown as we've grown: from our early efforts to build a safe and healthy workplace environment, to the World Environmental Center's Gold Medal for International Corporate Achievement in 2002.

Endorsed at the top

Our commitment to environmental protection is endorsed at the highest levels of our company. Our Board of Directors and Chairman and CEO drive the environmental policies and strategy setting for the entire organization through periodic reviews of our environmental policy and our environmental, health, and safety indicators.

Important environmental programs and initiatives

Our worldwide operations continuously implement new programs and initiatives to improve their environmental performance, minimize their environmental impact, and promote a better quality of life for their people and neighbouring communities. Our sustainability report reviews our environmental performance, including our progress in the following areas:

- Eco-efficiency program
- Air emissions control program
- Reforestation and green areas program
- Natural resources conservation program
- Relations with the community and non-governmental organizations (NGOs)

9.2.4 *RINKER's Environmental Management System*

RINKER's safety, health and environment (SHE) management system is based on high environmental standards. The RINKER board's SHE committee closely monitors RINKER's performance in managing workplace safety and protection for the environment.

The environmental component of the management system helps identify and manage potential environmental risks. Operations are assessed against the requirements of standards and improvements made.

9.2.4.1 Environmental Reporting

RINKER report environmental incidents based on five levels of severity: (1) minor, (2) significant, (3) serious, (4) severe and (5) extreme. Each year, RINKER report environmental incidents in their annual report. RINKER has increased their focus on accurate reporting of minor incidents meaning that they are even more aware of their operations potential impact – however small. This increased focus is to help identify actionable trends and improvement opportunities to prevent more significant incidents.

Audits are integral to the SHE management system, to ensure operations are meeting internal standards as well as external regulatory requirements. Such checks identify site issues so that corrective action is taken to improve performance and ensure legal compliance.

9.2.4.1.1 Improving environmental performance

RINKER believes that, as well as complying with the law, they should be progressively reducing the environmental impact of their operations, especially the amount of energy and water consumed and the amount of waste and carbon dioxide emissions generated.

In the US operations, RINKER Materials produces cement and cement based products. RINKER is actively working with the Portland Cement Association to reduce carbon dioxide emissions and energy consumption.

The two cement mills in Florida, at Miami and Brooksville, use state-of-the-art technology for emission controls. The third mill, to be built in Brooksville, will use the best available emission reduction technology to control emissions. All cement mills use low sulphur coal as their primary fuel and RINKER are recycling used vehicle tyres, which burn more cleanly than coal at high temperatures, as an additional fuel source.

9.2.4.1.2 Recycling and Waste Management

RINKER continually looks for opportunities to recycle waste where it cannot be eliminated. Many of the concrete plants reprocess excess concrete returned from jobs, as construction fill.

We strive to maximise water recycling. At the concrete plants, for example, stormwater and process water is reused for washing out trucks. Also, where materials specifications make it possible, recycled water is reused in concrete mixes. At the quarries, recycled process water and stormwater are used for suppressing dust.

RINKER Materials has fitted Envirowash equipment to concrete trucks in Arizona and Nevada to collect water used to clean pouring chutes after delivery, for recycling. The wash system enables drivers to clean their concrete chutes without the need for job site concrete washout areas.

At the Miami cement mill, a commercially operated environmental service is available which processes petroleum contaminated soils as part of the cement manufacturing process.

At Penrith quarry, west of Sydney, Readymix is gearing up to reprocess 50,000 tons (55,000 tons) a year of excess concrete from all of the Sydney plants. The waste concrete will be processed to reclaim 85 per cent of the original concrete as sand and aggregate.

9.2.4.1.3 Environmental Awards and Activities

RINKER has received many awards for their environmental efforts. Some of the more recent awards are listed below.

1. In the US, the National Stone Sand and Gravel Association (NSSGA) recognised RINKER Materials' Dogwood quarry, Georgia, with its 2005 National Stars of Excellence Award. As well, the NSSGA presented our Florida Brooksville quarry and Davenport sand mine with its Environmental Silver Eagle Award.
2. RINKER Materials West received the Arizona Governor's Award for Energy Efficiency, for the company's use of an innovative combustion catalyst system on its diesel generators to save fuel and reduce air emissions.
3. In Australia, Readymix was presented with three awards in the Victorian Department of Primary Industries' inaugural Strzelecki Awards for sustainable development in the earth resources industries for Karkarook Park, a rehabilitated sand mine joint venture.
4. Commerce Queensland and the Brisbane City Council both rewarded the people at our Tivoli quarry with environmental awards for their efforts in rehabilitating Sandy Creek in south east Queensland.
5. The Cement Concrete & Aggregates Australia industry association bestowed 13 state based environmental excellence awards on Readymix's concrete operations.

9.2.4.1.4 Environmentally Friendly Products

In Florida, RINKER Materials is a major supplier of pervious concrete, for use in surfacing driveways and parking areas. The concrete's porous structure allows rain water to pass directly through the pavement and into the ground, reducing problems with stormwater runoff.

The RINKER group manufactures a range of innovative pre-cast concrete/fibreglass devices, installed underground, that remove oil and sediment from stormwater from roads and car parks, so that clean water flows into waterways. They are sold as Stormceptor™ in the US and Humeceptor™ in Australia.

9.2.4.1.5 Partnerships

In the US, RINKER Materials has formed several partnerships with organisations to help contribute with our broader environmental efforts. Some of these are:

- The Nature Conservancy
- Audubon of Florida
- The Arthur R. Marshall Foundation
- The Florida Earth Foundation

ENVIRONMENTAL MONITORING PLAN

10 Environmental Monitoring Plan

10.1 Introduction

The Monitoring Plan to be devised for the development should be implemented during the pre-construction and construction phases of the project. Monitoring involves the observation, review and assessment of onsite activities to ensure adherence to regulatory standards and the recommendations made to reduce negative impacts. The Plan must be comprehensive and address relevant issues, with a reporting component that will be made available to the regulatory agencies based on a mutually agreed frequency. It is recommended that a minimum monthly monitoring report be prepared and submitted to NEPA, if required.

The monitoring report will include at a minimum:

- Raw data collected
- Tables/graphs (where appropriate)
- Discussion of results with respect to the development in progress, highlighting parameters which exceed standards
- Recommendations
- Appendices with photos/data, etc.

At a minimum, the following basic activities will be monitored during specified phases of the project:

10.1.1 *Pre-Construction Phase Monitoring*

- During site clearing activities, any trees that will be saved and incorporated into the development must be identified and protected. The plants to be retained should be flagged, and if necessary fenced. It is suggested that the developers assess a monetary value to be placed on each plant, for which the contractor will be made liable. Should the contractor damage or remove a flagged tree, the penalty should be assessed. An inventory and map (if applicable) of all trees to be retained must be developed. (Weekly Monitoring)
- Where identified, endemic and rare species should be preserved in place or collected for transplanting (As Observed)
- Stockpiles of soil and vegetative debris generated during site clearing activities should be monitored and maintained to eliminate generation of fugitive dust. (Daily Monitoring)
- Noise levels along the perimeters of the project area should be monitored and recorded to ensure that activities at the site are not exceeding standards. (Daily Monitoring)

10.1.2 *Construction Phase Monitoring*

- Sewage - Ensure that temporary portable chemical toilets are available for construction personnel and that the contents are disposed by an approved waste hauler in an appropriate waste disposal facility. (Weekly Monitoring)
- Sand/Marl/Aggregate Supply - Routinely monitor sourcing of quarry materials to ensure supplier is obtaining supplies from licensed operations. (Monthly Monitoring)
- Solid Waste Management - Ensure that solid waste management plan is prepared, and that workers are aware that no solid waste material should be scattered around the site. Monitor availability and location of skips/dumpsters. (Weekly Monitoring)

  Monitor the disposal of refuse to ensure that skips/dumpsters are not overfilled. (Weekly Monitoring)

  Routine collection of solid waste for disposal must be implemented, and disposal monitored to ensure use of approved disposal facilities. (Weekly Monitoring)

- Erosion/Siltation Management – Exposed soil areas must be monitored to determine potential for erosion, silting and sedimentation particularly during storm events. (Weekly Monitoring)

  If erosion, silting or sedimentation is a potential or occurs, immediate steps must be taken to negate the impact on the coastal waters and other receptors where applicable. (As Needed)

- Equipment staging and parking areas must be monitored for releases and potential impacts. (Weekly Monitoring)
- If any cultural heritage resources are unearthed during construction, activities should be stopped and the Archaeological Retrieval Plan included in this report implemented. (As Needed)
- If any unexploded ordinance or other military materials are unearthed, work should be stopped immediately, the site vacated and professionals brought in to determine how to proceed.
- Noise levels along the perimeters of the project area should be monitored and recorded to ensure that activities at the site are not exceeding standards. (Daily Monitoring)

10.1.3 *Operation Phase Monitoring*

- Sewage - Monitor effluent quality periodically to determine compliance with regulatory standards and appropriateness for use as irrigation water. (Monthly Monitoring or as determined by regulatory standards)
- Solid Waste - Monitor solid waste skips/dumpsters and removal contractor to ensure proper waste handling and disposal. (Weekly Monitoring)
- Drainage - Regular inspections of drainage systems should be performed to ensure that the drains remain clear of blockages to safeguard against flooding or damage to wetland. (Monthly Monitoring).

10.2 Detailed Environmental Monitoring Plan

The development of appropriate environmental management and monitoring programmes and methodologies are a vital part of the environmental management and monitoring control of the project. This section outlines the main environmental parameters to be monitored, timing of the monitoring work and the recommended frequency of monitoring for general aspects of the proposed project. A more detailed scope of work will be provided by RINKER once a contractor for the construction of the proposed development has been selected, and will be subjected to NEPA's approval prior to the commencement of any pre-construction/construction work.

The main objectives of the proposed management and monitoring protocol are:

1. to clarify and identify sources of pollution, impact and nuisance arising from the proposed works;
2. to confirm compliance with legal and contract specifications;
3. to provide an early warning system for impact prevention;
4. to provide a database of environmental parameters against which to determine any short term or long term environmental impacts;
5. to propose timely, cost-effective and viable solutions to actual or potential environmental issues;
6. to monitor performance of the mitigation measures;
7. to verify the EIA predicted impacts;
8. to collate information and evidence for use in public, NEPA, and any other required regulatory consultation; and
9. to audit environmental performance

The proposed environmental monitoring will take the form of site inspection and supervision. The two main phases of the project for which the proposed monitoring will cover are the pre-construction (baseline) and construction phases

Environmental monitoring for dust and noise during the construction phase is recommended in order to ensure all proposed mitigation measures are implemented and effective.

Obtaining a suitable and representative baseline data set will be critical to the whole monitoring and audit process because it forms the standard against which environmental impacts are assessed. Thus, baseline monitoring for dust and noise will be required prior to the start of construction.

Mitigation to avoid the pollution of any water courses in the study area have also been recommended by the EIA, as have waste management procedures and thus, monitoring in the form of regular site inspections is also required to ensure mitigation measures are being implemented and are effective.

In addition, monitoring of mitigation measures to avoid impacts on landscape and visual resources will be required during the construction period. Maintenance and monitoring will be the responsibility of the management put in place after this period.

The details of monitoring are discussed in the following sections and summarised in **Table 10-1** below.

Table 10-1: Framework for Environmental Monitoring Plan

Monitoring	Period	Parameters	Monitoring Frequency
Noise	Baseline (1 occasion)	Leq* (30 mins) GPS location	One set of measurements at selected locations (within and surrounding project site)
	Construction Phase	Leq (30 mins) GPS location	One set of measurements between 0700-1900 hours on normal weekdays once per week.
Air Quality	Baseline (1 occasion)	Total Suspended Particulates, wind speed/ direction GPS location	One set of measurements (24 hour sampling) at selected locations.
	Construction Phase	Total Suspended Particulates, wind speed/ direction GPS location	One set of measurements (1 hour sampling) between 0700-1900 hours on normal weekdays once per week. , At selected locations, identified with the assistance of the local governing body, NEPA
Water	Baseline	Survey of coastal waters,	One set of measurements

Monitoring	Period	Parameters	Monitoring Frequency
		stream and tributaries in the study area BOD, Total & Faecal Coliform, DO, Nitrates, Phosphates, Turbidity, pH, Oil & Grease	
	Impact (during construction)	Visual Survey of watercourses in area of active construction works and other areas with stockpiled materials on exposed ground surface BOD, Total & Faecal Coliform, DO, Nitrates, Phosphates, Turbidity, pH, Oil & Grease	Once per week in areas undergoing construction Once bi- monthly during construction at select locations.
Waste	Baseline	Visual Survey of area around proposed sites	Once
	Construction Phase	Routine supervision of construction works	As per site inspection schedule
Landscape/ Visual Resources	Construction Phase	Survey of protection measures for trees and landscaping GPS location	Once every two (2) months during construction works
	Operational Phase	Survey of establishment of planting	Once every four (4) months for a one year period after completion of the works.
Chemical Waste & Control of Spills	Construction	Materials and chemicals that will be used during construction	Once per week during construction works
Construction Camps	Construction	Establishment and operation	Once per week

Note (1): Should the construction schedule require works in restricted hours, monitoring in the form of 3 consecutive $L_{eq\ (5mins)}$ readings should be taken.
Leq: One of the more common descriptors used to characterize the fluctuating noise levels is called the Equivalent Sound Level or Leq. The Leq sound level is the steady A-weighted sound energy which would produce the same A-weighted sound energy over the same given period of time as the specified time-varying sound.

