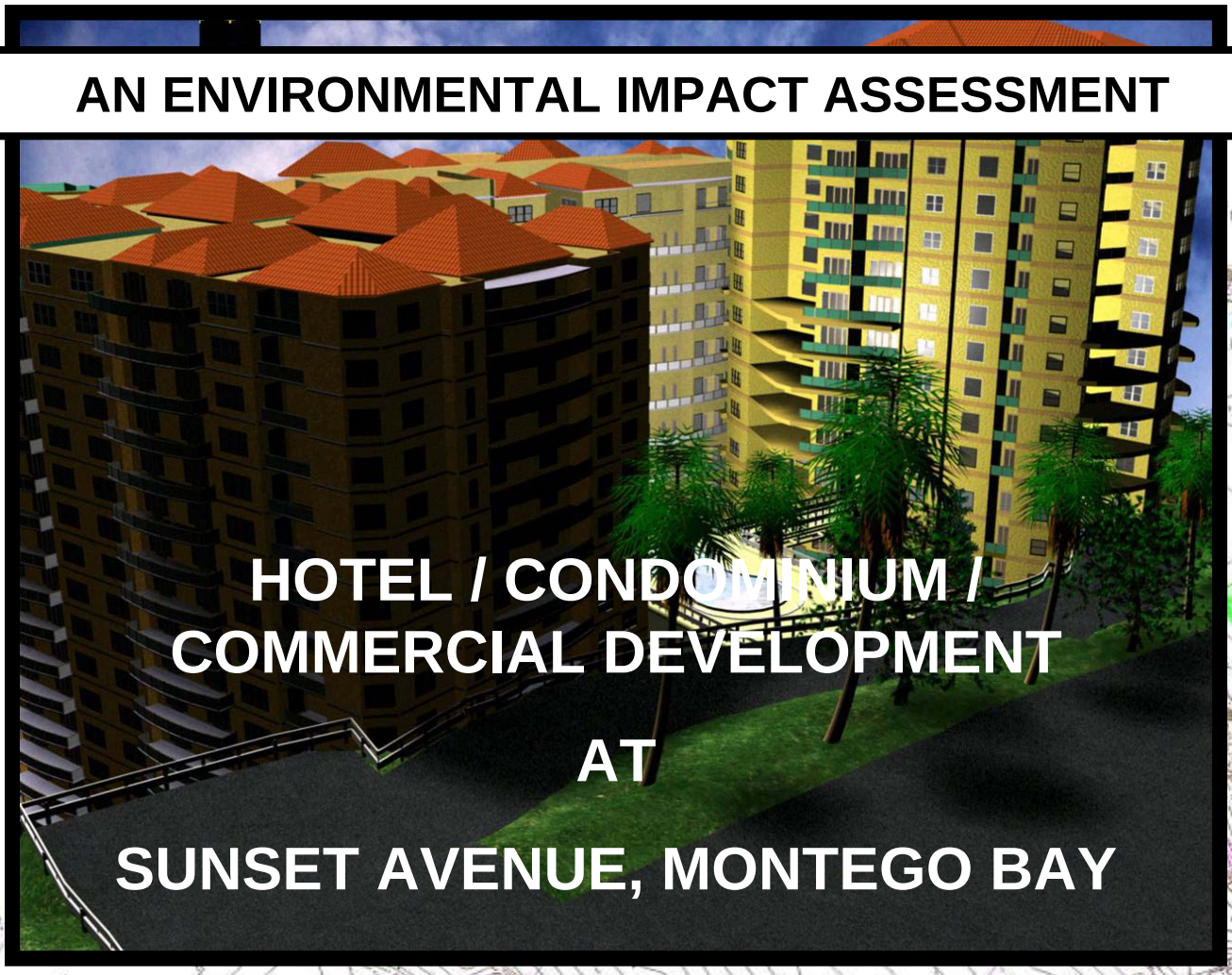
AN ENVIRONMENTAL IMPACT ASSESSMENT



HOTEL / CONDOMINIUM / COMMERCIAL DEVELOPMENT

AT

SUNSET AVENUE, MONTEGO BAY

Prepared for CAREIF Ltd

By

PETER WILSON-KELLY

AND ASSOCIATES

SEPTEMBER 2007

EXECUTIVE SUMMARY

Introduction

CAREIF Ltd. proposes to develop approximately 3.6 hectares of land on property in the city of Montego Bay, St. James. The site is bordered by the Sunset Avenue to the north, Queens Drive to the east and Gloucester Avenue to the west.

THE development will comprise two phased components. Phase 1 will accommodate offices, a cinema, retail shops and elevated parking in 4 multi-storey buildings on site and will be known as **THE SUNSET TOWN CENTRE**. Phase 2 will comprise 4 multi-storey Hotel/Condominium and Spa blocks and will be designed to cater to both local and foreign professionals and residents. This phase will be known as **PHENION ON THE RIDGE (note building and drainage layouts on attached development drawings)**.

THE distinguishing feature of this development is its multi-level building concept, with a maximum of seven floors for the Sunset Town Centre and 15 floors for the Phenion on the Ridge.

Summarized Site Description

Vegetation and Fauna

THE development is found within a forest vegetation assemblage characterized as Tall Open Dry Forest. This forest assemblage is typically an “open natural woodland or forest with Deciduous/Semi-deciduous trees”.

“Trees are at least 5 m tall and crowns not in contact with each other”. This forest type is typically found within altitude ranges of 0 – 400 meters above sea level.

THE vegetation assemblage on site has been disturbed over the years, with significant vegetation disturbance being observed on the western, central and northern sections of the property. Additionally, there were clear examples of trees that had been introduced onto the site. These were mainly fruit, hardwood and palm varieties.

TWO endemic species of plants were observed during vegetation traverses on site, namely a bromeliad (***Agave sp.*)** and an arboreal Cactus **(*Hylocereus sp.***)

THE most obvious examples of fauna observed at the site were **BIRDS, BUTTERFLIES** and **LIZARDS.** All fauna observed appeared to interact closely with the natural and introduced vegetation on site and observations lead to the opinion that there was a fairly vibrant population of birds on site, the most common being various species of **Doves**.

Topography and Geology

THE development site could easily be described as having a variable topography, progressing from low lying and gradually sloping (<10 degrees) to the western sections of the property to elevated and steep sloping (> 60 degrees) towards the eastern boundaries. Prominent cliffs, characteristic of Pleistocene raised reef terraces observed in western St. Mary, western St. Ann and western Trelawney, dominate the eastern sections of the site.

DUE to tectonic uplift, the highest altitude difference is situated to the SE of the property. This section has its summit at about 53 m above sea level against the gentle slope to the north which has a minimum height of 7 m above sea level.

THE underlying bedrock is comprised of tectonically raised reef limestone, which occurs along the north coast and is classified in the Upper Coastal Group. These rocks overlay another geological feature known as the Montpelier Formation located to the east and south of the project area.

Drainage

NO permanent drainage channels were observed on site. However, there was evidence to show that springs occasionally generate on-site, particularly during protracted rainfall periods.

TWO locations were observed where surface drainage accessed the development site from offsite. The sources of these drainages appear to be runoff from Queens Drive. These features do not constantly flow, but appear to be natural conveyances of water during rainfall events. One drainage feature flows onto the north eastern section of the property sheet flows and dissipates onto the northern section of the property. The second feature flows onto the southeastern section of the property and is intercepted in a concrete and block drain that flows to an underground drain leading onto Gloucester Avenue.

Foreseeable Environmental Impacts:

Long Term Impacts:

THESE are summarized as follows:

Vegetation Related Impacts:

1. Approximately 42% of the existing forest area is likely to be disturbed by the development
2. The percentage outlined above does not include other areas upon which vegetation clearances and subsequent re-growth may have occurred.
3. Approximately 50% of the introduced trees that had been surveyed by the developers will be disturbed by the implementation of the development.
4. The loss of forest vegetation will impact negatively on the presence of the animal-life observed in the area.

5. Loss of construction noise attenuation capabilities
6. Loss of rainfall absorptive functions leading to increased surface water collection.

Drainage Related Impacts:

1. Water volumes in excess of that which would have been conveyed offsite prior to the development will impact external sites due to vegetation removal and hard surface creation.
2. An increase in the turbidity of the runoff leaving the site could occur if uncontrolled surface water flows onto or over unprotected loose substrates or sediment stockpiles

Aesthetic Impacts:

1. A development of this stature and vertical scale, if not designed with good aesthetics in mind, will ultimately be perceived as an eyesore to persons transiting the immediate vicinity of the development area.
2. If the development results in the blocking of views traditionally enjoyed by occupiers of dwellings to the east of the development, then this will also be viewed as a negative and permanent impact.
3. Unmitigated vegetation loss and construction alterations to the site will have negative impacts on these aesthetic characteristics.

Short Term Impacts

THESE are summarized as follows:

- Dust Generation Impacts
- Construction Noise Impacts
- Solid and Liquid Waste Generation Impacts – both on site and external
- Sewage Generation Impacts – resulting from inadequate disposal facilities on site
- Siltation Impacts due to the erosion of uncovered stockpiles of materials or exposed, excavated soils.
- Impacts due to inadequate traffic management
- Impacts related to the use of natural resources for construction –e.g., natural lumber for scaffolding and for slab shoring – resulting in forest reductions at unspecified locations. .