10.2.1 *Action and Limit Levels*

Monitoring stations will be set up at representative sensitive receivers and the results will be used to ensure compliance with determined performance criteria, based upon specific action and limit levels. The definitions of these are as follows:

- the Action Level represents a level at which some appropriate action will be required to prevent conditions deteriorating to the extent that statutory or guide criteria are breached; and
- the Limit Level represents the upper limit permitted and is generally equivalent to the statutory levels specified in legislation

The construction phase monitoring for dust and noise are highlighted below. Action plans will be developed for use in the event of exceedances and will be included in Contractor's Operating Manual.

Action plans are not relevant to the water quality, waste, and landscape and visual criteria. However, the supervision methodology is highlighted below.

10.2.1.1 Noise

To minimise the amount of noise generated at the construction site, a Noise Control Plan will be prepared.

The construction noise level will be measured in terms of the A-weighted equivalent continuous sound pressure level (L_{eq}). L_{eq} measurements will be taken during 30 minutes of typical construction activity during unrestricted periods. No work during restricted periods is anticipated at this stage; however, three consecutive $L_{eq\ (5mins)}$ readings will be taken to monitor the noise during these periods if required.

Sound level metres in compliance with NEPA specifications will be used for carrying out the noise monitoring, in accordance with any Specific Conditions issued under the Environmental Permit. The noise measurements should be carried out 10m from the worst affected external receptors and not be made in the presence of fog, rain or excessive steady or gusty wind.

The proposed construction phase sampling frequency will be once per week and action and limit levels for work during the unrestricted period, and restricted periods for reference, are shown in the table below.

Table 10-2: Action and Level Limits for Construction Noise

Time Period	Action Level	Limit Level
Unrestricted Period Normal work days (0700 -1900)	When one documented complaint is received	75 dB(A)
Restricted Period 1 All days during the evening (19.00-23.00) and general holidays (including Sundays) during the daytime and evening (07.00-23.00)	When one documented complaint is received	65 dB(A)
Restricted Period 2 All days during the night-time (23.00-07.00)	When one documented complaint is received	45 dB(A)

10.2.1.2 Air Quality

To minimise the emissions from vehicles and equipment used for construction activities, and minimise fugitive dust from construction areas and unpaved roads within construction areas, a, Emissions & Dust Control Plan will be prepared.

Monitoring of the Total Suspended Particulates (TSP) levels shall be carried out to detect any deterioration in air quality and so enable early action to be taken for impact prevention or amelioration. One 24-hour TSP levels shall be measured, at designated levels e.g. once per week, to indicate the impacts of construction dust on air quality using direct reading methods. Other relevant data that will need to be recorded will include the prevailing weather conditions, namely wind speed and direction and rainfall. Also, any other point sources with photographic evidence.

The sampling frequency will be once per week. Action and limit levels are shown in the following table.

Table 10-3: Action and Level Limits for Air Quality

Parameters	Action	Limit
24 Hour TSP Level ($\mu g/m^3$)	For baseline level ≤150 $\mu g/m^3$, action level = average of baseline level plus 30% and limit level For baseline level >150 $\mu g/m^3$, action level = limit level	150 $\mu g/m^3$

10.2.1.3 Water Quality

The monitoring program will include monitoring for both point and non-point sources to assess the effects of surface water runoff and wastewater discharges from areas disturbed by all construction related activities on water quality.

Surveys are to be undertaken for watercourses which are within the influence of construction works. The surveys should include a description of the stream course, influencing factors, photographs of the watercourse and a map showing areas of project construction works.

Any noticeable change to water quality will be recorded in the watercourse survey reports. This will be investigated and remedial actions taken to reduce impacts.

Particular attention shall be paid to incorporation of mitigation measures.

10.2.1.4 Waste

Supervision of the construction works should be undertaken during site inspections to ensure that waste material is being properly stockpiled and handled. Any malpractice should be reported and remedial measure recommended.

Table 10-4 below lists the manner in which each type of waste will be managed.

Table 10-4: Waste Material Management during Pre-Construction and Construction Phases

Type of Waste	Description	Fate or Deposition
Plant material and cuttings	All plant material, including invasive plant removal, shrubs and trees removed from project site	Chip and compost small material, recycle tree logs as needed or disposal in an approved landfill
Construction debris	Large pieces of non-toxic waste from packing material, concrete, wire and lumber	Lumber recycled in landscaping where possible, Unusable material compacted and disposed of at an approved landfill
Recycled material	Glass, tin, paper, and plastic	Any material that can be recycled in the operations or otherwise should be recycled
Sewage and wastewater treatment	High organic content, potential public health hazards	Tertiary treatment facility , Composting and/or chemical toilets

10.2.1.5 Landscape and Visual

To minimise vegetation clearing for construction activities and control erosion and sedimentation from disturbed areas a Vegetation Clearing Plan will be prepared. This will include specifications for the removal of vegetation from the construction areas and the management of runoff from disturbed areas, and will utilise site vegetation surveys and construction plans to mark out areas to be cleared.

The landscape and visual mitigation proposals comprise a combination of preventive measures to protect the existing landscape resources, including careful alignment of the conveyor corridor and associated works to avoid any mature trees and or plants identified for saving, as well as new tree and shrub planting to the perimeter of the conveyor corridor. To ensure these impact mitigation measures are carried out satisfactorily, monitoring during the construction and operational phases are proposed.

Baseline monitoring for the landscape will comprise a vegetation survey of the entire selected route option undertaken on an 'area' basis, as work progresses. An assessment of landscape character will be made against which future change can be monitored. The landscape resources and elements of particular concern are to be noted. Reference to the terrestrial findings included in the EIA shall be made.

Trees identified for protection or transplanting shall be identified at the outset of the construction contract and all approved protection measures such as hoarding and fencing, and nursery setup shall be in place prior to any excavation or site formation works. The tree felling, transplanting, protection and new planting works shall be carried out with the assistance of NEPA.

Upon completion of the works, monitoring of the maintenance and establishment works to all planted areas shall be undertaken for a 12 month period over the responsibility management structure put in place. Inspections of the works shall be undertaken at scheduled instalments during the establishment period to ensure the intended mitigation of landscape and visual impacts is achieved. That is, the trees and shrubs planted or kept create the desired screen and provide a fully vegetated cover.

10.2.1.6 Soil Conservation

Soil erosion rates, slope stability, effectiveness of soil conservation measures should be monitored at frequent intervals during construction, as necessary.

10.2.1.7 Chemical Waste & Control of Spills

The objective to minimise the potential for impacts associated with handling, storage, use and disposal of any chemicals on site during construction. A Chemical Waste & Spillage Management Plan will be prepared, which will include implementation and monitoring of the use of chemicals and chemical wastes to cover materials such as fuel and oils, paints, solvents, and concrete additives.

10.2.1.8 Traffic and Access

To implement measures to manage traffic and access on the construction site during construction works, a Traffic and Access Management Plan will be prepared and monitored by the Police and NWA, as necessary.

10.2.2 *Proposed Mitigation Monitoring and Reporting Protocol for Seagrass and Mangrove Impacts*

The applicant will follow the proposed monitoring and reporting protocols proposed below. These monitoring and reporting protocols are based on the recommendations contained in a letter received by CD&A from NEPA dated October 29, 2008. The protocols proposed below are appropriate for the proposed restoration plan. However, once the final design is complete it may be beneficial to both the applicant and NEPA if the monitoring protocol is revised as necessary to adequately assess the restoration areas as design-specific monitoring goals may be identified.

10.2.2.1 Seagrass Mitigation Monitoring

In accordance with NEPA's requests, a total of twelve (12) monitoring reports will be completed for a period of five (5) years subject to the following schedule:

- Ten (10) days after the completion of the transplanting activities – (Time Zero)
- Quarterly for the first year – (Time-One to Time-Four)
- Semi-Annually for years two (2) to five (5) – (Time-Five to Time-Twelve)

The reports will include:

- The name(s) of the persons responsible for the monitoring.
- The date and time that monitoring is completed.
- Photographs, video and geo-referenced maps showing the location of the restoration sites.
- Remedial planting activities conducted and locations using geo-referenced maps.
- Details on the following:

    1. Total area of the planted seagrass beds (initial and remedial transplanting activities).
    2. Areal coverage, transplanted unit survival (25% total population assessment), shoot density and leaf length.
    3. Water quality (suspended solids, nutrients (Nitrates and Phosphates), salinity, temperature, sediment type and composition at recipient site and donor site.
    4. Aerial extent and coverage over time using photographic inventory.

5. Presence or absence of bioturbation (disturbance caused by shrimps, stingrays, turtles etc.) with details including number of individuals, species observed.
6. Any problems that occurred during replanting that would affect the integrity of the beds.
7. Qualitative observations of natural seagrass recruitment and vegetative expansion of meristems from transplanted units.

10.2.2.2 Mangrove Mitigation Monitoring

In accordance with NEPA's requests, a total of twelve (12) monitoring reports will be completed for a period of five (5) years subject to the following schedule:

- Ten (10) days after the completion of the transplanting activities – (Time Zero)
- Quarterly for the first year – (Time-One to Time-Four)
- Semi-Annually for years two (2) to five (5) – (Time-Five to Time-Twelve)

The reports will include:

- The name(s) of the persons responsible for the monitoring.
- The date and time that monitoring is completed.
- Photographs, video and geo-referenced maps showing the location of the restoration sites (from defined photo stations).
- Estimate of survival success rate at time of planting
- Remedial planting activities conducted and locations using geo-referenced maps.
- Details on the following:

1. Growth density, percentage cover, and species composition of planted (initial and remedial transplanting activities) and volunteer mangroves.
2. Stem structure and node production over time.
3. Management of seedling density at optimal level (degree of thinning, remedial planting, natural regeneration).
4. Areal extent and coverage over time
5. Assessment of seedling failure (25% total population assessment).
6. Qualitative assessment of fauna, flora, and physical environment within restoration area and comparison with a previously-defined, undisturbed reference/control mangrove community.

10.2.3 *Environmental Management & Monitoring Responsibilities*

The noise and dust baseline and impact environmental monitoring, water quality and waste supervision should be carried out by an independent Environmental Specialist (ES), who will be employed by RINKER but remains an independent company. The responsibilities of the ES will include field measurements, sampling, analysis of monitoring results, and reporting. The ES will be required to be approved by NEPA. The ES shall be competent and have relevant environmental monitoring experience.

Due to the specialist nature of some of the monitoring works required for this project, the Environmental Team (ET) should comprise professionals proficient to undertake the tasks involved. Thus, the ET should include personnel experienced in noise, dust and supervision of water quality and waste management. **Table 10-5** below outlines the proposed management approach for this project.

Table 10-5: Proposed Management Protocol

Task	Implementation	Coordination	Site Monitoring	Oversight	Funding
Compliance with environmental construction obligations					
Construction site management♦	Construction and/or Project Management Contractors	RINKER	Contractors	RINKER & NEPA	RINKER and/or Contractors
Adaptive Ecological Management*					
Rivers/Stream impacts	Construction Contractors & Environmental Consultants	RINKER	Environmental Consultant	NEPA	RINKER and/or Contractors
Terrestrial animals in site area	Construction Contractors & Environmental Consultants	RINKER	Environmental Consultant	NEPA	RINKER and/or Contractors
Wetland formation and restoration	Environmental Consultants	RINKER	Environmental Consultant	NEPA	RINKER and/or Contractors

- ♦ includes; traffic, noise, air quality etc management
- *a structured, iterative process of optimal decision-making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring.

10.2.4 *Reporting*

Deliverables in the form of the baseline survey reports and regular and summary environmental monitoring reports should be prepared in accordance with any requirements issued by NEPA as part of the Environmental Permit.

It is recommended that reports are issued monthly during the construction phase and bi-monthly during the operational phase in respect of the tree planting monitoring. Further details on the contents of these reports should be provided in the Contractors Operating Manual.

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APPENDIX

Appendix I: Approved Terms of Reference

TERMS OF REFERENCE

FOR

RINKER JAMAICA LIMITED PROPOSED PORT AND CONVEYOR CORRIDOR

AT ROCKY POINT,

CLARENDON

Table of Contents

Introduction

Conrad Douglas and Associates (CD&A) will work closely with our clients, RINKER Jamaica Limited and their partners, to complete a high quality EIA report that addresses all environmental and engineering concerns that may be associated with the construction of a limestone aggregate exporting facility in the vicinity of the JAMALCO Rocky Point Port at Rocky Point, Clarendon.

RINKER Jamaica Limited, a subsidiary of CEMEX, has negotiated a lease agreement with JAMALCO/Alcoa to install and operate a port facility for the export of crushed, sized and washed limestone aggregate from Rocky Point to serve its Florida market. RINKER has also acquired exclusive rights to operate the existing Chemical Lime Quarry at Brazilletto Mountain in South Clarendon.

Current plans are to construct a state of the art port facility from which RINKER will be able to load aggregates into PANAMAX size vessels (60,000 ton capacity) using a high capacity ship loader.

In keeping with the NRCA Act of 1991, RINKER is required to conduct an EIA on the proposed operations. This includes port construction and transportation linkages (conveyor corridor) to and from a proposed plant site on ruinate lands (formerly used for sugarcane cultivation) south of the Brazilletto Mountains. This plant will subsequently connect to the mining lease area in the Brazilletto Mountains. The EIA will be submitted to the National Environment and Planning Agency (NEPA), for review and permitting in order to facilitate implementation of the plans.