Proposed Mitigations

These would include:

Vegetation Mitigations:

- The removal and relocation of introduced and naturally occurring trees from the footprint of buildings to be constructed.
- The removal of only the vegetation within the footprint of the construction area, utilizing vehicular access ways created within footprints to be ultimately developed.

- The use of elevated parking within the buildings, as opposed to extensive exterior parking - to conserve vegetation at the Northeastern and Central sections of the property.
- The collection of representative, naturally occurring juvenile plants from the site for rearing in a nursery for subsequent re-planting on-site.
- The utilization of introduced plants (trees, shrubs and flowering plants) that would be compatible with the naturally occurring vegetation to serve both an aesthetic (decorative) function and maintain the area's habitat function.
- The maximization of trees, shrubs and hedges to maintain the area's water absorptive capacity.
- The utilization of **GREENROOF** technology to re-introduce vegetation that would have been lost or relocated within the footprint of the proposed buildings.
- The embodiment of the mitigations outlined above in a landscaping plan through the combined efforts of a Landscape Architect and a Terrestrial Botanist.

Drainage Mitigations:

- Placing special emphasis on the maintenance of vegetation cover on site (**see vegetation mitigations**).
- The use of permeable surfaces for parking, walkway and roadway areas to facilitate ground infiltration.
- The incorporation of **GREENROOF** technology into the drainage mechanisms for roof areas.

- The use of ground-based storm water disposal options where the geology of the area will facilitate its use. This would be particularly relevant on the eastern, northeastern and southeastern sections of the site.
- The control of storm water accessing the site from offsite locations.
- The incorporation of all drainage mitigations, along with a back-up surface drainage proposal, within an overall drainage plan for the development, with specific attention being placed on the terminal portion of the surface drainage, which may present a flooding risk to Gloucester Avenue.

Aesthetic Mitigations:

- Vegetation mitigations outlined should be promoted to integrate the development's appearance into the natural greenery on-site.
- Vegetation mitigation will also ensure that natural habitats are maintained, thus ensuring that other aesthetically pleasing wildlife, such as birds, can be maintained in the area.
- Emphasis should be placed on an architectural design that will ensure that the multi-storey buildings proposed blend into the environment.
- Emphasis should be on an architectural design that will ensure that no obstruction of scenic views occur.

Construction Noise Mitigations:

- The use of the lowest noise-emitting equipment appropriate for the given task should be opted for, since this will result in less noise generated on-site.
- Time limits should be imposed to limit the periods during which construction noises can be generated. The following times are proposed: - **Mondays to Fridays 0800hrs to 17hrs. Saturdays 0800hrs to 1300hrs. Sundays and Holidays – no noisy activities are to be permitted**.
- Physical noise barriers should be considered for the property, particularly its eastern, northern and western perimeters.
- Adherence to the vegetation mitigations outlined above will aid in the attenuation of noise generated on the property.

Solid Waste Mitigations:

- Operational measures should be designed and put in place to guide the process of waste reduction on-site.
- Waste reduction mechanisms should be employing on-site to reduce the volume of any solid wastes generated.
- The collection and safe storage of solid wastes on-site should be encouraged to facilitate transportation off-site.
- The facilitation of safe transport of solid wastes off-site to authorized solid waste disposal sites should be encouraged. This would discourage accidental waste disposal during transport.

Dust Generation Mitigations:

1. Dust generation on-site should be controlled through the following activities:

- The imposition of speed limits for vehicular movement on dust sources.
- The enclosing of raw material dumping and stockpiling areas to contain generated dust
- The controlling of wind movement of exposed materials through the use of frequent wetting or the use of dust stabilization products.

2. Preventing fugitive dust from exiting the construction site through the use of containment barriers at the site's periphery. This ,mitigation would work in tandem with noise mitigation measures to prevent sound releases into the external environment.
3. Controlling fugitive dust generation from sources external to the construction site, such as at Concrete Batching plants and from trucks transporting raw materials to the site – using the containment methods outlined above.

Sewage Mitigations:

- The provision of adequate access to toilet and bathroom facilities that meet both numerical standards (to prevent workers from using the bushes) and treatment standards.

- The employment of chemical toilets for sewage treatment, along with personal washing areas tied into an approved disposal mechanism, such as a tile field.
- The separation of sewage and grey water streams to reduce sewage effluent volumes.

Siltation Mitigations:

- The employment of drainage mitigation measures to assist in the reduction of the volume and velocity of run-off from the site.
- The minimization of vegetation removal from the site during and after construction to retain the site's natural sediment anchoring mechanisms.
- The placement of sediment curtains at the down-slope sections of cleared sites to act as breaks for any sediment-bearing sheet-flows moving down-slope during rainfall periods.
- The covering and berming of stockpiles of materials during rainfall periods to prevent the washing away of these materials.
- The recycling of sediment-loaded wash-water from batching plants to prevent the discharge of these waters into the environment.

Other Mitigations:

- The careful choosing of heavy vehicular access points to the site to reduce obstructions to traffic movement.
- The limiting of heavy vehicle movement on-site to non-peak daytime traffic periods.

- The use of metal scaffolding and shoring equipment for construction purposes to limit the exploitation of natural resources.
- The limiting of unregularized vending at the perimeter of the development to restrict the generation of uncontrolled solid and liquid wastes.

PAGES

NOTE:

This document comprises the text outlined below, along with the document entitled "Figures for an Environmental Impact Assessment – Hotel/Condominium/Commercial Development at Sunset Avenue, Montego Bay (Sept 2007).

1.0 Introduction:

CAREIF Ltd[1], responding to the directives of the **NATIONAL ENVIRONMENT AND PLANNING AGENCY** (NEPA) in their letter dated November 6, 2006, has compiled environmental information about its **PHENION** development proposal for Montego Bay. The information collated has been prepared with a view to achieving the following objectives:

1. To give a clear understanding of what is to be physically implemented on the ground.
2. To describe the environmental features of the lands upon which the proposed development is to be implemented.
3. To describe the socio-economic climate within which the development is to be instituted.
4. To examine the environmental impacts that could occur as a result of the implementation of the project in its initially proposed format.
5. To propose mitigations or development options that will seek to promote conditions of:

- No Net Loss of important biological components from the site.
- No Net Increase in naturally occurring discharges or emissions from the site (specifically drainage, dust, effluent and noise)
- No negative change in the aesthetics of the site
- No Negative Impact on the socio-economic climate of the area.

6. To propose a system of monitoring to ensure compliance with the mitigation recommendations outlined in the EIA.

[1] www.careif.com

2.0 Description of Development:

CAREIF Ltd. has conceived a development to be implemented on approximately 4 hectares of land in the city of Montego Bay (see **FIGURES 1A – D and submitted site drawings**). The site is bordered by Sunset Avenue to the north, Queens Drive to the east and Gloucester Avenue to the west.

2.1 Design – Phenion Commercial:

THE development is to be implemented in two phases. Phase 1 (see **FIGURE 2A**) will be implemented on the lower sections of the property and will be the commercial component of the development - regarded as the commercial section of **THE SUNSET TOWN CENTRE**. Phase 1 will accommodate offices, retail shops and elevated parking in 4 multi-storey buildings on site. The maximum proposed building heights for phase 1 is seven (7) storeys. A four screen cinema and a theatre are additional components to Phase 1.

2.2 Design – Phenion on the Ridge:

PHASE 2 (see **FIGURE 2B**) is to be erected on the upper sections of the site mentioned and will be regarded as **PHENION ON THE RIDGE**. Phase 2 will comprise 4 multi-storey Hotel/Condominium and Spa blocks and will be designed to cater to both local and foreign professionals and residents. Maximum building heights for phase 2 will be fifteen (15) storeys.

2.3 Drainage & Sewage:

FIGURE 2C outlines the proposed routes for storm water that will be generated on the site. This proposal has been submitted to the National Works Agency for its consideration and approval.

All conveyances will meet into one central drain at the western section of the property (defined by the **RED** arrow). From here, storm drainage will be routed into an existing drainage system leading to the sea. Note that there is an intercept for drainage generated from the Queens Drive roadway, which, at this time, is routed to the property and which ultimately percolates into the ground.

SEWAGE from the various bathroom facilities will be centrally collected and routed through an easement to an existing sewer main on Glouster Avenue. From here, sewage will be routed to the central treatment facility at Bogue.

3.0 Study Methods:

FOR the evaluation of the development's environmental components, descriptions have been broken down into the following groups, as outlined in the generic Terms of Reference submitted in NEPA's letter dated November 6, 2006 (**TASK 2**). These are:

- **CLIMATE**
- **NATURAL HAZARDS**
- **TOPOGRAPHY**
- **GEOLOGY**
- **DRAINAGE**
- **FLORA**
- **FAUNA**
- **SOCIO-ECONOMICS**

CLIMATE and natural hazards descriptions of the site were obtained as outlined in existing information references for the Montego Bay area. Similar descriptions were also obtained for topography and geology, with supporting observations being made in the field at the site.

PLANT life at the site was examined based on known descriptions characteristic of the vegetation assemblages within which the site exists. From this, indicator plants were sought and identified to confirm the assemblages identified.