A detailed description of all elements of the project during the pre-construction, construction and operational phases will be prepared. The elements analyzed will include the infrastructure of the project including: drainage features; roads; waste generation, and management; and utility requirements.

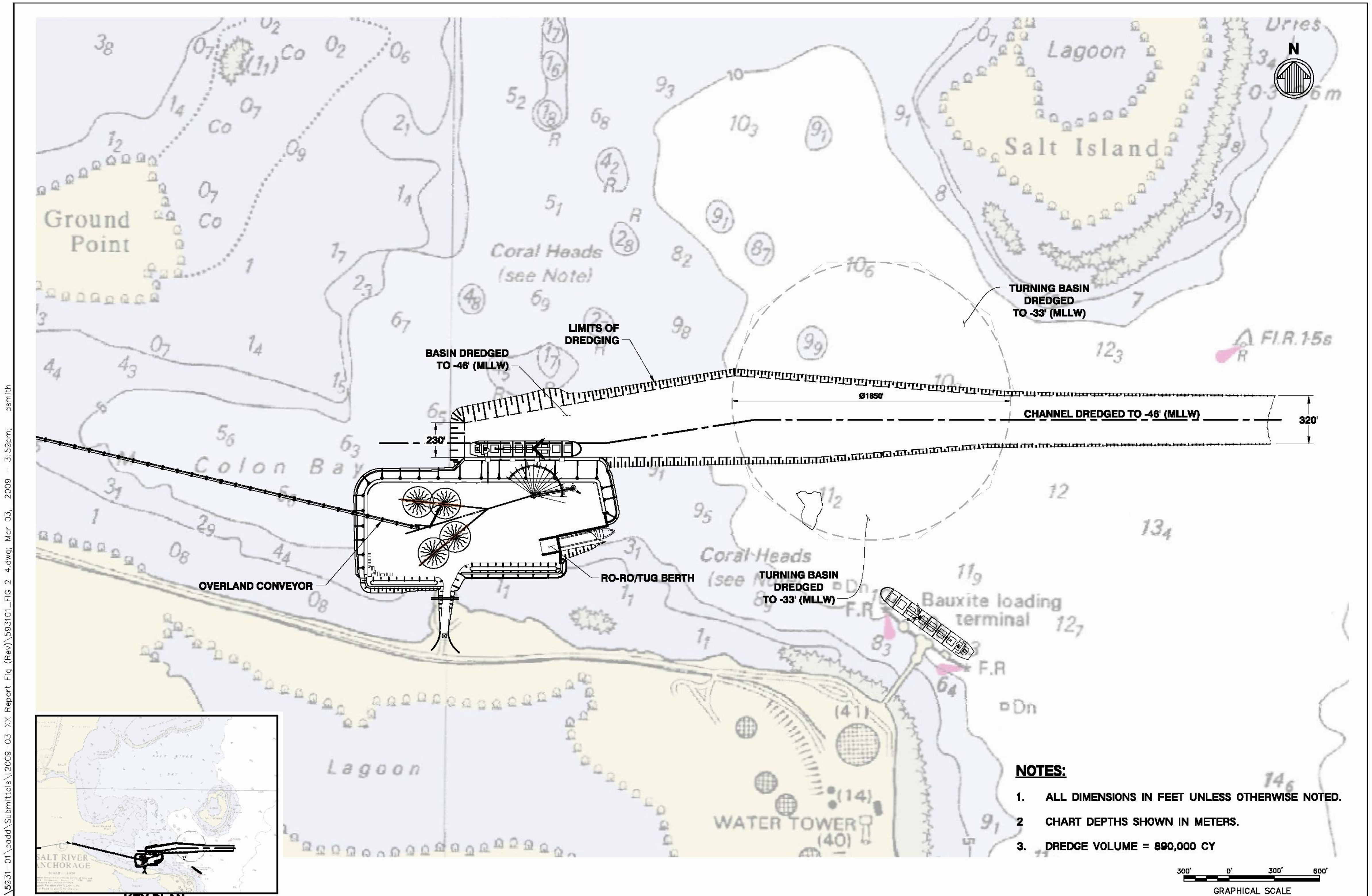


Figure 1: Proposed Port, Rocky Point, Clarendon

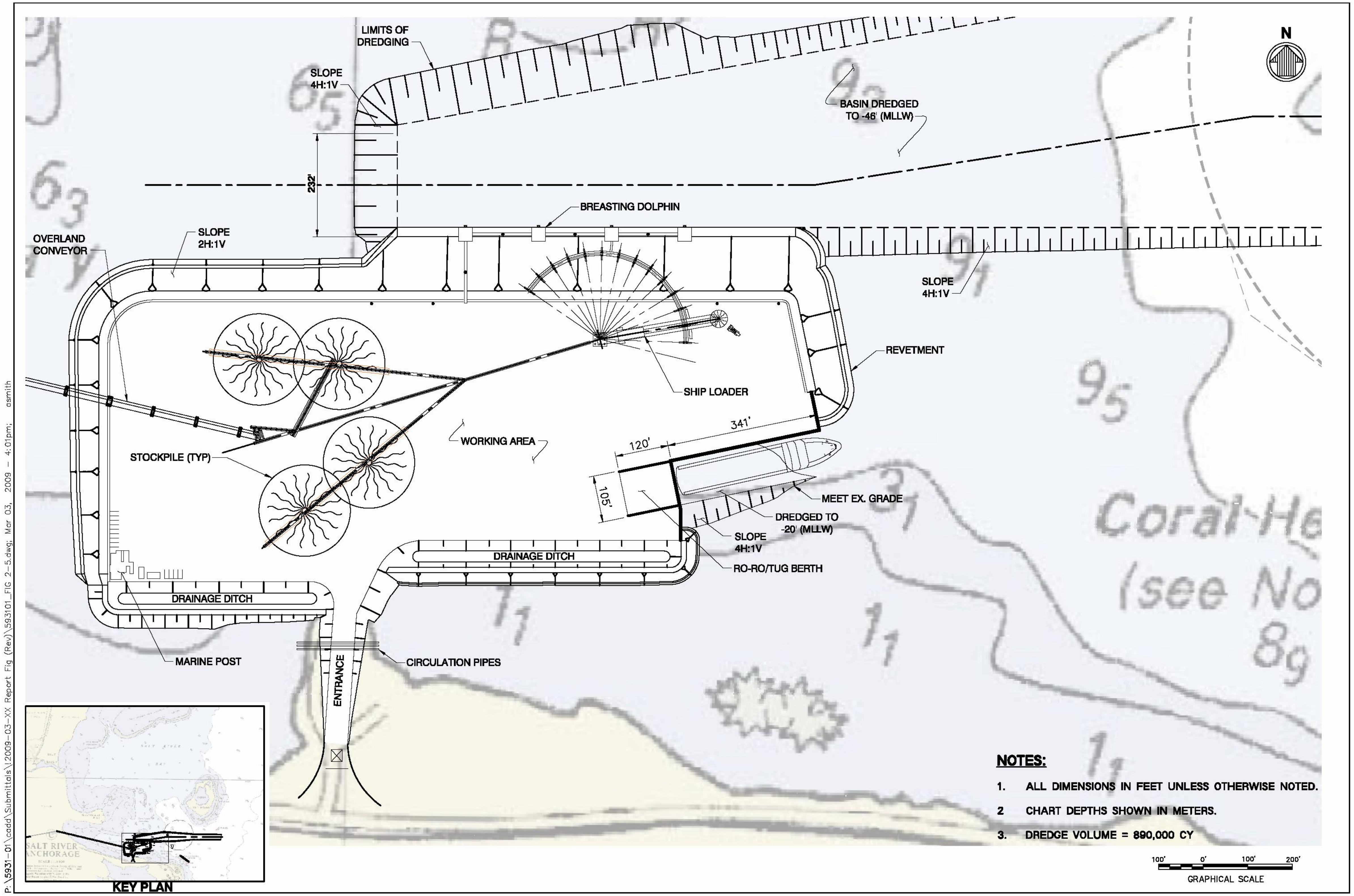


Figure 2: Port Area – Rocky Point, Clarendon

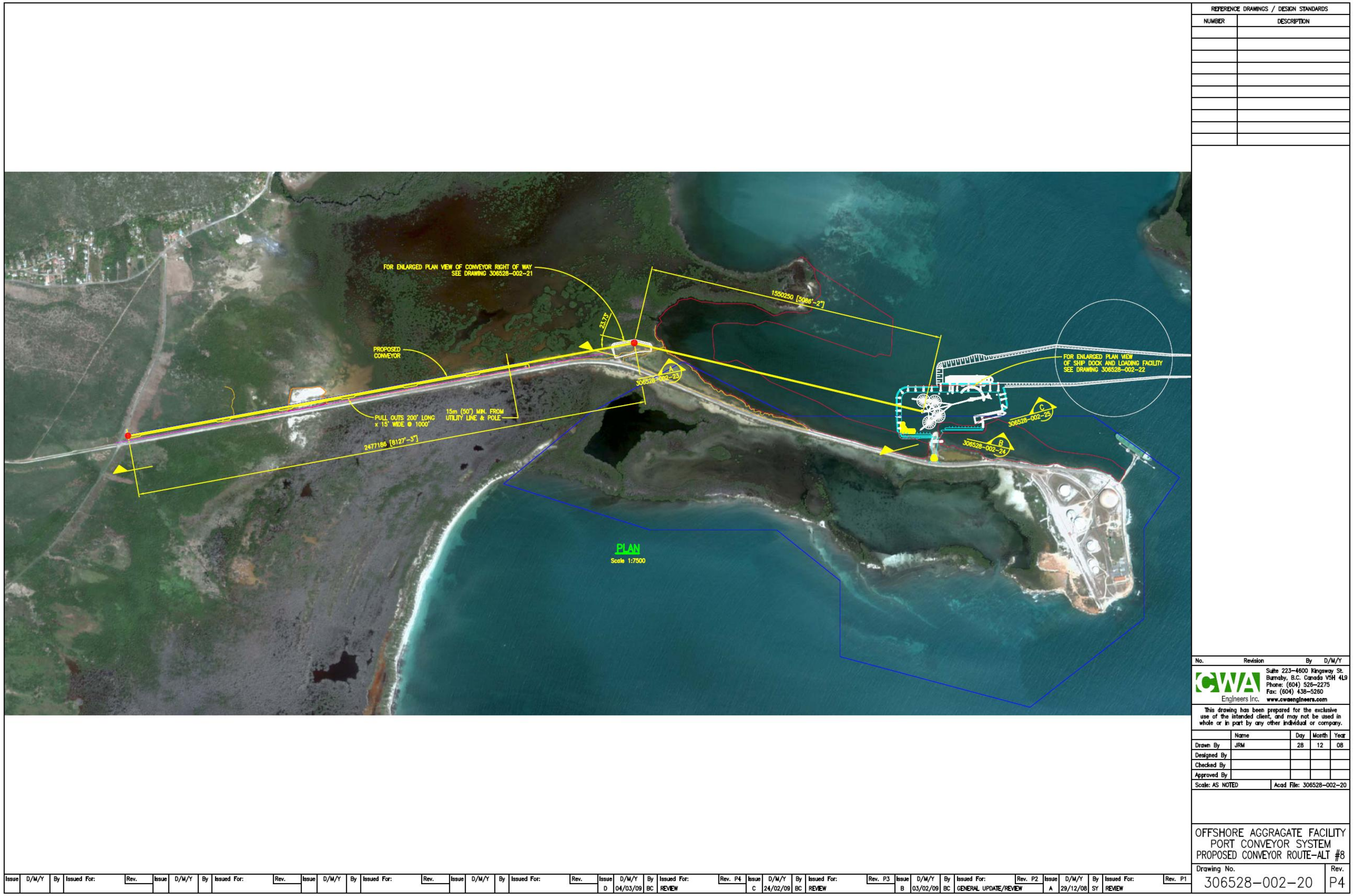


Figure 3: Routing of the Conveyor Corridor to Proposed Port

Terms of Reference

The Environmental Impact Assessment will:

1) Provide a complete description of the existing site proposed for the Proposed Port and Conveyor Corridor. Detail the elements of the project, highlighting areas to be reserved for construction and the areas which are to be preserved in their existing state.

2) Identify the environmental issues of concern through the presentation of baseline data which will include social and cultural considerations. Assess public perception of the proposed development.

3) Outline the Policies, Legislation, Regulations and Standards relevant to the project.

4) Predict the likely impacts of the project on the environment, including direct, indirect and cumulative impacts, and indicate their relative importance to the design and function of the facilities.

5) Identify mitigation actions to be taken to minimise adverse impacts and quantify associated costs.

6) Design a Monitoring Plan which will ensure that the mitigation plan is adhered to.

7) Describe the alternatives to the project that could be considered at that site

To ensure that a thorough Environmental Impact Assessment is carried out, the following tasks will be undertaken:

Task 1: Description of the Project

CD&A will provide a comprehensive description of the project explaining details of the works and infrastructure proposed for the Proposed Port and Conveyor Corridor, noting areas reserved for construction and areas to be dredged and reclaimed. Areas to be reserved for construction, areas to be preserved in their existing state as well as activities and features which will introduce risks or generate impact (negative or positive) on the environment will be noted. This will involve the use of maps, site plans, aerial photographs and other graphic aids and images, as appropriate, and include information on location, general layout and size, as well as pre-construction, construction, and post-construction plans. A description of raw material inputs, technology and processes to be used as well as products and by-products generated, should be provided

Sewage treatment system including treated effluent disposal will be clearly outlined as well as solid waste disposal option. In addition, plans for storm water collection and disposal as well as plans for providing utilities and other services will be clearly stated. This will involve the use of maps at appropriate scales, site plans, aerial photographs and other graphic aids and images, as appropriate.

In terms of beach modification, the proposed works on the foreshore and the floor of the sea will be clearly described including but not limited to any seagrass or mangrove removal and replanting.

A storm surge analysis and impact mitigation structures/measures will be conducted.

Task 2: Description of the Environment

For this EIA Report, CD&A will generate baseline data which will be used to describe the study area in terms of:

i) physical environment
ii) biological environment
iii) socio-economic and cultural constraints

Methodologies employed to obtain baseline and other data will be clearly detailed. Baseline data will include:

(A) Physical

i. A detailed description of the existing **geology**, **hydrology** **and resultant impacts on nearby mangroves.** Emphasis will be placed on storm water run-off, drainage patterns, impact on groundwater and coastal waters. Any slope stability issues that could arise will be thoroughly explored.
ii. **Water quality** of any existing wells, rivers, ponds, streams or coastal waters in the vicinity of the project. A complete water chemistry report will be detailed; Quality Indicators will include but not necessarily be limited to oil and grease, nitrates, phosphates, total and faecal coliform, total suspended solids and turbidity.
iii. Climatic and air quality (TSP) conditions in the area of influence including wind speed and direction, precipitation, relative humidity and ambient temperatures,
iv. Marine dynamics including detail marine assessment of the project area such as wave and current movements.
v. Assessment of the corridor/right of way for the conveyor belt.
vi. Noise levels of the undeveloped site and the ambient noise in the radius of influence.

vii. Obvious sources of pollution existing and extent of contamination.
viii. Availability of solid waste management facilities and procedures.

(B) Biological

CD&A will present a detailed description of the flora and fauna of the area, with special emphasis on rare, endemic, protected or endangered species. Migratory species will also be considered. Generally, species dependence, niche specificity, community structure and diversity will be considered. This will include an extensive assessment of the marine environment, including but not limited to: The biological description will include but not limited to:

- An extensive assessment of the marine environment with special emphasis but not limited to benthos, coral cover, sea grass, fish, invertebrate and macro-invertebrate populations
- landscape impacts of excavation and construction
- Loss of natural features, habitats, and species by construction and building
- Impact on coastal, surface and ground waters
- Impact of dredging and spoil disposal
- Risk assessment
- Loss, relocation/replanting of mangroves/sea grass
- Oil/fuel spills and their clean-up
- Solid waste management
- Hazard vulnerability
- Concerns for migratory species

(C) Socio-economic & cultural

Present and projected population; present and proposed land use; planned development activities; issues relating to squatting and relocation; (housing demand and supply) community structure; economic base /employment; distribution of income; goods and services; utilities; recreation; public health and safety; cultural peculiarities, aspirations and attitudes will be explored. The historical importance (heritage, archaeological sites and feature) and other material assets of the area will also be examined. While this analysis is being conducted, an assessment of public perception of the proposed development will be conducted, and may take the form of consultation meetings with the public and key stakeholders as well as questionnaires/surveys.

Task 3: Legislative and Regulatory Considerations

The EIA will outline the pertinent regulations and standards governing environmental quality, protection of sensitive areas, protection of endangered species, siting and land use control at the national and local levels. The examination of the legislation will include at a minimum, legislation such as the NRCA Act, policies and regulations from the Water Resources Authority, the Watershed Protection Act, The Clean Air Act, Public Health Act, Beach Control Act, Building Codes and Standards, Development Orders and Plans and any appropriate international convention/protocol/treaty where applicable.

Additionally, consideration will be made for the Protected Area status and RAMSAR designation of the Portland Bight Protected Area. The site was given RAMSAR designation on 2nd February, 2006, as Portland Bight Wetland and Cays (RAMSAR Site No. 1597). Consideration will also be given to industrial zoning and other land, riverine and marine uses in the area.

Task 4: Identification of Potential Impacts

CD&A will identify the major environmental issues of concern and indicate their relative importance to the design of the facility. Identify potential impacts as they relate to (but are not restricted by) the following:

- change in drainage pattern
- flooding potential
- storm surge
- excavation and construction
- aesthetics
- loss of natural features, habitats and species by construction and operation
- pollution of surface and ground water
- sea level changes
- coastal stability impacts
- biodiversity
- dredging and spoil disposal
- coral reef smothering
- proliferation of macro algal species
- seagrass loss
- air pollution
- capacity and design parameters of proposed sewage handling/treatment facility
- socio-economic and cultural impacts
- public health and safety
- risk assessment
- noise
- oil spills

- leaching of substances or chemicals into ground water supply

Special attention will be placed on any potential impact the development could have on the existing adjacent Jamalco Port.

The EIA Report will:

1. **Identify** - the interaction between different impacts and impacts of other projects. In addition, the impacts that have occurred and those impacts which could still occur as a consequence of the clearing works at the site will also be identified and analysed.
2. **Distinguish** - between significant positive and negative impacts, reversible or irreversible direct and indirect, long term and immediate impacts as well as avoidable and irreversible impacts.
3. **Characterize** - the extent and quality of the available data, explaining significant information deficiencies, assumptions and any uncertainties associated with the predictions of impacts. Project activities and impacts will be represented in matrix form with separate matrices for pre and post mitigation scenarios

Task 5: Mitigation

We will prepare guidelines for avoiding, as far as possible, any adverse impacts due to the proposed project and utilising of existing environmental attributes for optimum development. For those impacts which are unavoidable, mitigative measures will be proposed. In the report, we will quantify and assign financial and economic values to mitigating methods, where applicable.

Task 6: Drainage Assessment

An assessment of Storm Water Drainage will be conducted. The EIA Report will cover, but not be limited to:

i. Drainage for the site during construction, to include mitigation for sedimentation to the marine environment
ii. Drainage for the site during operation, to include mitigation for sedimentation to the marine environment

Task 7: Environmental Management &Monitoring

CD&A will design a plan to monitor implementation of mitigatory or compensatory measures and project impacts before, during and post construction. An Environmental Management Plan and Historic Preservation Plan (if necessary) for the long term operations of the site will also be prepared.

An outline of the monitoring programme will be included in the EIA, and a detailed version submitted to NEPA for approval after the granting of the permit and prior to the commencement of the development. At the minimum the monitoring programme and report will include:

- Introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit license(s) granted.
- The activity being monitored and the parameters chosen to effectively carry out the exercise.
- The methodology to be employed and the frequency of monitoring.
- The sites being monitored. These may in instances, be pre-determined by the local authority and will incorporate a control site where no impact from the development is expected.
- Frequency of reporting to NEPA

The Monitoring report will also include, at a minimum:

- Raw data collected.
- Tables and graphs, where appropriate
- Discussion of results with respect to the progress of work, highlighting any parameter(s) which exceed the expected standard(s).
- Recommendations
- Appendices of data and photographs.

Task 8: Project Alternatives

The EIA process will include the examination of alternatives to the project including the no-action alternative. This examination of project alternatives will incorporate the history of the overall area in which the site is located and previous and potential future uses of the site itself.

Task 9: Public Participation / Consultation Programme

A public presentation on the findings of the EIA to inform, solicit and discuss comments from the public on the proposed development will be conducted. As a part of this process, the following will be done:

- Document the public participation programme for the project.
- Describe the public participation methods, timing, type of information to be provided to the public, and stakeholder target groups.
- Summarise the issues identified during the public participation process
- Discuss public input that has been incorporated into the proposed project design; and environmental management systems

All Findings will be presented in the **EIA Report** and will reflect the headings in the body of the TOR, as well as references. Eight hard copies and an electronic copy of the report will be submitted to NEPA for distribution to stakeholders and review. The report will include an appendix with items such as maps, site plans, the study team, photographs, and other relevant information.

Appendix II: Survey Instrument

SURVEY INSTRUMENT

Administered by

Conrad Douglas and Associates Limited

In support of an

ENVIRONMENTAL IMPACT ASSESSMENT

for

RINKER Jamaica Limited Proposed Aggregate Limestone Activities

at Brazilletto and Rocky Point, Clarendon

Community Name	______________________	Community Code					

Social Impact Assessment

SECTION 1

PERSONAL CHARACTERISTICS

1) Gender

1. Male
2. Female

2) Age Range

1. Under 20
2. 20 – 39
3. 40 – 49
4. 50 – 59
5. 60 – over
6. Not Stated/No Response

3) How many years have you been living in the community?

1. 0 – 5 Years
2. 6 – 10 Years
3. 11 – 20 Years

4. more than 20 Years
5. Not Stated/No Response

4) What is your level of educational attainment (at what level did you finish school)?

1. Did not attend School
2. Primary
3. Secondary/Junior High
4. Tertiary

5) What is your occupation?

____

6) What is your annual income?

1. < $100,000
2. $100,000 - $300,000
3. $300,000 - $500,000
4. $500,000 - $700,000
5. >$700,000
6. No Response

SECTION 2

OPINIONS ON THE COMMUNITY

7) What do you like most about the community? **(*ASK & WAIT FOR RESPONSE)***

1. Friendly people
2. Clean environment:
3. Availability of farmland
4. Quiet
5. No crime & violence
6. Other, (specify)_________________________
7. Not Stated/No Response

8) What don't you like about the community? (***ASK & WAIT FOR RESPONSE)***

1. Poor roads
2. Lack of Utilities
3. Crime & violence
4. Unemployment
5. Dirty environment
6. Other, (specify)_________________________
7. Not Stated/No Response

9) How is the traffic on the roads in your community?

1. Too much traffic

2. Not bad/ ok traffic
3. More in the morning/ afternoon/ night
4. Other __________________

SECTION 3

AWARENESS & OPINIONS ON EXISTING MINING FACILITIES

10) Are you aware that the Brazilletto area has limestone deposits?

1. Yes
2. No

11) Are you aware that there is a limestone mining operation in your area?

1. Yes
2. No (Go to Q 11)
3. Not Stated/No Response

12) What are your experiences with mining in your area?

1. Negative
2. Positive
3. No impact

13) If negative, what? **(ASK AND WAIT)**

1. Odour
2. Traffic
3. Dust, soot or gaseous emissions
4. Noise
5. Damage to your property
6. Water quality
7. Not stated/ No response
8. Other ______________________________________

14) How do you think this could be addressed?

____

____

15) Do you lease or use any lands in the limestone mining area?

1. Yes
2. No

16) If this land is needed for limestone mining, what will you do?

____

____

____

17) Would you say that limestone mining operations have had negative impacts on the people in this community?

1. Yes
2. No (Go to Q 16)
3. Not Stated/No Response

18) If **YES, ASK** - WHY WOULD YOU SAY THAT?

1. The area has widespread corrosion
2. You get sick more often
3. Plants are harder to grow
4. Too much noise
5. Other (specify)
6. Not Stated/No Response

19) Would you say that limestone mining operations have had a positive impact on this community?

1. Yes
2. No

20) Are you experiencing any **negative** impacts from the Brazilletto Quarry operations in the vicinity of Tarentum Coffee Factory?

1. Yes (Go To Question 21 below)
2. No (Go To Question 22)
3. Not Stated/No Response

21) If **YES ASK**: What is this negative impact?

1. Odour
2. Oil Pollution
3. Dust, soot or gaseous emission
4. Noise
5. Damage to fishing grounds
6. Not Stated/No Response
7. Other, (specify)____________________

22) What impacts do you think the **existing** quarry has had on the community? (***ASK & WAIT FOR RESPONSE)***

1. Job opportunities
2. Improved community relations
3. Educational and social benefits
4. Improved Amenities – roads, lights, water supply
5. Improved Environmental conditions
6. More dust
7. More noise
8. More blasting/noise
9. Increased traffic
10. Less Job opportunity
11. None of the above
12. Other (specify)________________________
13. Not Stated/No Response

23) What **positive** impacts do you think limestone mining operations have had on the community?

1. Improved community relations
2. Job opportunities
3. Educational and social benefits
4. Amenities – roads, lights, water supply
5. Environmental conditions
6. None of the above
7. Other (specify)___________________________
8. Not Stated/No Response

SECTION 4

KNOWLEDGE AND VIEWS ON UPGRADE PLANS AND PORT FACILITIES

24) Are you aware that there is a proposal to transport limestone mined at the Brazilletto Quarry via a conveyor system to a proposed Port facility at Rocky Point (in the vicinity of the JAMALCO Port)?

1. Yes
2. No
3. Not Stated/No Response

25) How did you hear about it?

1. Community Representation
2. Poster/Flyer/Fact Sheet
3. Word of mouth
4. Brazilletto Quarry Representative
5. Consultant
6. This Survey is first knowledge of the project

26) What effect do you think the conveyor system and the Port development in or near your area will have on the following: (**Answer in terms of positive, negative, no change, doesn't know. ASK AND WAIT)**

i. Income/Economic value of the community
   1. Positive
   2. Negative
   3. No Change
   4. Don't Know
   5. Not Stated/No Response

ii. Job Opportunities
   1. Positive
   2. Negative
   3. No Change
   4. Don't Know
   5. Not Stated/No Response

iii. Pollution
   1. Positive
   2. Negative
   3. No Change
   4. Don't Know
   5. Not Stated/No Response

27) Are you aware that there is a proposal to expand the mining of limestone within the Brazilletto Mountains?