EXTENSIVE plant lists were not obtained for the study since the site had exhibited signs of vegetation removal in the past, with dense scrub vegetation dominating the areas that had been cleared in the past and grasses in areas that had been more recently cleared. It was opined that the simplest approach that could be taken, considering the circumstances, was to do the following:

1. Define and visually confirm common assemblage indicator species for plants on the site.
2. Identify and locate the most prominent vegetation components on the site. These were defined as trees of a trunk diameter greater than 20 centimeters at 130 meters height from the ground, as per forestry reference[2].
3. Presence/absence examinations of the site for plants known to be found only within the vegetation assemblage identified for the area (provide reference list).

THE survey methods utilized for plants also involved:

- The initial analysis of 1961, 1991[3] and 2007[4] aerial images of the site in order to illustrate the extent of vegetation density changes over time.
- The confirmation of the locations of trees on the property, as defined on tree survey diagrams submitted by the developer. This confirmation was done through the use of land surveying techniques.

[2] http://sres-associated.anu.edu.au/mensuration/dob.htm
[3] 1961 & 1991 aerial images obtained from Survey Department
[4] Taken above site by proponents

ANIMAL groups examined on the site were Birds, Butterflies and Lizards, being the most obvious groups observed on the site. Surveys to identify the presence or absence of these groups of animals were conducted through the use of stationary observation sites and walking transects on the property for general identification, utilizing the point count method[5]. The DAFOR[6] method of abundance assessment was used to evaluate the relative abundance of animal species observed, with the following numerical categories being assigned to each abundance category:

Dominant……>30 Observations
Abundant……20-30 Observations
Frequent……10-20 Observations
Occasional……..5-10 Observations
Rare……<5 Observations

SOCIO-economic information was obtained by an examination of the 2001 statistical information generated for the Montego Bay – St. James area by the Statistical Institute of Jamaica. In addition, walking surveys were conducted at establishments existing along the Gloucester Avenue, Sunset Avenue and Queens Drive roadways. Here, establishment owners / operators were given a brief presentation on what was intended at the Phenion location and impressions obtained.

[5] http://findarticles.com/p/articles/mi_qa3793/is_200704/ai_n19432119
[6] The **DAFOR** scale is an internationally recognized abundance scale for counting wildlife and other populations. It evaluates populations either quantitatively or qualitatively by dividing observations according to whether the population item is Dense, Abundant, Frequent, Occasional or rare in numbers - www.earthdive.com.

AIR photo interpretation and mapping techniques were used to provide both a spatial understanding of the information on the resources existing at the site and also a visual basis for the presentation of information obtained. Vertical air photos from 1961 and 1991 were analyzed and interpreted for the study. Comparisons were also made with low oblique air photos taken of the site during the study and 2007.

BOTH air photo interpretation data and information obtained in the field were then layered together onto land survey development plan information generated by the Architects of the developers using Mapmaker Pro geographical information system software so as to identify where environmental impacts could occur.

WHERE conflicts between natural resources and development were identified, mitigations were developed in conjunction with the developers. The process of mitigation development was conducted through the examination of three approaches, namely:

1. No development,
2. Development as proposed
3. Development with modifications to the originally proposed design.

A fourth option that of conducting the development at a different venue was not considered. This was owing to the fact that the proposed development area is currently owned by the developer.

4.0 Study Limitations:

NOISE and dust sampling equipment that had been ordered for the purpose of sampling for the measurement of ambient noise and airborne particulates at the site had not arrived at source in the time allotted for field evaluations for the EIA. A recommendation has been tendered under **section 8 – Mitigations**, which will ensure that this information is obtained under the conditions for monitoring. This will be done **PRIOR TO** the implementation of construction works at the site.

ATTEMPTS at obtaining on-site discharge information from drainages accessing the property were unsuccessful, owing to difficulties in timing visits with the occurrence of rainfall at the site. It is recognized that this will be needed to confirm baseline estimates calculated for both on-site and off-site drainage contributions to determine whether or not drainage mitigations are achieving the desired effects. This information will be collected prior to the implementation of construction works at the site and incorporated into the monitoring component of the project evaluation.

5.0 Regulatory Setting:

THE Natural Resources Conservation Authority (NRCA) Act Permit and Licensing Regulations (1996) gives the National Environment and Planning Agency (NEPA) the power to require that all developments of prescribed categories occurring within Jamaica be subjected to an environmental examination process. This process would include the conducting of an Environmental Impact Assessment, in the event that the examination of development proposal points to the need for one. The favourable conclusion of the permit review process lead to the issuing of an Environmental Permit for those developments that have been deemed to be environmentally sound.

APART from NEPA and the NRCA Act, other Agencies and legislative instruments that would apply to the governance of the proposed development would include:

1. **TOWN AND COUNTRY PLANNING AUTHORITY** (TCPA) - under the Town and Country Planning Act (1948), the TCPA has the responsibility to implement and manage land use zoning and planning regulations as they relate to tracts of land defined in Development Orders. The proposed development area is zoned for commercial/resort use in the St. James Parish. Confirmed Development Order, 1982.

2. **ST. JAMES PARISH COUNCIL** – provides public services, such as health, fire prevention and response, road and recreational amenity maintenance, plus urban and rural building and development control.
3. **NATIONAL WATER COMMISSION** - provides potable water and sewage services and reviews proposals involving the utilization of existing supply and disposal systems by oncoming developments.
5. **THE NATIONAL SOLID WASTE MANAGEMENT AUTHORITY** – under the guidance of the Solid Waste Management Authority Act (2001) seeks to promote the proper collection and disposal of solid wastes
6. **THE ENVIRONMENTAL HEALTH UNIT** (EHU -Ministry of Health) – is concerned with environmental management, as it relates to human health. The Public Health Act (1974), which it administers, authorizes the EHU to monitor for pollution from sources that could affect public health. More specific to development, it examines and grants approvals for sewage treatment and disposal designs.
7. **NATIONAL WORKS AGENCY** -has the responsibility for approving roads, traffic access arrangements and drainage conveyances.
7. **TOURISM PRODUCT DEVELOPMENT COMPANY Ltd.** (TPDCo) facilitates the development of the tourism product by undertaking improvements to the physical, social, economic, cultural and environmental aspects of the product to ensure its sustainability and benefits to the community.

8. **THE MONTEGO BAY MARINE PARK** (MBMP)– established in 1992 through regulations existing within the NRCA Act, the role of the MBMP is embodied within their mission statement, which is “To restore and protect a healthy Montego Bay ecosystem for the betterment of Jamaica and the world”. In advancing this mandate, the MBMP would be concerned with land-based sources of marine impacts and as such would be keen on ensuring that developments proposed for the city of Montego Bay are implemented in such a way as to prevent such impacts from affecting the marine resources within the Marine park boundary.
9. **THE GREATER MONTEGO BAY REDEVELOPMENT COMPANY (GMBRC)** - established in 1995, the GMBRC was designed to enforce planned development, growth and protection of coastal resources in the Greater Montego Bay Area (GMBA). The GMRC, working in collaboration with the then Town Planning Department and the Urban Development Corporation, has completed an overall development plan for the city.

It would be critical that any environmental document prepared for this development be circulated to the agencies afore mentioned.

6.0 Site Descriptions - Observations:

6.1 Climate:

CLIMATIC data sourced for the Montego Bay area[7] is summarized below under the following headings:

6.1.1 Rainfall:

MONTEGO Bay, as is typical of the island, has two distinct wet seasons. These occur between May to June and September to November, coinciding with the Atlantic Hurricane season and the period of greatest daytime solar heating. Highest rainfall over a one month period exceeds 800 mm of rainfall and occurs during the months of May and October[8]. The driest period of the year is usually between December to March. However, rainfall associated with cold fronts migrating from North America does occur within this period.

FIGURE 3A illustrates rainfall intensities, measured in millimeters per hour for varying return period events, as measured at the Donald Sangster International Airport.

[7] **www.weatherreports.com** and **www.metservice.gov.jm**

[8] **http://www.world66.com/centralamericathecaribbean/thecaribbean/jamaica/montegobay/lib/climate**.

6.1.2 Wind:

The Northeast Trade winds are the dominant wind source during the days. This wind source is also influenced by sea breezes, which result in an average wind direction of east-northeasterly, blowing at an average speed of 15 knots. At night, there is a general re-orientation of the wind to a southerly component, blowing at an average of 5 knots.

EXCEPTIONS to this rule do occur between December to March as a result of the influence of cold fronts originating out of North America. Here, winter storms, or “Northers”, result in northwesterly winds occurring.

6.1.3 Temperature:

IN coastal areas, such as Montego Bay, daily temperatures average 26.2 degrees Celsius (79.2ºF). The warmest months of the year are June to August and the coolest occur between December to February.

6.2 Natural Hazards:

THE Office of Disaster Preparedness and Emergency Management [9]has indicated that because of its location, geology and geography, Jamaica (and by extension, the city of Montego Bay) is prone to several natural hazards. The major threats include landslides, Hurricanes, floods, droughts and Earthquakes. The highlighted hazards present a risk to the proposed development site and have been specifically examined within the context of this study.