1. Yes
2. No
3. Not Stated/No Response

28) How did you hear about it?

1. Community Representation
2. Poster/Flyer/Fact Sheet
3. Word of mouth
4. Brazilletto Quarry Representative
5. Consultant
6. This Survey is first knowledge of the project

29) What effect do you think the proposed expansion of limestone mining operations in or near your area will have on the following: (**Answer in terms of positive, negative, no change, doesn't know. ASK AND WAIT)**

i. Income/Economic value of the community
   1. Positive
   2. Negative

3. No Change
4. Don't Know
5. Not Stated/No Response

ii. Job Opportunities
1. Positive
2. Negative
3. No Change
4. Don't Know
5. Not Stated/No Response

iii. Pollution
1. Positive
2. Negative
3. No Change
4. Don't Know
5. Not Stated/No Response

30) Do you think the proposed conveyor, quarry expansion, and port facility will affect you personally?

1. Yes
2. No
3. Don't Know/Not Sure
4. Not Stated/No Response

SECTION 5

AVAILABILITY OF WATER

31) What is your main source of drinking water?

1. Indoor tap/pipe
2. Outdoor private tap/pipe
3. Public standpipe
4. Spring, pond, river
5. Rainwater (tank or drum)
6. Trucked water (NWC)
7. Other (specify)
8. Not Stated/No Response

32) "In this community, I think that we have access to safe water to drink" Do you agree?

1. Yes
2. No
3. Don't Know/Not Sure
4. Not Stated/No Response

33) Why do you think so?

1. limestone mining affects the drinking water
2. Sources (not limestone mining related) affect the drinking water quality
3. The water is tested frequently by the NWC
4. The water looks and/or smells clean
5. Other, please specify
6. Not Stated/No Response

34) Have you or any member of your household ever worked for the Brazilletto Quarry or in the limestone mining industry?

1. Yes
2. No
3. Don't Know/Unsure
4. Not Stated/No Response

35) Are you aware of any programs or activities initiated by the Brazilletto Quarry in your community?

1. Yes
2. No
3. Don't Know/Unsure
4. Not Stated/No Response

36) Do you rely on the areas close to the quarry for your livelihood?

1. Yes (Go To Next Question)
2. No (Skip To Question 38)

37) How do you rely on the area for your livelihood?

1. Firewood
2. Farming
3. Bird shooting
4. Eco-Tours (dry limestone forest)
5. Other ______________

38) Do you use the area for recreational purposes?

1. Yes
2. No

39) How many days per week do you use the area?

6. One
7. Two - Three
8. Four or more

40) When do you use the area?

9. Weekends only (Fri, Sat, Sun)
10. Sun-Sat (all week)
11. Mon – Fri

41) What are the areas you utilize? (Name them).

____
____
____

END OF QUESTIONNAIRE

Name of interviewer:

____

Signature of interviewer:

____

Date of interview: ____

Appendix III: Records of Inter-Agency Communication

WATER RESOURCES AUTHORITY

ESTABLISHED BY THE WATER RESOURCES ACT, 1995

HOPE GARDENS, P.O. BOX 91, KINGSTON 7, JAMAICA
TEL: 927-0077, 927-0293, 927-0189, 927-0302
FAX: 977-0179, 702-3937

REF: HB IV-4

February 1, 2008

Mr. Dudley Roberts
Consultant to Rinker Jamaica Limited
5 Stilwell Crescent
P.O. Box 734
Kingston 8

Dear Sir

Re: **Water for Rinker Operations**

As stated in my letter of October 25, 2007, the drilling of an exploratory boring, in no way bounds the Water Resources Authority or is a guarantee that a permit to drill a production well, will be granted by the Authority. A copy of the letter is attached for ease of reference.

The data on the exploratory/test bore submitted under letter dated 28 January 2008 indicates that the chloride concentration is elevated at 71.2 mg/l and the pH is high at 8.1. It is expected that with pumping the concentration will become further elevated.

There is still no indication of the water demand for the project. While the test bore has given information on the geology, water level and water quality, the yield of any well cannot be stated.

Yours faithfully
WATER RESOURCES AUTHORITY

Basil P. Fernandez, O.D.
Managing Director

Attachment

*BPF*mc*

Jamaica's Hydrologic Agency

JPS
Jamaica Public Service Company Limited
CHANGING LIVES WITH OUR ENERGY

6 Knutsford Boulevard, Kingston Jamaica, W.I.
Telephone: (876) 926-3190-9
Fax: (876) 511-2167
Website: www.jpsco.com

January 22, 2008

Rinker Materials
1501 Belvedere Road
West Palm Beach
Fl 33406

Attention: Mr. Greg Hazel - Vice President, Rinker Materials

Dear Sirs,

Re: Proposed Commercial Quarry at Brazilletto

Reference is made to the meeting held on October 10, 2006 at the JPS Corporate Office between the management of JPS and Rinker Materials, and subsequent telephone conversations between both parties.

JPS has reviewed the load requirements submitted by Rinker Materials (Plant-13,000 HP and Load Out-7,000 HP) and is willing to facilitate the project. A 20MVA 69/24 KV Substation should be constructed by Rinker to facilitate the interconnection to the JPS Grid.

JPS will be responsible for:

- Reviewing the substation design,
- Assisting with the commissioning of the station,
- Providing a maintenance contract for the substation if required.

Rinker Materials will be responsible for:

- Designing the substation and acquiring all approvals,
- Procuring the substation equipment,
- Constructing the substation as per JPS specifications and obtain the certification from the Government Electrical Inspector,
- Providing spares for repairs etc.

Rinker Materials
Attn: Greg Hazel – Vice President, Rinker Materials
Re: Proposed Commercial Quarry at Brazilletto
January 22, 2008
Page 2 of 2

JPS will quote Rinker Materials for the provision of the interconnection to the JPS Old Harbour/Monymusk 69 KV Line on receipt of a formal application. The service provided will be as per the JPS All Island Electricity Licence and applicable Rate Schedule.

Should you need further clarification, please call me at 878-3718.

Yours truly,
JAMAICA PUBLIC SERVICE COMPANY LTD.

Errington Case
Key Account Manager

Cc Jacqueline Simmonds – Manager – Marketing and Energy Services, JPS
Heather Rowe – Manager – Economic Development, JPS
Damian Obiglio – President and CEO, JPS
Johnny Arellano – Operations Manager, Rinker Materials
Audley L. Roberts – Mining Engineer

Appendix IV: List of Preparers

1. Dr. Conrad Douglas – Process and Environmental Management Specialist – Project Planning & Project Director
2. Prof. Edward Robinson and Geology Team Members (Marine Geology Unit)– Geologist - Geology, Hydrology and Natural Risk Assessment
3. Mr. Orville Grey Jr. – Project Manager - Coastal Ecologist & EIA Specialist
4. Mr. Delford Morgan Jr. – Land Use Planning & Development
5. Mr. Wayne Morris – Chemical Engineer
6. Mr. Doran Beckford – Process and Environmental Engineer
7. Mr. Marco Campbell – Senior Environmental Technician
8. Mr. Phillip Rose - Botanist
9. Mr. Peter Wilson-Kelly – Marine Scientist
10. Mr. Damion White – Environmental Scientist – Avifauna Assessment
11. Mr. Damian Graham - GIS
12. Mr. Burklyn Rhoden – Socio-Economic Survey
13. Mr. Noel Watson – Socio-Economic Survey
14. Mr. Michael Ward – Socio-Economic Survey
15. Socio-Economic Survey Team
16. WilsonMiller Inc. – Seagrass and Mangrove Impact Assessment & Mitigation Measures

Appendix V: Noise & Air Quality Data

Conrad Douglas & Associates Limited

TECHNICIAN	Marco Campbell	
LOCATION:	Salt River	
EQUIPMENT #:	31776	
TIME:	1:30 PM	
Time	Readings	Standard
1:30 PM	23.6	70
1:31 PM	24.5	70
1:32 PM	22.8	70
1:33 PM	23.5	70
1:34 PM	25.3	70
1:35 PM	25.6	70
1:36 PM	25.7	70
1:37 PM	22.9	70
1:38 PM	21.6	70
1:39 PM	23.8	70
1:40 PM	25.3	70
1:41 PM	52.9	70
1:42 PM	33.5	70
1:43 PM	34.8	70
1:44 PM	31.6	70
1:45 PM	34.2	70
1:46 PM	28.1	70
1:47 PM	27.8	70
1:48 PM	24	70
1:49 PM	23	70
1:50 PM	21.2	70
1:51 PM	22.3	70
1:52 PM	23.8	70
1:53 PM	22.9	70
1:54 PM	22.8	70
1:55 PM	23.7	70
1:56 PM	23.8	70
1:57 PM	24.3	70
1:58 PM	21.5	70
1:59 PM	21.8	70
2:00 PM	22.5	70
2:01 PM	22.8	70
2:02 PM	23.7	70
2:03 PM	24.1	70
2:04 PM	32.4	70
2:05 PM	32.4	70
2:06 PM	23.9	70
2:07 PM	22.3	70
2:08 PM	24.2	70
2:09 PM	25.4	70
2:10 PM	24.5	70
2:11 PM	25.8	70
2:12 PM	22.4	70
2:13 PM	22.1	70
2:14 PM	23.5	70
2:15 PM	22.1	70
2:16 PM	22.7	70
2:17 PM	25	70
2:18 PM	22.3	70
2:19 PM	25.2	70
2:20 PM	26.4	70

Conrad Douglas & Associates Limited

TECHNICIAN	Marco Campbell	
LOCATION:	WISCO	
EQUIPMENT #:	31776	
TIME:	9:21 AM	
Time	Readings	Standard
9:21 AM	31.4	70
9:22 AM	30.6	70
9:23 AM	33.8	70
9:24 AM	34.1	70
9:25 AM	33.8	70
9:26 AM	33.5	70
9:27 AM	31.5	70
9:28 AM	30.2	70
9:29 AM	33.2	70
9:30 AM	33.4	70
9:31 AM	33.8	70
9:32 AM	36.1	70
9:33 AM	36.1	70
9:34 AM	31.5	70
9:35 AM	30.3	70
9:36 AM	30.9	70
9:37 AM	33.2	70
9:38 AM	32.2	70
9:39 AM	29.8	70
9:40 AM	30.5	70
9:41 AM	29.6	70
9:42 AM	34.6	70
9:43 AM	31.5	70
9:44 AM	35	70
9:45 AM	31.9	70
9:46 AM	30.7	70
9:47 AM	31.6	70
9:48 AM	31.3	70
9:49 AM	30	70
9:50 AM	30.9	70
9:51 AM	30.3	70
9:52 AM	29.4	70
9:53 AM	30.7	70
9:54 AM	30.1	70
9:55 AM	30	70
9:56 AM	32	70
9:57 AM	32.2	70
9:58 AM	30	70
9:59 AM	31.2	70
10:00 AM	29.5	70
10:01 AM	32.7	70
10:02 AM	33.6	70
10:03 AM	30.3	70
10:04 AM	29.3	70
10:05 AM	29.5	70
10:06 AM	31.6	70
10:07 AM	32.4	70
10:08 AM	35.3	70
10:09 AM	29.8	70
10:10 AM	29.6	70
10:11 AM	27.6	70
10:12 AM	28.3	70
10:13 AM	32	70
10:14 AM	28.8	70
10:15 AM	30.3	70
10:16 AM	29.9	70
10:17 AM	27.5	70
10:18 AM	34.3	70
10:19 AM	29.6	70
10:20 AM	23.2	70
10:21 AM	25	70

Conrad Douglas & Associates Limited

TECHNICIAN	Marco Campbell	
LOCATION:	Brazilletto Quarry	
EQUIPMENT #:	31776	
TIME:	12:57 PM	
Time	Readings	Standard
12:57 PM	16.5	70
12:58 PM	15.9	70
12:59 PM	14.4	70
1:00 PM	16.4	70
1:01 PM	15.7	70
1:02 PM	19.1	70
1:03 PM	25.1	70
1:04 PM	17.2	70
1:05 PM	18.9	70
1:06 PM	19.7	70
1:07 PM	15.6	70
1:08 PM	11.5	70
1:09 PM	13.8	70
1:10 PM	15.8	70
1:11 PM	19.8	70
1:12 PM	15.6	70
1:13 PM	16.6	70
1:14 PM	18.2	70
1:15 PM	15.5	70
1:16 PM	21.5	70
1:17 PM	18.3	70
1:18 PM	19.2	70
1:19 PM	25.6	70
1:20 PM	18.9	70
1:21 PM	22.4	70
1:22 PM	20.3	70
1:23 PM	19.1	70
1:24 PM	20.4	70
1:25 PM	20.5	70
1:26 PM	14.5	70
1:27 PM	17.4	70
1:28 PM	19.1	70
1:29 PM	20.2	70
1:30 PM	14.7	70
1:31 PM	19.6	70
1:32 PM	21.6	70
1:33 PM	18.3	70
1:34 PM	14.2	70
1:35 PM	11.3	70
1:36 PM	12.1	70
1:37 PM	13.3	70
1:38 PM	10.7	70
1:39 PM	14.1	70
1:40 PM	11.2	70
1:41 PM	10.1	70
1:42 PM	12.1	70
1:43 PM	9.8	70
1:44 PM	10.2	70
1:45 PM	11.8	70
1:46 PM	10.4	70
1:47 PM	9.7	70
1:48 PM	8.1	70
1:49 PM	10.8	70
1:50 PM	14.1	70
1:51 PM	12.3	70
1:52 PM	10.5	70
1:53 PM	9.8	70
1:54 PM	10.1	70
1:55 PM	8.7	70
1:56 PM	9.2	70
1:57 PM	11.2	70
1:58 PM	9.4	70
1:59 PM	8.9	70
2:00 PM	7.8	70
2:01 PM	8.2	70
2:02 PM	9.1	70

Conrad Douglas & Associates Limited

TECHNICIAN	Marco Campbell	
LOCATION:	Tarentum	
EQUIPMENT #:	31776	
TIME:	10:58 AM	
Time	**Readings**	**Standard**
10:58 AM	36.9	70
10:59 AM	32.6	70
11:00 AM	37.6	70
11:01 AM	45.1	70
11:02 AM	44.1	70
11:03 AM	42	70
11:04 AM	37	70
11:05 AM	36.4	70
11:06 AM	37	70
11:07 AM	36	70
11:08 AM	35.1	70
11:09 AM	32.3	70
11:10 AM	30.8	70
11:11 AM	32.3	70
11:12 AM	37.4	70
11:13 AM	37.3	70
11:14 AM	44.2	70
11:15 AM	36.1	70
11:16 AM	42.2	70
11:17 AM	41.8	70
11:18 AM	39.9	70
11:19 AM	36.3	70
11:20 AM	35.2	70
11:21 AM	47.6	70
11:22 AM	35.1	70
11:23 AM	37.1	70
11:24 AM	35.4	70
11:25 AM	37.9	70
11:26 AM	45.7	70
11:27 AM	46	70
11:28 AM	26.3	70
11:29 AM	32.8	70
11:30 AM	33.1	70
11:31 AM	34.2	70
11:32 AM	36.1	70
11:33 AM	35.3	70
11:34 AM	41	70
11:35 AM	41.8	70
11:36 AM	39.3	70
11:37 AM	40.9	70
11:38 AM	41	70
11:39 AM	40	70
11:40 AM	42.2	70
11:41 AM	42.2	70
11:42 AM	42.7	70
11:43 AM	40.5	70
11:44 AM	40.4	70
11:45 AM	39.9	70
11:46 AM	39.7	70
11:47 AM	38.9	70
11:48 AM	40	70
11:49 AM	39.1	70
11:50 AM	39.1	70
11:51 AM	36.8	70
11:52 AM	41.1	70
11:53 AM	41.4	70
11:54 AM	39.1	70
11:55 AM	38.6	70
11:56 AM	41	70
11:57 AM	39.2	70
11:58 AM	37.9	70

Conrad Douglas & Associates Limited

TECHNICIAN	Marco Campbell	
LOCATION:	Mitchell Town	
EQUIPMENT #:	31776	
TIME:	14:59	
Time	**Readings**	**Standard**
2:59 PM	21.4	70
3:00 PM	24.5	70
3:01 PM	25.5	70
3:02 PM	22.5	70
3:03 PM	25.3	70
3:04 PM	23.4	70
3:05 PM	26.3	70
3:06 PM	21.2	70
3:07 PM	21.5	70
3:08 PM	22	70
3:09 PM	23	70
3:10 PM	21.1	70
3:11 PM	20.7	70
3:12 PM	23.2	70
3:13 PM	25.2	70
3:14 PM	25.1	70
3:15 PM	22.9	70
3:16 PM	21.8	70
3:17 PM	21.9	70
3:18 PM	21.3	70
3:19 PM	20.9	70
3:20 PM	21.7	70
3:21 PM	38	70
3:22 PM	37.5	70
3:23 PM	23.5	70
3:24 PM	21.8	70
3:25 PM	21.8	70
3:26 PM	38.6	70
3:27 PM	19.9	70
3:28 PM	23.4	70
3:29 PM	22.9	70
3:30 PM	26.7	70
3:31 PM	29.5	70
3:32 PM	24.3	70
3:33 PM	25	70
3:34 PM	23.2	70
3:35 PM	26.2	70
3:36 PM	25.1	70
3:37 PM	23.7	70
3:38 PM	23.3	70
3:39 PM	22.8	70
3:40 PM	22	70
3:41 PM	22.5	70
3:42 PM	20.5	70
3:43 PM	23.4	70
3:44 PM	22.8	70
3:45 PM	21.6	70
3:46 PM	22.1	70
3:47 PM	24	70
3:48 PM	27.8	70
3:49 PM	21.3	70
3:50 PM	22.4	70
3:51 PM	24.3	70
3:52 PM	24.5	70
3:53 PM	22.6	70
3:54 PM	24.1	70
3:55 PM	23.8	70
3:56 PM	25.7	70
3:57 PM	26.2	70
3:58 PM	28.1	70
3:59 PM	29.4	70

Conrad Douglas & Associates Limited

TECHNICIAN:	Marco Campbell	
LOCATION:	Rocky Point	
EQUIPMENT #:	31756	
Time	13:57	
Time	**Readings**	**Standard**
1:57 PM	14.4	70
1:58 PM	13.2	70
1:59 PM	12	70
2:00 PM	17.5	70
2:01 PM	18.8	70
2:02 PM	17.6	70
2:03 PM	16.2	70
2:04 PM	10.3	70
2:05 PM	12.1	70
2:06 PM	10.3	70
2:07 PM	12.1	70
2:08 PM	8.2	70
2:09 PM	12.6	70
2:10 PM	13.3	70
2:11 PM	13.5	70
2:12 PM	13.7	70
2:13 PM	12.2	70
2:14 PM	14.6	70
2:15 PM	10.2	70
2:16 PM	8.4	70
2:17 PM	15.3	70
2:18 PM	14	70
2:19 PM	11.5	70
2:20 PM	11.6	70
2:21 PM	10.2	70
2:22 PM	14.3	70
2:23 PM	15.2	70
2:24 PM	17.6	70
2:25 PM	14.1	70
2:26 PM	11.3	70
2:27 PM	10.2	70
2:28 PM	15.2	70
2:29 PM	14.8	70
2:30 PM	14.7	70
2:31 PM	11.6	70
2:32 PM	11.8	70
2:33 PM	12.2	70
2:34 PM	9.2	70
2:35 PM	10.3	70
2:36 PM	11.4	70
2:37 PM	15.2	70
2:38 PM	10.3	70
2:39 PM	14.5	70
2:40 PM	7.7	70
2:41 PM	5.3	70
2:42 PM	6.2	70
2:43 PM	2.3	70
2:44 PM	12.2	70
2:45 PM	13.5	70
2:46 PM	14.6	70
2:47 PM	15.2	70
2:48 PM	5.2	70
2:49 PM	13.2	70
2:50 PM	13.8	70
2:51 PM	10.2	70
2:52 PM	14.6	70
2:53 PM	15.3	70
2:54 PM	11.1	70
2:55 PM	10	70
2:56 PM	12.3	70

LOCATION:	Brazilletto Quarry				
EQUIPMENT # :	07-0396				
FILTER # :	P5029294				
WEATHER CONDITIONS:	Sunny				
START DATE & TIME :	8-Mar-08	1:41 PM			
END DATE & TIME :	3/9/2008	1:42 PM			
Mass Concentration (MC) is given by	MC = (Wf -Wi) / V				
Where Wf = final mass of filter element					
Wi = initial mass of filter element					
V = corrected sample volume					
Now					
Wf =	0.1433	g	(=)	143300	µg
Wi =	0.1429	g	(=)	142900	µg
Wf - Wi =	400	µg			
Corrected Volume =	4015.6	L	(=)	4.0156	m^3
Mass Concentration (MC)			(=)	99.612	µg/ m^3
Run Time	1441	min			
Regulatory Standard for TSP is					
24 hr (average)	**150**	**µg/ m^3**			
Annual Average	60	µg/ m^3			

LOCATION:	Tarentum Coffee Factory				
EQUIPMENT # :	07-0397				
FILTER # :	P5029447				
WEATHER CONDITIONS:	Sunny				
START DATE & TIME :	23-Feb-08	11:01 AM			
END DATE & TIME :	2/24/2008	11:02 AM			
Mass Concentration (MC) is given by	MC = (Wf -Wi) / V				
Where Wf = final mass of filter element					
Wi = initial mass of filter element					
V = corrected sample volume					
Now					
Wf =	0.1448	g	(=)	144800	µg
Wi =	0.1439	g	(=)	143900	µg
Wf - Wi =	900	µg			
Corrected Volume =	6771.2	L	(=)	6.7712	m^3
Mass Concentration (MC)			(=)	132.92	µg/ m^3
Run Time	1441	min			
Regulatory Standard for TSP is					
24 hr (average)	**150**	**µg/ m^3**			
Annual Average	60	µg/ m^3			

LOCATION:	Brazilletto Quarry				
EQUIPMENT # :	07-0396				
FILTER # :	P5029294				
WEATHER CONDITIONS:	Sunny				
START DATE & TIME :	8-Mar-08	1:41 PM			
END DATE & TIME :	3/9/2008	1:42 PM			
Mass Concentration (MC) is given by	MC = (Wf -Wi) / V				
Where Wf = final mass of filter element					
Wi = initial mass of filter element					
V = corrected sample volume					
Now					
Wf =	0.1433	g	(=)	143300	µg
Wi =	0.1429	g	(=)	142900	µg
Wf - Wi =	400	µg			
Corrected Volume =	4015.6	L	(=)	4.0156	m^3
Mass Concentration (MC)			(=)	99.612	µg/ m^3
Run Time	1441	min			
Regulatory Standard for TSP is					
24 hr (average)	**150**	**µg/ m^3**			
Annual Average	60	µg/ m^3			

LOCATION:	Tarentum Coffee Factory				
EQUIPMENT # :	07-0397				
FILTER # :	P5029447				
WEATHER CONDITIONS:	Sunny				
START DATE & TIME :	23-Feb-08	11:01 AM			
END DATE & TIME :	2/24/2008	11:02 AM			
Mass Concentration (MC) is given by	MC = (Wf -Wi) / V				
Where Wf = final mass of filter element					
Wi = initial mass of filter element					
V = corrected sample volume					
Now					
Wf =	0.1448	g	(=)	144800	µg
Wi =	0.1439	g	(=)	143900	µg
Wf - Wi =	900	µg			
Corrected Volume =	6771.2	L	(=)	6.7712	m^3
Mass Concentration (MC)			(=)	132.92	µg/ m^3
Run Time	1441	min			
Regulatory Standard for TSP is					
24 hr (average)	**150**	**µg/ m^3**			
Annual Average	60	µg/ m^3			

LOCATION:	Mitchell Town				
EQUIPMENT # :	07-0396				
FILTER # :	P5029205				
WEATHER CONDITIONS:	Sunny				
START DATE & TIME :	6-Mar-08	3:15 PM			
END DATE & TIME :	3/7/2008	3:16 PM			
Mass Concentration (MC) is given by	MC = (Wf -Wi) / V				
Where Wf = final mass of filter element					
Wi = initial mass of filter element					
V = corrected sample volume					
Now					
Wf =	0.1416	g	(=)	141600	µg
Wi =	0.1414	g	(=)	141400	µg
Wf - Wi =	200	µg			
Corrected Volume =	7032.7	L	(=)	7.0327	m^3
Mass Concentration (MC)			(=)	28.439	µg/ m^3
Run Time	1441	min			
Regulatory Standard for TSP is					
24 hr (average)	**150**	**µg/ m^3**			
Annual Average	60	µg/ m^3			

LOCATION:	Rocky Point				
EQUIPMENT # :	07-0396				
FILTER # :	P7016228				
WEATHER CONDITIONS:	Sunny				
START DATE & TIME :	9-Apr-08	11:27 AM			
END DATE & TIME :	4/10/2008	11:28 AM			
Mass Concentration (MC) is given by	MC = (Wf -Wi) / V				
Where Wf = final mass of filter element					
Wi = initial mass of filter element					
V = corrected sample volume					
Now					
Wf =	0.142	g	(=)	142000	µg
Wi =	0.1419	g	(=)	141900	µg
Wf - Wi =	100	µg			
Corrected Volume =	5471.6	L	(=)	5.4716	m^3
Mass Concentration (MC)			(=)	18.28	µg/ m^3
Run Time	1441	min			
Regulatory Standard for TSP is					
24 hr (average)	**150**	**µg/ m^3**			
Annual Average	60	µg/ m^3			

Appendix VI: Impact Identification Definition and Significance of Impacts

In assessing the significance of potential impacts, various measures are used. These include the use of checklists/matrices, expert knowledge and a keen assessment of the project plans and details. Each parameter is evaluated according to the following:

- Potential impact - any change to the environment, whether adverse or beneficial, wholly or partially resulting from the proposed activities, products or services
- Activity – phase of development that action takes place in
- Environmental receptor - sensitive component of the ecosystem that reacts to or is influenced by environmental stressors
- Magnitude - A measure of how adverse or beneficial an effect may be
- Duration - the length of time needed to complete an activity
- Significance - A measure of importance of an effect
- Mitigation - Measures taken to reduce adverse impacts on the environment

Outlined below are the impacts on the various phases of the proposed development as they relate to key aspects of the project. Namely:

- Physical environment
- Biological environment
- Socio-economic environment
- Cumulative impact assessment

Mitigation measures are provided, where necessary, at the end of each subsection.