6.2.1 Tropical Disturbances:

HURRICANES and their weaker tropical disturbance counterparts (tropical depressions and storms) generate extremely high wind conditions that could lead to vegetation damage and structural damage to buildings and infrastructure.

Rainfall conditions associated with these systems can also lead to Flooding, particularly if physical development promotes water collection and conveyance.

STORM related Flooding conditions can occur in coastal areas due to inundation by Storm surges, as was graphically illustrated during Hurricane Ivan in September 2004.

THE city of Montego Bay is vulnerable to the influence of hurricanes. Forty two cyclonic events of varying stages of development have passed within 100 Km of the City within the past 155 years.

[9] www.odpem.gov.jm.

Eleven of these events occurred within the last 27 years (see **FIGURE 3B[10]),** with the most recent being Hurricane Dean in August, 2007. Coincidentally, the most severe events to date occurred within this period, with several Hurricane strength / genesis records being re-established in 2004 and 2005.

6.2.2 Storm Surge:

WHERE storm surge related flooding conditions are concerned, interpretation of the 50 year return period storm surge run-up maps outlined in the USAID-OAS Caribbean Disaster Mitigation Project Organization of American States report titled "Storm Surge Mapping for Montego Bay, Jamaica - September 1999[11] suggested that the western sections of the property are just outside of the run-up limits for a 1:50 year return period storm (See **FIGURE 4**[12]).

6.2.3 Earthquakes:

FIGURE 5[13] suggests that the Montego Bay area has a low vulnerability to Earthquakes. However, the country has been influenced by at least 6 recorded Tsunami events triggered by offshore or near shore earthquake events[14] and there has been one report (27th October, 1787) of a sea quake affecting vessels in the Montego Bay harbour.

[10] stormcarib.com/climatology/MKJP_weekly.htm
[11] www.oas.org/CDMP/document/**km**a/mo**bay**/mo**bay**.htm
[12] www.oas.org/CDMP/document/**km**a/mo**bay**/mo**bay**.htm

[13] (sourced from both the RIU IV [C&L Environmental] and Seawind Cay [Environmental Solutions Ltd] EIAs
[14] http://www.mona.uwi.edu/uds/Tsunami_Jam_letter-1999.html

DR. MARGARET HIGGINS, Head of the Seismic Unit, UWI Mona, in an article published on the ODPEM website, suggests that while the area has experienced tsunamis historically, the risk of such an event is low. Based on current experience, the natural hazard most likely to occur annually is a hurricane.

6.3 Vegetation:

O. B. EVELYN AND R. CAMIRAND[15] outlined a definition of the various forest types in Jamaica, as assembled through the Forestry Department. The development is found within a forest vegetation assemblage characterized as Tall Open Dry Forest. This forest assemblage is typically an "open natural woodland or forest with Deciduous/Semi-deciduous trees. Trees are at least 5 m tall and crowns not in contact with each other". This forest type is typically found within altitude ranges of 0 – 400 meters above sea level. Natural indicators of such assemblages include the **Red Birch Tree** (see **FIGURE 6A**).

THE site currently has an estimated **1.41 hectares** of undisturbed naturally occurring vegetation on the ground. Aerial photo analysis of 1991 images of the area show an estimated **2.29 hectares** of naturally occurring vegetation on site, a reduction of **0.88 hectares** over a **16 year period**.

[15] www.forestry.gov.jm/PDF_files/JA%20Forest%20Cover%20Change.pdf

SIGNIFICANT vegetation disturbance had occurred on the western, central and northern sections of the property, which was illustrated on the 2007 image **FIGURE 6B**) and summarized through the use of GIS in **FIGURE 6C**. Further illustration of the state of the naturally existing forest on the site, along with trees that had been surveyed by the developers were outlined on **FIGURES 6D-F**.

With the extent of regrowth that was observed on the site in 2007 (see panoramic sequence **FIGURES 6G - L**), this suggests that vegetation removal pressure had been relaxed on the eastern section of the site over a period of 1-4 years.

ONE Hundred and Thirty Six naturally occurring and introduced trees, with diameters greater than 20cm at chest height[16] were surveyed on the site (note tree symbols on **FIGURE 6C**). The majority of the trees surveyed were trees introduced by the current owners of the property and these included **Fruit, Hardwood** and **Palm** Trees.

OVER 50 endemic plant species exist within Dry Limestone forest assemblages. Of this number, two endemics were observed during vegetation traverses on site. These are illustrated on **FIGURE 6M**. The assemblage is not in a totally natural, undisturbed state. It is clear that various levels of denudation have occurred. A comparison of the 1991 photo with the 2007 oblique aerial images taken during the study showed that the areas of vegetation disturbance seen in figure 14 remained the same in 2007.

[16] Forestry Reference for mature tree size

6.4 Fauna:

THE most obvious examples of fauna observed at the PHENION site were **BIRDS, BUTTERFLIES** and **LIZARDS.** A number of birds were observed foraging within or transiting the site.

OBSERVATIONS made from Observation post A (see **FIGURE 7A**), which was elevated above the development site, showed that a number of the birds seen (particularly Doves) transited to and from the site from external forest areas. A list of the birds observed is given in **FIGURE 7B**. Butterflies and Lizards observed during the conducting of bird surveys and vegetation traverses, are illustrated on **FIGURES 7C - D**.

6.5 Geology & Topography:

6.5.1 Topography:

THE development site could easily be described as having a variable topography, progressing from low lying and gradually sloping (<10 degrees) to the western sections of the property to elevated and steep sloping (> 60 degrees) towards the eastern boundaries. Prominent cliffs, characteristic of Pleistocene raised reef terraces[17] observed in Discovery Bay St. Ann, dominate the eastern sections of the site.

[17] mona.uwi.edu/geoggeol/mgu/Big%20Boulders%20on%20the%20Beach.pdf

THE existing contour of the development site is illustrated on **FIGURES 8A-C**. Due to tectonic uplift, the highest altitude difference is situated to the SE of the property. This section has its summit at about 53 m above sea level against the gentle slope to the north which has a minimum height of 7 m above sea level.

6.5.2 Soil:

Soil coverage is shallow and generally lacking on the highest summit where mostly bedrock has been observed. A thicker profile is present on the gentler slope of the property. The soil is reddish brown in colour and comprises a mixture of clay and coral rubble in texture. Permeability for this area is variable, typically low on the gentle slope, but is moderate in the region of vuggy[18] limestone.

6.5.3 Bedrock:

THE underlying bedrock is comprised of tectonically raised reef limestone, which occurs along the north coast and is classified in the Upper Coastal Group. (See **FIGURE 9A -B**) This representative of the Coastal Group is comprised of poorly bedded to massive rubbly and often vuggy limestone with coral and mollusk debris making up the bulk of the rock[19]. These rocks overlay another geological feature known as the Montpelier Formation located to the east and south of the project area.

[18] Defines porosity that is within grains or crystals or that is significantly larger than grains or crystals**.**

[19] Geological Survey Division, 1983, *Geotechnical Classification of Jamaican Rocks, Bulletin No. 10, M. O'Hara and R. Bryce*.

This formation consists of bedded white chalky limestone with flint nodules. The layers are often interbedded with fossil-bearing limestone.

THIS limestone was formed due to the deposition of Pleistocene and Recent marine or fluviate sediments during the upliftment and rapid erosion of previously exiting limestones and chalks.

ALONG the top road and to the south of the property the rocks are pinkish-white, a hard re-crystallized limestone. This rock has a vuggy texture and solution pitting is strongly developed at the surface.

ON the northern section of the property where the topography is gentler, a massive limestone outcrop with vuggy texture is present to the east along with rubbly textured limestone as observed in a shallow pit on site (see geological feature layout on **FIGURE 9C**).

6.5.4 Structure:

MAJOR faulting within close proximity of the site exhibits two main directions, Northwest to Southeast and approximately East to West. (see **FIGURE 9C**) The escarpment visible on the property to the south resulted from tectonic activity along with sea level changes. Minor faulting where present produces fracturing and plays a major role in the drainage of this area.

6.6 Drainage:

NO evidence of permanent drainage channels is present on this property. In the southern region of the property a spring was identified at Grid Reference 704349E 652354N releasing groundwater at surface (see **FIGURE 10A**).

The source of this water is most likely the Montpelier Formation which acts as a conduit that transmits water along fissures and other lines of weaknesses. Several springs have been recorded within this regional extent classified as the Montego River Basin and the smaller of these springs often express themselves during periods of protracted rainfall. This was the case with the spring shown in **FIGURE 10A.** At the time of the observation, the area had been subjected to extensive rainfall over several days.

THE Montpelier Formation is considered to be a part of the principal water reservoir of the Montego River Basin. Springs here are generally permanent or semi-permanent and have average flows of approximately 0.03 cubic meters per second during most of the year[20].

[20] UNDP/FAO, 1971, *Water Resources Survey of the Montego River Basin SF/JAM3 Tech. Rpt. No. 3 Kingston, Jamaica. 142p*.

TWO locations were observed where surface drainage accessed the development site from offsite. These are outlined on **FIGURES 10B - D**. The sources of these drainages appear to be runoff from Queens Drive. These features do not constantly flow, but appear to be natural conveyances of water during rainfall events.