<u>Impact Identification & Mitigation Method</u>

A. Impact Identification

This section is undertaken to forecast the characteristics of the main potential impacts. Known as impact analysis, this stage can be broken down into three overlapping aspects:

- *identification* — to specify the impacts associated with each phase of the project and the activities undertaken;
- *prediction* — to forecast the nature, magnitude, extent and duration of the main impacts; and
- *evaluation* — to determine the significance of residual impacts i.e. after taking into account how mitigation will reduce a predicted impact

Impact identification and prediction are undertaken against an environmental baseline, such as:

- human health and safety;
- flora, fauna, ecosystems and biological diversity;
- soil, water, air, climate and landscape;
- use of land, natural resources and raw materials;
- protected areas and designated sites of scientific, historical and cultural significance;
- heritage, recreation and amenity assets; and

- livelihood, lifestyle and well being of those that may be affected by the proposed project

These requirements were identified in the Terms of Reference. The parameters to be taken into account in impact prediction and decision-making include:

- likelihood (probability, uncertainty or confidence in the prediction);
- nature (positive, negative, direct, indirect, cumulative);
- magnitude (severe, moderate, low);
- extent/location (area/volume covered, distribution);
- duration (short term, long term, intermittent, continuous);
- reversibility/irreversibility; and
- significance (local, regional, global)

A.1 Nature

The most obvious impacts are those that are directly related to the proposed project, and can be connected (in space and time) to the action that caused them. Typical examples of direct impacts as it relates to this project are: modification of a degraded wetland to amend impacts caused by agricultural drainage; loss of habitat caused by land clearance; any perceived changes/increases in air particulate emissions (temporary/permanent), etc.

Indirect or secondary impacts are changes that are usually less obvious, occurring later in time or further away from the impact source. Typical example of indirect impact as it relates to this project is: noise related stress caused by urban and industrial development.

Cumulative effects, typically, result from the incremental impact of an action when combined with impacts from projects and actions that have been undertaken recently or will be carried out in the near or foreseeable future. These impacts may be individually minor but collectively significant because of their spatial concentration or frequency in time. Cumulative effects can accumulate either incrementally (or additively) or interactively (synergistically), such that the overall effect is larger than the sum of the parts.

A.2 Magnitude (Intensity)

Estimating the magnitude of the impact is of primary importance. In this document it is expressed in terms of relative severity, such as major, moderate or low. Severity, will also take into account other aspects of impact magnitude, notably whether or not an impact is reversible.

- **Low**: negligible effect when component is slightly altered. For human population the effect is negligible when it slightly affects a component or its use or valuation by the community.
- **Moderate**: moderate effect when component is altered to a lesser extent but doesn’t compromise its presence in the new environment. For human population the effect is less intense when it partially limits the use of the component or its valuation by the community.

- **Major**: major effect when component is completely destroyed or is altered significantly. For human population the effect is when it compromises or alters significantly the component or its use or valuation by the community.

A.3 Duration

Some impacts may be short-term, such as the noise arising from the operation of equipment during construction. Others may be long-term, such as noise arising from the operation of conveyor during operation. Certain impacts may be intermittent, whereas others may be continuous.

- **Short-term impacts**: when component will be affected for a limited period such as the pre-construction phase of the project, i.e., pre-construction and construction.
- **Intermittent impacts**: when component will have difficulty to adjust at first to the new environmental conditions but will eventually return to pre-project levels and the population will be able to use it eventually as before or even better.
- **Long-term impacts**: when component will be affected for the lifetime of the project enough to compromise the survival of a local species or use of a component by the population.

Impact magnitude and duration classifications will be cross-referenced; as necessary, for example, major but short term (less than one year).

A.4 Extent/Location

The spatial extent or zone of impact influence can be predicted for site-specific versus regional occurrences. Depending on the type of impact, where necessary, the variation in magnitude will be estimated.

- **Limited**: When impact occurs in relatively restricted areas such as the construction site facilities
- **Local**: Limited area when component is well represented in region (<1 km radius)
- **Regional**: When an impact exceeds local boundary and has the potential to affect a wide radius of communities such as a nearby town (1-10 km radius)
- **National**: When an impact has the potential to affect the entire island
- **International**: Impacts that may be considered as affecting the global population such as contributions to global warming

A.5 Significance

The evaluation of significance at this stage of EIA will depend on the characteristics of the predicted impact and its potential importance for decision-making. An impact may be categorized as negative if it adversely affects an environmental component and positive if it favourably affects an environmental component. For the purposes of this project:

- **Minor**: An impact of low significance is one that is short term and will have no long term cumulative effect on the environment and/or will affect a negligible portion of an environmental component.
- **Moderate**: An impact may be considered to be of moderate significance when the change is medium to long term and/or will result in changes that affect a considerable portion of the environmental component.
- **Major**: An impact of high significance will cause long term changes and/or will result in changes that affect a major percentage of the environmental component.

Significance may also be attributed in terms of an existing standard or criteria of permissible change.

B Impact Mitigation

The elimination of adverse environmental impacts or their reduction to an acceptable level is at the heart of the EIA process. By definition all EIA projects are likely to have significant environmental effects. In this case, the potential for mitigation will be considered at every stage of the proposed project. In determining the level of effectiveness of mitigation measures, the following will be taken into account:

A. **Prevent** - The most effective approach will be to prevent the creation of adverse environmental effects at source rather than trying to counteract their effects through specific mitigation measures. At source solutions may include:
   - specification of operational equipment- for example the use of an inherently quieter machine

B. **Reduce** - If the adverse effects cannot be prevented steps will be taken to reduce them. Methods to reduce adverse effects include: minimisation at source
   - use of low noise or vibration construction equipment
   - operating the site to minimise the production of leachate
   - abatement on site
     i. colour of buildings
     ii. screen planting and landscaping
     iii. noise attenuation measures
     iv. reduced hours of construction
   - abatement at receptor
     i. noise insulation for houses
     ii. relocating rare species

Quantification of impacts is a difficult technical aspect of an EIA. For some impacts the theoretical basis for computing the magnitude does not exist. Such impacts may have to be addressed in a qualitative way.

C. Summary of Impact Matrices

Summary matrices are included and give an overall picture of the potential pre-mitigation impacts and residual impacts.

C.1 Residual Impacts

Any potential residual impacts, ranked as moderate or major will be discussed in more detail in the subsequent text in the section addressed. The residual environmental impacts refer to the net environmental impacts after mitigation, taking into account the background environmental conditions and the impacts from existing, committed and planned projects.

The following table outlines the criteria used to assess environmental impacts in terms of minor, moderate, or major impact subsequent to mitigation measures being incorporated.

Table C: Level of Impact after Mitigation Measures

	Ecological Effects	Socio-economic Effects	Stakeholders	Consequence for Proponent
Major	Degradation to the quality or availability of habitats and/or fauna with recovery taking more than 2 years	Change to commercial activity leading to a loss of income or opportunity beyond normal business variability/risk Potential short term effect upon public health / well-being, real risk of injury	Concern leading to active campaigning locally or wider a field	Introduce measures to avoid these impacts wherever possible, closely monitor and control areas of residual impact
Moderate	Change in habitats or species beyond natural variability with recovery potential within 2 years	Change to commercial activity leading to a loss of income or opportunity within normal business variability/risk Possible but unlikely effect upon public health/well-being. Remote risk of injury	Widespread concern, some press coverage, no campaigning	Actively work to minimize scale of impacts
Minor	Change in habitats or species which can be seen and measured but is at same scale as natural variability	Possible nuisance to other activities and some minor influence on income or opportunity. Nuisance but no harm to public	Specific concern within a limited group	Be aware of potential impacts, manage operations to minimize interactions
Negligible	Change in habitats or species within scope of existing variability and difficult to measure or observe	Noticed by but not a nuisance to other commercial activities. Noticed by but effects upon the health and well-being of the public	An awareness but no concerns	No positive intervention needed but ensure they do not escalate in importance
Positive	An enhancement of ecosystem or popular parameter	Benefits to local community	Benefits to stakeholder issues and interests	Actively work to maximize specific benefits

Appendix VII: Photo-Inventory

Community Sensitivities

Children Swimming in Salt River – Water Pumping Station at Bratts Hill

Children Swimming at the Salt River Mineral Spring Location

Children Fishing in Salt River at WISCO Wharf

Children Swimming at the Salt River Mineral Spring Location

Community Water supply

Noise influence

Basic School

Squatting

Illegal Felling of Mangroves for Bee-Keeping

Illegal Dumping and Wash-up in Mangrove

Illegal Felling of Trees for Charcoal

Illegal Dumping and Wash-up in Mangrove

Dry Scrub Forest – Coastal Plains

Open grassland

Acacia scrub

Acacia scrub

Grassland, fruit trees (background)

Acacia scrub & Grassland

Acacia scrub & Grassland

Coastal Vegetation

Logwood – endemic cacti

Opuntia (smooth pear)

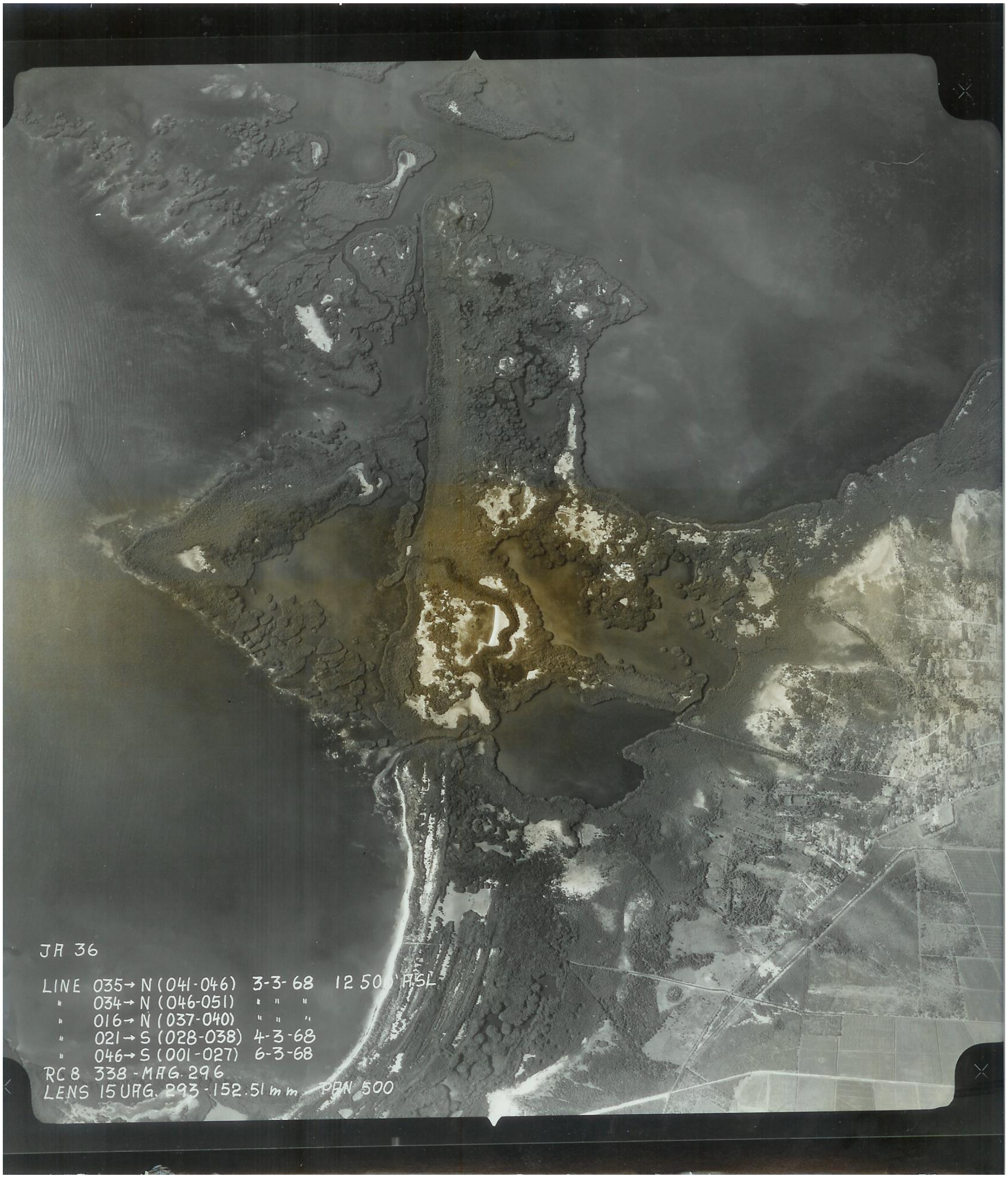
Red mangrove

Red mangrove - Acacia

Black & red mangrove – Seaside Mahoe

Jamaican samphire

Appendix VIII: Historical Aerial Imagery of Rocky Point, Clarendon (1968)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" 021→S (028-038) 4-3-68
" 046→S (001-027) 6-3-68
RC8 338 - MAG. 296
LENS 15 UAG. 293 - 152.51 mm PAN 500

Appendix IX: Pre-Engineered Wastewater Treatment Package Plant

SEAPOINT **B-Series**

Pre-engineered Wastewater Treatment Package Plants in Prefabricated Modular Concrete Structures

SEAPOINT B-Series Systems

Up to 30,000 GPD advanced wastewater treatment in prefabricated structures incorporating process equipment

- All SEAPOINT products are pre-engineered and manufactured at our facilities.
- Our products are delivered to you ready for installation at your prepared site.
- SEAPOINT products have the smallest footprint on the market for wastewater package plants.
- Save time and money by specifying one of our many standard packages with the options you need.

Typical Applications

Features

- Fully integrated, automatic treatment process with submerged membrane bioreactor (MBR) technology and UV
- Durable modular structure with multiple finish options; power and liquid connections to customer-supplied external waste-water collection, equalization and sludge holding tanks
- Produces reuse quality effluent (typical BOD_5, TSS $\leq$ 5 mg/L, TN $\leq$ 10 mg/L, CFU = ND)
- Reliable technology, PLC control, easily maintained, duplex pumps, blowers and UV

Options

- Work space insulation and heating
- Remote system monitoring with auto dial
- Exterior and roof finish options
- Total phosphorus control
- Upgrades for extreme wind, seismic and snow conditions

Applications include:

- Small Communities • Cluster Housing
- Commercial Campuses • Schools
- Visitor Centers • RV Parks • Golf Courses

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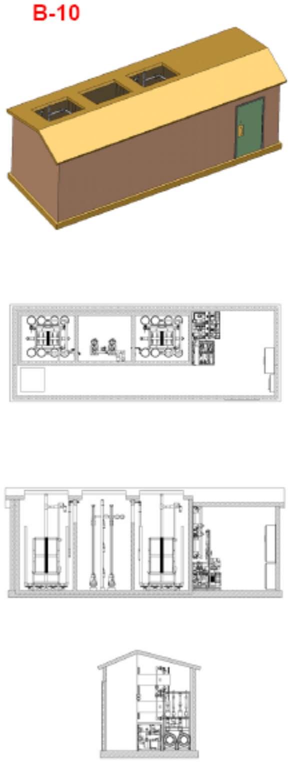
Pre-engineered Wastewater Package Plants in Prefabricated Modular Concrete Structures

SEAPOINT B-series units come in four standard flow capacities with typical flow rates as follows:

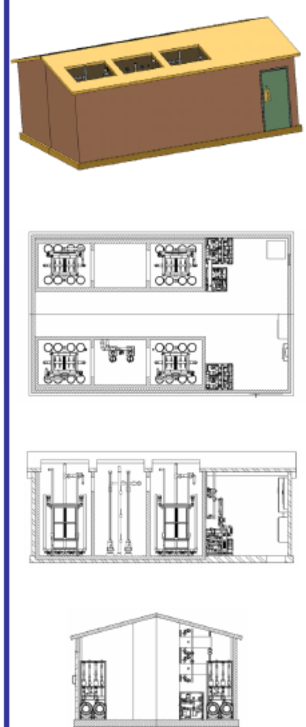
- The **B-5**: 5,000 GPD or up to 7,500 GPD with optional E (extended) configuration upgrade
- The **B-10**: 10,000 GPD or up to 15,000 GPD with optional E (extended) configuration upgrade
- The **B-20**: 20,000 GPD or up to 30,000 GPD with optional E (extended) configuration upgrade
- The **B-30**: 30,000 GPD with attached anoxic tank

B-10



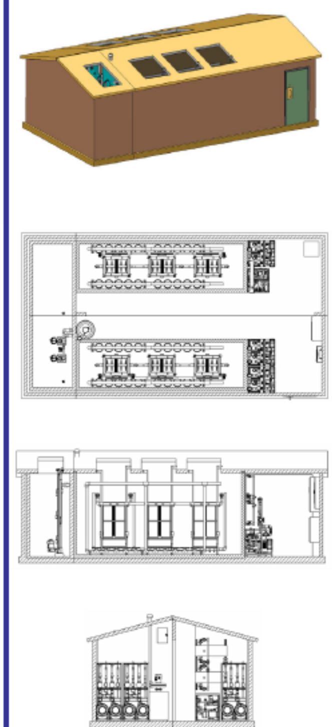
26'-6" Long
9'-6" Wide
10'-4" High
89,000 lbs Dry
116,000 lbs Wet

B-20



26'-6" Long
16'-6" Wide
11'-2" High
146,000 lbs Dry
201,000 lbs Wet

B-30



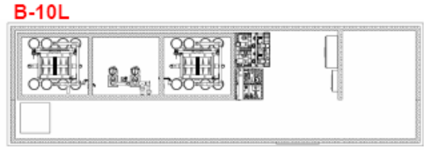
30'-6" Long
16'-6" Wide
11'-2" High
172,000 lbs Dry
255,000 lbs Wet

Note: Length and Width are foundation size

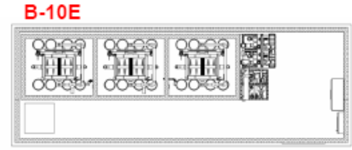
Each B-Series version is also available in 2 alternative configurations (individually or in combination):

- The **L** (long) version with additional 6 or 10 foot length for optional or customer-supplied equipment, and
- The **E** (extended capability) version with the additional treatment capability of one or more MBR tanks.

B-10L



B-10E



Pre-engineered Wastewater Package Plants in Prefabricated Modular Concrete Structures

Finish and Color Options

SEAPOINT has a large selection of standard and upgraded packages in a variety of colors from which to choose. These prefabricated structures will lower your project costs and shorten time to completion.

- Construction materials are reinforced concrete.
- Two coats of modified latex exterior paint are applied at the factory.
- Architectural upgrades, including exterior wall and roof finishes, are available.

Exterior Wall Finishes: (Options at extra cost)

Standard: Painted Stucco

Optional: Split Block Concrete Form

Optional: River Rock Exposed Aggregate

Color Options: Benjamin Moore Industrial Coating Color Pallet

Other Optional Exterior Wall Finishes Include:
Clapboard Look
Cedar Shingle Look

Roof Finishes: (Options at extra cost)

Standard: Finished and Painted Concrete
Options: Asphalt Shingle Roof
Standing Seam Metal Roof

Structure Code Compliance

The standard B-Series package plant structures are built in accordance with the 2003 International Building Code (IBC). The standard structure conforms to:

- Winds up to 140 MPH
- Seismic Zone 2
- 20 inch snow load

Upgraded structures can be built for seismic zone 4, higher wind stress, and higher snow load.

Additionally, the structures are in full compliance with the following codes: 2003 International Plumbing Code, 2003 International Mechanical Code and 2002 National Electric Code

Wastewater Treatment Package Plant Capabilities

Typical Maximum Influent Concentrations:
- BOD_5: 300 mg/L 30 day average
- TSS: 300 mg/L 30 day average
- TKN: 45 mg/L 30 day average

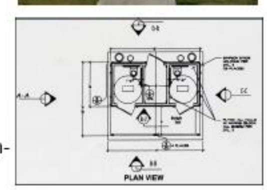
Treated Effluent Concentrations
- BOD_5: $\leq$ 5 mg/L
- TSS: $\leq$ 5 mg/L
- TN: $\leq$ 10 mg/L

Additional treatment options are available for higher influent concentrations and lower effluent values. Modifications are available to achieve compliance with total N $\leq$ 3 mg/L and total P$\leq$1 mg/L .

Other Available Products:

Prefabricated Restroom Buildings

- Available in a variety of sizes, configurations and finishes
- ADA compliant
- Ideally suited for recreation areas, RV parks, etc.
- Contact your sales representative for more information



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General Structure Specifications

Pre-cast Components:

- All concrete used in the pre-cast walls, roof, and floor has a minimum compressive strength of 5,000 psi and conforms with the requirements of ACI standard 318-83.
- Test samples are taken during the manufacture of each structure.

Reinforcement:

- All reinforcing steel bars conform to ASTM 615 Grade 60.
- Wire mesh and flat sheets used for reinforcing conform to ASTM 185.

Assembly: All pre-cast wall panels are welded together and attached to the floor in such a way as to form a continuous unit.

Doors: Exterior door is 3' 0" x 6' 8", 1 3/4" thick pre-hung metal with a matching metal frame permanently attached to the building.

Exterior Walls: The exterior concrete walls of the structure have a concrete stucco finish. Other finishes are available as options.

Electrical:

- All electrical items are pre-wired.
- Fixtures include:
  - Interior lighting
  - Exterior lighting by entry door
  - 120 volt electrical outlets
  - Exterior power disconnect box

Design Loads: The standard building is designed for wind speeds up to 140 MPH, snow loads of 20", and Seismic Zone 2. Building upgrades are available for Seismic Zone 4, snow loads up to 60", and wind speeds as required.

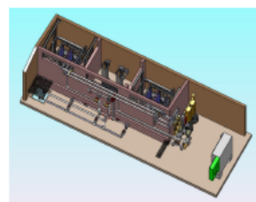
Site Preparation Requirements

Location: The installation site should be in close proximity to the wastewater collection area and a power source sufficient to operate the system. The installation site must permit access by equipment capable of transporting, offloading, and handling the designated loads.

Site Suitability: The site must be level and stable enough for the system's gross weight, when fully loaded and processing wastewater. The foundation must be designed in accordance with local codes.

Additional Tanks: A collection/separation tank, which receives all wastewater, and an equalization tank, which supplies the treatment unit, are required. The minimum size of each is determined in consultation with SEAPOINT in consideration of the flow details of the application. Filtering capable of removing all particles greater than 1/8 inch is required between tanks. These filters are supplied by SEAPOINT for installation into the collection tank. A sludge holding tank is recommended. Tanks are available from SEAPOINT as options.

Site Work: Installation of building and tanks, and all on-site plumbing and electrical connections are the responsibility of the customer.



General Treatment System Specifications

Treatment Technology:

- Submerged membrane bioreactor with denitrification, influent pre-filtration, and permeate disinfection

Wastewater Processing Capabilities:

- Available in standard sizes capable of treating up to 30,000 GPD
- Effluent Supplied Head Pressure: 15' minimum

Wastewater Influent Characterization: The system is optimized to operate within the following blended municipal wastewater input parameters:

- TSS: 30 day average not to exceed 300 mg/L
- BOD_5: 30 day average not to exceed 300 mg/L
- TKN: 30 day average not to exceed 45 mg/L
- Wastewater Temperature: 50°F (10°C) to 80°F (27°C)
- pH: 5.0 – 9.0

Treated Effluent Characterization :

- Maximum Particle Size: not to exceed .005"
- TSS: $\leq$ 5 mg/L average
- BOD_5: $\leq$ 5 mg/L average
- Total Nitrogen: $\leq$ 10 mg/L average
- Turbidity: not to exceed 1.0 NTU
- Fecal Coliform Bacteria: None detectable

These influent and effluent values are for standard plant equipment. Additional treatment options are available for influent concentrations that exceed these values or effluent concentrations that must be lower.

Electric Power Requirements:

- Customer Supplied Inlet Power: 208 or 480VAC, 3-phase. Single phase option available for smaller units.
- Frequency Stability Limit: +/- 1 Hz of specified line frequency
- Line Voltage Fluctuation Limit: +/- 5%

Mechanical Equipment:

- Effluent pumps, recirculation pumps, aeration blowers, control valves, and ultraviolet disinfection units are pre-mounted in the system
- Supply pumps are included with the system for installation in the equalization tank.
- Duplex designs are standard; simplex designs are available.

System Controls & Process Monitoring:

- PLC controlled
- Display panel for alarms and faults
- Internal modem for remote monitoring with optional auto-dialer

Operating Temperature: The system will operate at ambient temperatures ranging from 40°F (4°C) to 90°F (32°C). Optional insulation and heating are available for operation outside this range.

Odor Control: An odor control system designed to manage the process air released from the membrane bioreactor is incorporated into the structure.

Rev: B010507NA

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Appendix X: Alternative to SCJ Lands in Salt River

This appendix outlines the possible alternative for Rinker's proposed development in Salt River. In discussions with NEPA it was agreed an alternative needed to be presented to the proposed plans for the Plant operations on the plains.

The lands are ruinate lands but represent parcels of sugar lands held by the Sugar Company of Jamaica Limited. Should the lands not be available the conveyor will be routed north alongside the Salt River to Mitchell Town road through the foothills of the Brazilletto Mountain to the quarry.

The figure below outlines the areal extent of such a deviation from the proposed designs.


REFERENCE DRAWINGS / DESIGN STANDARDS
NUMBER
DESCRIPTION
NVEYOR RIGHT OF WAY
SEE DRAWING 306528-002-21
23.73
500,000 TON STOCKPILING AREA
PROPOSED
CONVEYOR
PULL OUTS 200' LONG
x 15' WIDE @ 1000'
2603930 [8543'-1"]
A
306528-002-23
FOR ENLARGED PLAN VIEW
OF SHIP DOCK AND LOADING FACILITY
SEE DRAWING 306528-002-22
C
306528-002-25
PLAN
Scale 1:7500
No. Revision By D/M/Y
CWA
Engineers Inc.
Suite 223-4600 Kingsway St.
Burnaby, B.C. Canada V5H 4L9
Phone: (604) 526-2275
Fax: (604) 438-5260
www.cwaengineers.com
This drawing has been prepared for the exclusive use of the intended client, and may not be used in whole or in part by any other individual or company.
Name Day Month Year
Drawn By JRM 16 03 09
Designed By
Checked By
Approved By
Scale: AS NOTED
Acad File: FIGURE 2.1
RINKER
JAMAICA LTD.
OFFSHORE AGGRAGATE FACILITY
PORT CONVEYOR SYSTEM
PLAN
Drawing No.
FIGURE 2.1
Rev.
Issue D/M/Y By Issued For: Rev.