THE drainage feature that flows onto the northeastern section of the property (**FIGURE 10B**) apparently receives water that flows directly across Queens Drive from Leader Avenue (see **FIGURE 1C**). This sheet flow dissipates onto the northern section of the property.

THE second drainage feature apparently receives water collected on the Queens Drive, below its intersection with Leader Avenue. This water flows through the eastern entrance to the Phenion on the Cliffs property and flows along a pathway defined on **FIGURE 10C**. According to a resident on the property, the water flowing from this feature “Cascades like Dunn’s River Falls” over a cliff onto the eastern section of the property where it is intercepted in a concrete and block drain that flows to an underground drain leading onto Gloucester Avenue. This drain, however, appears to have been designed to route excess flow onto the roadway (**FIGURE 10D -D**) and interviews conducted on the site suggest that this happens frequently, leading to inundation of the roadway leading to Gloucester Avenue.

DETAILED calculations of water flow through the property were not done (as outlined under **section 4.0).** However, estimates of the volumes of water that could access the property during various rainfall events were calculated using the **Rational Method** for discharge rate calculations[21]. This method calculates **Peak Runoff Rate (Q –** in cubic feet/second**)** from the formula **Q= (CIA),** where **C** is the runoff coefficient of the area, **I** is the rainfall intensity (inches per hour) and **A** is the area of the catchment in acres.

RUNOFF was estimated as being generated from two separate sources. The first was a combination of both a defined section of both Leader Avenue and Queens Drive and land areas bordered by these two roadways that were immediately up-gradient of the development site (as defined on **FIGURES 10E –F**). The total area estimated was 31,028.7 square meters (7.7 acres). The runoff coefficient was determined for a 10 year return period event for a multi-family residential area (0.43 [22]) and the rainfall intensities for the same return period event defined on **FIGURE 3A** were used in the calculations.

FOR a 10 year rainfall event, Q was calculated at **0.08 meters per second** (3 cubic feet per second) being divided between the two discharges onto the property. To put this in perspective, in a one hour period, approximately **288 cubic meters** of water would be discharged onto the property from off-site.

[21] http://www.accesskent.com/YourGovernment/DrainCommisioner/pdfs/DrainageRules_B5.pdf
[22] As defined in reference 21 immediately above

THE second drainage water source was viewed as the development site, which was estimated as having an area of 3.6 hectares, with a natural forest area of 1.41 hectares (as estimated in **section 6.3).** The remaining 2.19 hectares of property was assumed to be equated to that of a rural residential area.

THE estimated runoff coefficient for the site for a 10 year return event was crudely calculated as the sum of the peak discharges from the forested and non-forested areas. With runoff coefficients expected for both areas being 0.24 for the forest and 0.30 for the remaining area, the sum of the peak discharges was estimated at $0.02m^3$ + 0.04 m^3 or **0.06 cubic meters per (**2.2 cubic feet per second**)** or **216 cubic meters** of water being discharged from the site in 1 hour.

WHEN combined, it is possible that approximately **504 cubic meters** of rainwater could be discharged from the site during a 10 year return period rainfall event.

6.7 Socio Econ & Community Perception:

6.7.1 Economic Information:

THE project area lies within what is known as the Greater Montego Bay Area (GMBA), for which a major development plan was created by the Greater Montego Bay Redevelopment Company in 1997. The GMBA is estimated to be 21,112 hectares in area and encompasses both residential and economic developments in the second city[23].

THE major economic sector within the GMBA is tourism and accounts for over 30% of the nation's tourism earnings[24]. Additionally, the Jamaica Tourist Board has indicated that Montego Bay accounts for 31% of visitor arrivals to Jamaica[25].

6.7.2 Socio- Demographic Information:

THE Statistical Institute of Jamaica's 2001 population census calculated that the population of Montego Bay and its immediate environs was 95,940 persons. However, an article in the Jamaica Gleaner, dated April 16, 2006, quotes Montego Bay businessman, **Mr. Kerr-Jarrett** as saying that while the official statistics list Montego Bay as having a population of 100,000, when the 19 informal communities, which each has approximately 5,000 residents, come into the mix, the true figure is closer to 200,000.

[23] www.un.org/esa/earthsummit/**montego**.htm
[24] Jamaica Tourist Board Statistics
[25] Jamaica Tourist Board Statistics

6.7.3 Public Perception- Proposed Development:

IT was opined that the zone of immediate influence for the proposed development would be peripheral to the sections of Sunset Avenue, Queens Drive and Gloucester Avenue bordering the development (as defined on **FIGURE 1C**). All developments within and just outside of the periphery defined by these roadways would be geographically close to the development. With the types of services being offered by the development, it was opined that the developments and residential areas defined in both **FIGURES 1B** and **1C** would benefit from having a development of this nature in close proximity. Unfortunately, there was no information to allow for an estimate of the resident or transient population within the area defined by both **FIGURES 1B** and **1C.**

A census of the developments existing within the area defined by **FIGURE 1C** was obtained through a walking interview survey conducted by the Developers in summer of 2007.

FIGURE 11A-C illustrates the signatures representing over 60 establishments peripheral to the proposed development site. A presentation was given to each of the establishments to sensitize them to the intended development and to gauge their reactions to the proposals. The developers have indicated that all persons interviewed had favourable comments. The comments were centered around the current lack of commercial space within the “Hip Strip” and its immediate environs. The **PHENION** development, in their view, represented an opportunity to solve this issue.

6.8 Noise:

IT is admitted that no noise measurements were taken at the site. This was due to the unavailability of the decimeter that was obtained for the purpose of collecting sound levels at the site**.**

IN the absence of actual noise measurements, noise intensity perceptions were made at the locations outlined on **FIGURE 12.** What can be said about the site is that ambient noise is highly influenced by Line Source noises[26] generated by vehicular traffic.

THE most prominent source of vehicular noise was generated on Queen's Drive (see **FIGURE 12 – F**). This roadway bypasses heavy traffic from the Hip Strip and is frequented by heavy trucks transiting the Montego Bay area heading eastbound and westbound, thus keeping them out of the Hip Strip area.

A stoplight is present at the junction between Queen's Drive and Leader Drive, towards the northeastern border of the property (see arrow on **FIGURE 12**). During field investigations conducted at the development site, 13 double axle dumper and articulated trailer trucks were counted approaching the stoplight in a 1 hour period (or about one truck every 6 minutes). All trucks engaged their engine brakes on approaching the stoplight. Gloucester Avenue and Sunset Drive were noticeably quieter without the truck traffic.

[26] Line source noise is generated by moving objects along a linear corridor. Highway traffic is the best example of line source noise – www.wikipedia.com.

7.0 Potential Environmental Impacts:

ENVIRONMENTAL impacts related to the implementation of the proposed development have been divided into two components. These are **Short Term Impacts** occurring during construction and **Long Term Impacts** related to the permanent presence of the development. A breakdown of the foreseen impacts that will be examined within this study is outlined below:

Long Term Impacts (Persistent as a result of the following):

Vegetation Related Impacts:

- Loss of Plants including possible endemics
- Loss of animal habitat, particularly birds
- Potential for increase in runoff

Drainage Related Impacts:

- Impacts due to routing of drainage to property (particularly from Queens Drive)
- Impacts due to the routing of storm drainage exacerbated by increases in impermeable surfaces and reduction of plant cover due to development

Aesthetic Impacts

- Impacts due to visual obstruction caused by high rise buildings
- Impacts due to visual obtrusiveness caused by inadequate attention to design.

Short Term Impacts (Temporary – occurring as a result of construction activities):

- Dust Generation Impacts
- Construction Noise Impacts
- Solid Waste Generation Impacts – both on site and external
- Sewage Generation Impacts – resulting from inadequate disposal facilities on site
- Construction Noise Generation Impacts
- Siltation Impacts due to the erosion of uncovered stockpiles of materials or exposed, excavated soils.

7.1 Long Term Impacts:

7.1.1 Long Term Impacts - Vegetation:

AN examination of the existing forest cover in relation to the projected footprint of the proposed development has revealed that **approximately 42% of the existing forest area is likely to be disturbed by the development** (see **FIGURE 13A**). Note that this area of disturbance is solely related to building footprints and does not take into account any clearances that may be required to facilitate access to the construction sites.

NOTE also that the areas outlined as forest do not include other areas upon which vegetation clearances and subsequent re-growth may have occurred.

This would therefore suggest that total vegetation loss from the site as a consequence of development will be significant.

ADDITIONALLY **an examination of FIGURE 13B suggests that approximately 50% of the introduced trees that had been surveyed by the developers will be disturbed by the implementation of the development**.

IT was outlined before (**sections 6.3 & 6.4**) that the forested areas may present a repository for endemic species of plants, which should be preserved. It was also outlined that the forest area represents a habitat for birds, some of which may nest, feed or otherwise transit the area. The site was also determined to be a habitat for species of Butterflies and Lizards. **The loss of forest vegetation will impact negatively on the presence of the animal-life observed in the area**.

7.1.2 Long Term Impacts - Drainage:

VEGETATION cover, whether forest canopy or underlying thick foliage, acts as a sponge for rainfall[27]. The influence of rainfall on the ground is thus delayed as it is slowly released by gravity from the surface of the plants, down trunks and stems to the ground. Invariably, some of the trapped rainfall also evaporates to the atmosphere.

[27] http://rainforests.mongabay.com/0902.htm

COUPLED with vegetation reduction influences on drainage will be impacts associated with the permanent change in the natural water absorbing properties of the underlying ground. This will occur due to the introduction of hard, impermeable surfaces (concrete roofs, roadways, walkways curbs, etc).

THE loss of vegetation cover will facilitate the impact of rainfall directly onto the ground, possibly introducing it at a rate that is faster than the capacity of the substrate to absorb. The net result becomes an increase in water available for runoff.

IT has already been established that rain water that has been collected on surfaces external to the site are naturally routed through the property through two drainage channels. One drain naturally dissipates on-site while the other empties offsite. The change of runoff characteristics will result in additional water volumes, generated on-site, being routed either to the existing conduits or to new naturally established points. **Consequently, water volumes in excess of that which would have been conveyed offsite prior to the development will impact external sites**. This would be a significant impact, considering the fact that persons interviewed adjoining the development area have indicated that runoff from the currently undeveloped area does have a flooding impact on Gloucester Avenue.

ADDITIONALLY, **if this water flows onto or over unprotected loose substrates or sediment stockpiles, then this will result in an increase in the turbidity of the runoff leaving the site**.

7.1.3 Long Term Impacts - Aesthetics:

WITH towers of 15 storeys being planned, it is a certainty that the development will represent a dominant and permanent fixture on the Hip Strip, once implemented.

An indication of the manner in which the development will ultimately dominate the landscape can be found on **FIGURE 14**. The Fantasy Hotel is approximately 8 storeys high, while the Doctor's Cave Hotel more closely approximates the Phenion towers in height at 13 storeys, and in its position at the cliffs.

A development of this stature, if not designed with good aesthetics in mind, **will ultimately be perceived as an eyesore to persons transiting the immediate vicinity of the development area. Additionally, if the development results in the blocking of views traditionally enjoyed by occupiers of dwellings to the east of the development, then this will also be viewed as a negative and permanent impact.**

AESTHETIC impacts can also be linked to the changes that will occur in the plant and animal-life characteristics of the site. The site's shaded and vegetated cliff faces and common bird, butterfly and lizard-life makes for a cool, visually pleasing experience, particularly important in an urban setting where buildings have gradually replaced natural settings. **Unmitigated vegetation loss and construction alterations to the site will have negative impacts on these aesthetic characteristics.**

7.2 Short Term Impacts:

7.2.1Construction Noise Impacts :

TABLE 1 (BELOW) gives a list of the typical sources of loud noises at a typical construction site. The National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) is 85 decibels (dB) over an 8 hour period. With the exception of the items underlined in **TABLE 1**, hearing protection would be required for the operation of all the equipment outlined below to protect workers from hearing loss.

TABLE 1: Common Construction Tools or Tasks Common Construction Tools or Tasks

Common Construction Tools or Tasks	Noise Level dBA, Leq.	Reference
Air Arching Gouging	110	CSM*
Air Grinder	102-104	CSM
Air Track Drill	113	BC**
Bobcat Driver	87.7	BC
Bulldozer - No Cab	101-103	CSM
Bulldozer - Insulated Cab	85	CSM
Bulldozer - No Muffler	107	CSM
Chipping Concrete	97	CSM
Circular Saw and Hammering	96	CSM
Compactor	108	BC
Compactor on Cab	94	CSM
Compressed Air Blower (100 PSI) Blowing Out Cuts	104	AIHA***
Compressors	62-92 (79 avg)	BC
Concrete Finishing - Electric Grinder, Chipping and Patching	91.3	BC
Crane - Uninsulated Cab	102	CSM
Crane - Insulated Cab	90	CSM
Dozers, Dumpers	89-103	BC
Electric Drill	102	BC
Excavators	86-90	BC
Foreman (Concrete Vibrator Used for Pour)	91.4	BC
Front-End Loaders	85-91	BC
Grader, Trucks, Concrete Pumps & Mixers, Generators	<85	BC

Hammer Drill, 1/4" Bit Drilling Holes into Concrete	95.7	AIHA
Hydraulic Breakers	90-100	BC
Impact Wrench	108	CSM
Jack Hammer	96	CSM

*CSM – Dru Sahai, "Hearing Conservation- How to Prevent Noise-Induced Hearing Loss in Construction," Construction Safety Magazine, August, 2000.

**BC – Heather Gillis and Christine Harrison, "Hearing Levels and Hearing Protection Use in the British Columbia Construction Industry – 1988-1997," Workers' Compensation Board of British Columbia.

***AIHA – Richard Neitzel et al., "An Assessment of Occupational Noise Exposures in Four Construction Trades," American Industrial Hygiene Association Journal, 60: 807-817 (1999).

THE noises generated by the equipments outlined above can be described as Point Source Noises[28]. These noises will attenuate[29] with distance from their sources. **TABLE 2**[30] (**BELOW**) gives an example of noise reduction over distance from a noise source of 95 decibels (dB) intensity.

THE reductions observed (-6dB for every 15 meters of distance the sound travels from the source) are typical of a "hard site", which exists where sound travels away from the source over a generally flat, hard surface such as water, concrete, or hard-packed soil. Here, the ground or surroundings do not provide any attenuation.

[28] Point source noise is associated with noise that remains in one place for extended periods of time, such as with construction activities.

[29] Decrease in intensity

[30] http://www.nonoise.org/resource/educat/ownpage/soundlev.htm

TABLE 2:

Example of noise reduction over distance from 95 dB source showing variation between point source and line source.

Distance from Source (meters)	Point Source Level (dB) Hard Site (-6dB)	Point Source Level (dB) Soft Site (-7.5dB)
15m	95	95
30m	89	87.5
60m	83	80
120m	77	72.5
244m	71	65
488m	65	57.5

A “soft site”, which would have existing ground cover or vegetation remaining, would see an additional attenuation reduction of -1.5dB over distances. On the other hand It can therefore be concluded that construction sites such as the one that will be created when the Phenion development construction phase is initiated, will generate noise that could impact negatively on surrounding areas.

IT can therefore be concluded (based on **TABLE 1**) that **typical construction sites are noisy and would thus impact negatively on the noise levels existing in the adjoining environment.** It can also be concluded that **ground cover loss (eg through vegetation removal) would further increase the perceived construction noise, due to reduction in sound attenuation from source**.

INFORMATION sourced[31] suggests that the responses of humans to increasing noise levels varies as summarized below:

1. **50dB - Quiet living room environment - Relaxed**
2. **80dB - Equivalent to the sounds made by an alarm clock – Annoying to humans.**
3. **90dB - Suffering hearing loss if exposed for 8 hours**

FIGURE 15 examines the distance over which noises generated by a jackhammer, one of the most commonly heard item of equipment on a construction site (referenced from **TABLE 1**) would have to travel in order to be reduced below 80dB (below values annoying to humans). At 96dB, sound would have to travel a distance of over 100 meters from source on both a hard and soft site to reduce levels to that not perceived as being annoying**. With the popular Hip Strip adjoining the site to the west, and the Big Apple, Grandiosa, El Greco and Decameron Hotels surrounding the site (see FIGURE 1C), unmitigated noise impacts will undoubtedly be significant.**

[31] http://www.nonoise.org/resource/educat/ownpage/soundlev.htm

7.2.2 Solid and Liquid Waste Generation Impacts:

SOLID wastes generated on construction sites can be divided into the following:

Construction wastes include the following:

1. Used product containers (cement bags, tile boxes, paint containers etc).
2. Used construction materials (cut rebar, lumber, broken blocks, tiles, wasted poured cement, spilled aggregates etc)
3. Cut vegetation and trees
4. Unusable excavated materials
5. Used oil and spilled fuel
6. Sediment-ladened wash down from cement batching.

Worker / Vender wastes including the following:

1. Kitchen wastes (uncooked and cooked food items, peelings, food containers etc)
2. Toiletry waste

The improper control, collection and disposal of these wastes will result in solid waste disposal impacts, both onsite and offsite.

7.2.3 Dust Generation Impacts:

CONSTRUCTION sites are often dusty locations, with aggregate stockpiles, bulk cement stores, concrete batching plant activities, and vehicular movement on denuded soils, excavations, demolition and other sources contributing to increases in airborne particulate matter.

The prevailing daytime wind at the development site (see section 6.1.2) would blow dust towards the southwest, onto the Hip Strip area, thus resulting in negative impacts on an area frequented by tourists. An additional consequence of the generation of dust nuisances **is the generation of sediment ladened runoff during rainfall periods.**

7.2.4 Sewage Generation Impacts:

CONSTRUCTION sites have numbers of persons working on-site, all of whom will at some point in time, will want to utilize bathroom facilities. If adequate numbers of such facilities are not available on site, **then workers will resort to less satisfactory and unsanitary means of relieving themselves.**

Additionally, if the facilities present onsite are not adequate for the treatment of human wastes**, then contamination of the environment could occur from discharges from these facilities.**

7.2.5 Siltation Impacts:

SILTATION Impacts are likely to occur from within the construction site as a consequence of the following:

1. Uncontrolled surface drainage over exposed and disturbed soil.
2. Excessive precipitation action on uncovered stockpiles of materials.
3. Uncontrolled treatment of sediment-loaded wash-water from batching plants.
4. Movement of materials spilled onto roadways from overloaded trucks by rainfall.

5. Sediment loads, in excess of that normally exiting the location under heavy rainfall periods will occur, leading to siltation of downslope roadways, raw material transportation routes, existing drainage facilities and ultimately the marine environment.

7.2.6 Other Impacts:

These include:

- Traffic obstructions caused by the accessing of the site by heavy vehicles
- The exploitation of natural resources for scaffolding and shoring. .
- Aesthetic social and solid waste impacts that could occur as a result of vending and the congregation of numbers of persons at the entrances to the construction site.
- Vegetation removal and substrate disturbance impacts as a consequence of the construction of temporary site management facilities, including site offices, bathroom, canteen and storage areas

8.0 Mitigations:

8.1 Long Term Mitigations:

8.1.1 Vegetation Mitigations:

VEGETATION mitigation for the proposed development will have to take the following approaches:

1. Mitigation of impacts to existing natural forest vegetation on-site.
2. Mitigation of impacts to existing introduced vegetation on-site.

The principle being advocated is that there be, at minimum, **NO NET LOSS** of the various vegetation types on the property. To achieve this, **the following mitigation measures are being proposed:**

- For those that can be relocated, the removal and relocation of introduced and naturally occurring trees from the footprint of buildings to be constructed.
- The removal of only the vegetation within the footprint of the construction area, utilizing vehicular access ways created within footprints to be ultimately developed.
- Emphasizing the use of elevated parking within the buildings, as opposed to extensive exterior parking at the locations outlined on **FIGURE 2A**. This will result in the conservation of vegetation at the Northeastern and Central sections of the property.

- The collection of representative, naturally occurring juvenile plants from the site for rearing in a nursery. This would be done with a view to re-introducing these plants at selected sections within the development.
- The utilization of introduced plants (trees, shrubs and flowering plants) that would be compatible with the naturally occurring vegetation to serve both an aesthetic (decorative) function and maintain the area's habitat function.
- The maximization of trees, shrubs and hedges where possible to maintain the area's water absorptive capacity.
- The utilization of **GREENROOF** technology[32] (see **FIGURE 16A - B**) to re-introduce vegetation that would have been lost or relocated within the footprint of the proposed buildings. **FIGURE 16C** indicates that, with the incorporation of Greenroof technology on all roofs within the development, a recovery of approximately **1.37 Hectares** of vegetation can be realized. Added to the 0.6 Hectares of natural vegetation expected to remain at the site, this would mean the maintenance of a total of **1.97 Hectares** of vegetation, 0.56 Hectares more than the area existing on site currently. Note that this does not include additional vegetation that could be saved through the use of elevated parking, as opposed to exposed parking.

[32]Green roofs are vegetative roof covers with growing media and plants taking the place of bare membrane and gravel ballast. Green roofs extend the life of the roof's waterproofing system, improves the efficiency of roof insulation and reduces rainfall runoff impact www.walshlandscape.com/green-roof.htm

- The embodiment of the mitigations outlined above in a landscaping plan through the combined efforts of a Landscape Architect and a Terrestrial Botanist. Such a plan should be prepared and presented to the relevant approving agencies prior to the implementation of the development.

8.1.2 Drainage Mitigations:

DRAINAGE mitigation for the proposed development will have to take the following approaches:

1. The maintenance of natural absorptive and percolation enhancement facilities provided by tree and shrub vegetation cover
2. The reduction of the area of impermeable surfaces on-site (such as roofs, pathways, roadways and parking lots)
3. The utilization of ground-based disposal options for storm water, particularly on the northeastern, eastern and southeastern sections of the property.
4. The interception and control of storm water that is routed onto the site from external areas, specifically at the northeastern and eastern sections of the property.

THE principle being advocated would have been that there be a **NET DECREASE** in the volumes of storm water departing the site by surface means. This has to be the case, since there is an issue with storm water currently transiting the site from external locations. The drainage proposal outlined on **FIGURE 2C** would therefore not be the sole solution to the issue of drainage on site.

A list of proposed solutions is outlined below:

- Special emphasis must be placed on the maintenance of vegetation cover on site. The vegetation mitigations outlined under section **8.1.1** would be vital to the process of reducing drainage water flow generated on-site by providing initial rainwater absorption and a reduction in the rate of rainwater release to ground. Vegetation cover will also facilitate the reduction in the amounts of sediments that would be dislodged and transported by surface runoff during rainfall periods.
- Emphasis must be placed on the use of permeable surfaces for parking, walkway and roadway areas. This will reduce areas on which water can collect and promote water movement to ground, as opposed to promoting surface runoff. **FIGURE 17** gives an example of the types of permeable surfaces that could be considered. The incorporation of **GREENROOF** technology into the drainage mechanisms for roof areas will provide the reductions in storm water releases required to control runoff collected on these areas.

- The geology of the eastern, northeastern and southeastern sections of the site shows typical karst features and in theory should be able to support storm water injection into the ground as a drainage mitigation strategy. The highly pitted nature of the limestone and the existence of sinkholes are indicative of the soluble nature of the limestone. Ground-based disposal mechanisms for collected storm water should be explored for areas where these features exist.
- Storm water accessing the site from locations outlined on **FIGURES 10 B-C** will have to be controlled and either disposed of on-site or intercepted and prevented from accessing the site.
- The mitigations outlined above, along with a back-up surface drainage proposal, must be contained within an overall drainage plan for the development, which will indicate where these mitigations will be laid out. Specific attention must be placed on the terminal portion of the surface drainage, as this area currently routes water onto Gloucester Avenue, resulting in the flooding of the roadway.

8.1.3 Aesthetic Mitigations:

AESTHETIC Mitigation for the proposed development will have to take the following approaches:

1. The promotion of a pleasing visual frontage for the development, so as to not create the perception of an eyesore to persons transiting the immediate vicinity of the development area.
2. Ensuring that the development does not block any existing views currently enjoyed by residents or commercial patrons located east of the location.
3. Ensuring that the site's current natural visual appeal is maintained through the maintenance of adequate vegetation cover
4. Ensuring that the animal life currently existing on-site, particularly birdlife, is maintained through the maintenance and enhancement of its supporting vegetation habitats.

A list of proposed solutions is outlined below:

- Vegetation mitigations outlined under section **8.1.1** above should be promoted to help to soften the development's look by giving it a view that is integrated into the natural greenery on-site.

- The promotion of vegetation mitigations outlined above will also ensure that appropriate natural habitats are maintained. If these habitats are promoted, then other aesthetically pleasing wildlife, such as birds, can be maintained in the area and enjoyed by patrons to the development.
- Emphasis should be placed on an architectural design that will ensure that the multi-storey buildings proposed blend into the environment. Additionally, emphasis should be on an architectural design that will ensure that any pre-existing views of the Montego Bay Harbour (particularly viewed from the east) are not disturbed.

8.2 Short Term Mitigations:

8.2.1 Construction Noise Mitigations:

CONSTRUCTION noise mitigations will have to focus on ensuring that these noises are contained within the borders of the construction site. To achieve this, the following mitigations are proposed:

1. Where applicable, the use of the lowest noise-emitting equipment appropriate for the given task should be opted for, since this will result in less noise generated on-site.
2. Time limits should be imposed to limit the periods during which construction noises can be generated. The following times are proposed: - **Mondays to Fridays 0800hrs to 17hrs. Saturdays 0800hrs to 1300hrs. Sundays and Holidays – no noisy activities are to be permitted**.

3. Physical noise barriers should be seriously considered for the property, particularly its eastern, northern and western perimeters. References[33] suggest that a combination of the following physical barriers could prove to be successful in reducing construction noises leaving the site:

1. **Walls**
2. **Portable Barriers**
3. **Vegetation Barriers**
4. **Earth Berms**

4. Adherence to the vegetation mitigations outlined under section **8.1.1** will aid in promoting attenuation of noise generated on the property by creating sound barriers within the periphery of the property.

8.2.2 Solid and Liquid Waste Mitigations:

SOLID waste mitigations will have to focus on the following:

1. Putting operational measures in place to reduce waste generation.
2. Employing waste reduction mechanisms on-site to reduce the volume of any solid wastes generated.
3. Facilitating the collection and safe storage of solid wastes on-site in preparation for transportation off-site.
4. Facilitating the safe transport of solid wastes off-site to authorized solid waste disposal sites.

[33] www.fhwa.dot.gov/environment/audible/al4.htm

The following mitigations are recommended:

- Construction management operatives should be required to prepare a waste reduction implementation and sensitization plan to encourage construction practices that will lead to less waste being produced. Such a plan will have cost saving benefits, in that wasted materials will be a direct cost to the development.
- Construction waste size reduction equipment (e.g., grinders, shredders and crushers) should be considered as mandatory items of equipment for the construction site. These items will be important as a means of reducing the bulkiness of both construction and domestic waste materials generated on-site.
- Sorting and containerization of construction and domestic wastes on-site will facilitate the efficient transport of these materials off-site.
- Site management should ensure that solid waste containers, skips or other receptacle areas are located at points that are easily accessible by workers for their use and by those persons responsible for the transportation of the materials off-site.
- The National Solid Waste Management Authority must be consulted for permission to dispose of construction wastes at facilities that will be authorized by them.
- Servicing of heavy equipment (with the exception of re-fuelling) should be conducted off-site at locations specifically prepared for these activities. Refueling facilities must meet the specific

conditions for fuel storage and dispensing that would be mandated by NEPA, particularly to mitigate against spillages.

- Sediment-bearing wastewater particularly that generated at batching plants should be recycled within the system to promote zero discharges to the environment.
- It is also recommended that the National Solid Waste Management Authority be consulted to advise on its best practices for solid waste management, so that a best practices inspection guide can be developed.

8.2.3 Dust Generation Mitigations:

DUST generation mitigations will have to focus on the following:

1. Controlling dust generation on-site due to the following
   - Vehicular movement on dust sources
   - Raw material dumping and stockpiling
   - Wind movement of exposed materials
2. Preventing fugitive dust from exiting the construction site
3. Controlling fugitive dust generation from sources external to the construction site, such as at Concrete Batching plants and from trucks transporting raw materials to the site.

To achieve this, the following mitigations are proposed[34]:

- For any earth-moving conduct watering as necessary to prevent visible dust emissions from exceeding 33 meters in length in any direction. This would be particularly important if these operations occur within 33 meters from all property lines.
- For exposed areas, apply dust suppression (whether water or dust suppression products) in a sufficient quantity and frequency to maintain a stabilized surface; any areas which cannot be stabilized, as evidenced by wind driven dust, must have an application of water at least twice per day to at least 80 percent of the unstabilized area.
- For exposed roadways, water all roads used for any vehicular traffic at least once per every two hours of active operations; OR water all roads used for any vehicular traffic once daily and restrict vehicle speed to 15 mph; OR apply chemical stabilizer[35] to all unpaved road surfaces in sufficient quantity and frequency to maintain a stabilized surface.
- For stockpiles apply chemical stabilizers; OR apply water to at least 80 percent of the surface areas of all open storage piles on a daily basis when there is evidence of wind driven fugitive dust; OR install a three-sided enclosure with walls with no more than 50 percent porosity that extend, at a minimum, to the top of the pile.

[34] Adapted from http://co.el-dorado.ca.us/emd/pdf/Append-C-1_RF6.pdf
[35] See http://www.ci.knoxville.tn.us/engineering/bmp_manual/AM-11.pdf for references to acceptable chemical dust stabilization products.

- For haulage vehicles, ensure that all are properly covered and comply with any vehicle freeboard requirements that may exist to ensure that hauled materials are not dumped accidentally onto roadways during transport.
- If construction work is to be temporarily halted, example on weekends or other periods, on the last day of active operations prior to the break, apply water with a mixture of chemical stabilizer diluted to not less than 1/20 of the concentration required to maintain a stabilized surface for a period of six months; OR apply water to all unstabilized disturbed areas 3 times per day; if there is any evidence of wind driven fugitive dust.
- No hauling or earth-moving activities should be conducted during strong wind events exceeding 40 kilometers per hour. Additionally, watering or chemical stabilization of all exposed surfaces or stockpiles should be conducted at least 3 times per day during these periods.
- Wind breaks should be employed both around the perimeter of the property (note noise mitigations at section **8.2.1**) and at locations that could pose a problem for dust generation, such as stockpiles or vehicle access ways.
- All measures outlined should ensure compliance with NEPA Ambient Air Quality Standards (150 µg/m^3 over a 24 hour period)

8.2.4 Sewage Mitigations:

SEWAGE mitigations will have to focus on ensuring that construction workers have adequate access to toilet and bathroom facilities that meet both numerical standards (to prevent workers from using the bushes) and treatment standards.

Considerations could be given to the employment of chemical toilets for sewage treatment, along with personal washing areas tied into an approved disposal mechanism, such as a tile field. A separation between sewage and grey water streams should be maintained to reduce sewage effluent. The developers should ensure that the providers of the chemical toilets have adequate mechanisms to collect, treat and dispose of the chemical agents within the portable toilets.

8.2.5 Siltation Mitigations:

SILTATION mitigations will have to focus on ensuring that construction activities do not increase the transportation of sediments off-site. Mitigations proposed include the following:

- The employment of drainage mitigation measures outlined in section 8.1.2 will assist in the reduction of the volume and velocity of run-off from the site, thus reducing the erosive capabilities of any surface runoff generated on the site.
- The placement of emphasis on the minimization of vegetation removal from the site will result in the retention of its natural sediment anchoring mechanisms. This will assist in the reduction of exposed sediment areas.

- The placement of sediment curtains[36] (see **FIGURE 18**) at the down-slope sections of cleared sites to act as breaks for any sediment-bearing sheet-flows moving down-slope during rainfall periods.
- The covering and berming of stockpiles of materials during rainfall periods to prevent the washing away of these materials.
- The recycling of sediment-loaded wash-water from batching plants to prevent the discharge of these waters into the environment.

8.2.6 Other Mitigations:

These include:

- The careful choosing of heavy vehicular access points to the site to reduce obstructions to traffic movement. Included in this choice would be the facilitation of slipways off the main road to allow heavy vehicles to come off the main road while waiting to access the construction site.
- The limiting of heavy vehicle movement on-site to non-peak daytime traffic periods. This would ease peak time traffic movement by not adding to traffic restrictions.
- The use of metal scaffolding and shoring equipment for construction purposes will eliminate the need to cut trees to facilitate lumber for these purposes.
-

[36] **http://www.franklin-gov.com/details/SD_23.jpg**

- The limiting of unregularized vending at the perimeter of the development so as to restrict the generation of uncontrolled solid and liquid wastes at these areas. These restrictions will also aid in reducing both aesthetic and social impacts caused by the congregation of numbers of persons at the entrances to the construction site.
- The construction of temporary site management facilities, including site offices, bathroom, canteen and storage areas, within the footprints of the areas to be built. This will prevent the unnecessary removal of vegetation from the site. This may mean that these facilities will be shifted as development progresses from one construction footprint to another.
- The posting of billboards along the border of the development to advise passersby of the intention to develop, the concept of the development to be implemented and telephone numbers to the respective regulating agencies and development management to which questions, concerns and complaints can be directed.

9.0 Monitoring:

THE implementation of the development will require monitoring to ensure that the conditions of the development approval are adhered to by the developers. Note, however, that the comprehensive monitoring of the proposed development will not be possible until access to a **CONTRACTOR'S METHOD STATEMENT** is obtained. Such a statement is necessary because, while the impact assessment process can speak to impacts, it can only speak to impacts specifically related to the footprint of the development as submitted. There may be components within the development implementation process (that may require mitigation) that only the contractor would be privy to. Additionally, a method statement will give an estimate of the construction timeframe.

IT is therefore being suggested that a comprehensive monitoring proposal cannot be generated until a comprehensive method statement is obtained. It is also recommended that the provision of a Contractor's Method Statement be a condition of any approval given for the development and that this provision be done so that it can be examined for possible impacts.

A Contractor's Method Statement must include the following:

- A layout of the location of the construction site's support facilities, including the location of its site offices, worker quarters, toilet, bathroom and canteen facilities.
- A layout of the location of any other site support facility external to the development site, such as quarries and batching plants.

- A pictorial description of the manner in which the site will be accessed by heavy equipment, inclusive of access ways to major traffic avenues and accesses on the property.
- A pictorial description of the manner in which the site will be prepared for construction, inclusive of any phases required and the timeframes required.
- A description of the manner in which the physical act of development will be conducted, inclusive of excavation, earth movement, piling, drilling and any other activities associated with the process of construction will be implemented
- A detailed project time schedule to outline the various construction related activities that are to be implemented and the expected timeframes for the implementation of these activities.

However, there are components of monitoring that can be suggested in the interim. These are outlined below:

1. Aerial monitoring of the development at intervals to show the progress of the development and its subsequent environmental changes over time. The recommended intervals are weekly for the first month of development and then monthly thereafter. Aerial monitoring would also be conducted after significant events, such as heavy or protracted rainfall.

2. Particulates and noise baseline assessments at stations peripheral to the development boundary, to establish baseline noise and particulates information to guide monitoring. Thereafter, monitoring at set intervals to determine compliance with noise and air quality guides. Monitoring intervals recommended would be weekly for the first month with monthly monitoring thereafter. Ad hoc monitoring would also be conducted on a case by case basis if complaints are received by the management of the development or through the regulating agencies (note **mitigation 8.2.6**). Monitoring would be conducted
3. Best practices monitoring to ensure compliance with mitigations for solid and liquid waste management. This monitoring would involve random visits to the site to evaluate whether or not solid or liquid wastes are being managed properly and to determine whether or not vehicles transporting materials into or solid wastes out of the site are doing so in accordance with the law.
4. Drainage assessments during a rainfall event to determine a base volume of water flow and sediment transport through the property prior to the onset of development. This would be best done during a rainfall event. From this, a monitoring regime can be established to determine changes in drainage during the course of the development implementation. Monitoring would be conducted based on predicted weather changes that could result in rainfall occurring.