TERMS OF REFERENCE

FOR PREPARATION OF AN ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED DOLPHIN COVE HANOVER DEVELOPMENT

1 INTRODUCTION

1.1 The Development Proposal

Dolphin Cove Ltd. is seeking permission to undertake the proposed Dolphin Cove Hanover development on 20 acres of seafront land being purchased from the National Housing Trust (NHT). The land is located just east of Lucea Harbour, and is approximately 22 km from Montego Bay along the North Coast Highway. The site consists of three bays on the seaward side of the north coast highway between Mosquito Cove and Lucea Harbour in a district known as Paradise/Point District.

As in the case of Dolphin Cove Ocho Rios, Dolphin Cove Hanover will be essentially a marine theme park, the primary attraction of which will be dolphin-interactive tours. However, there will be a range of other mini-attractions at the facility, designed to keep visitors there longer, and cater to a variety of needs. These include a bird sanctuary in the mangrove area to be preserved in the western bay, and a fish sanctuary in the sea grass meadow to be preserved in the western bay.

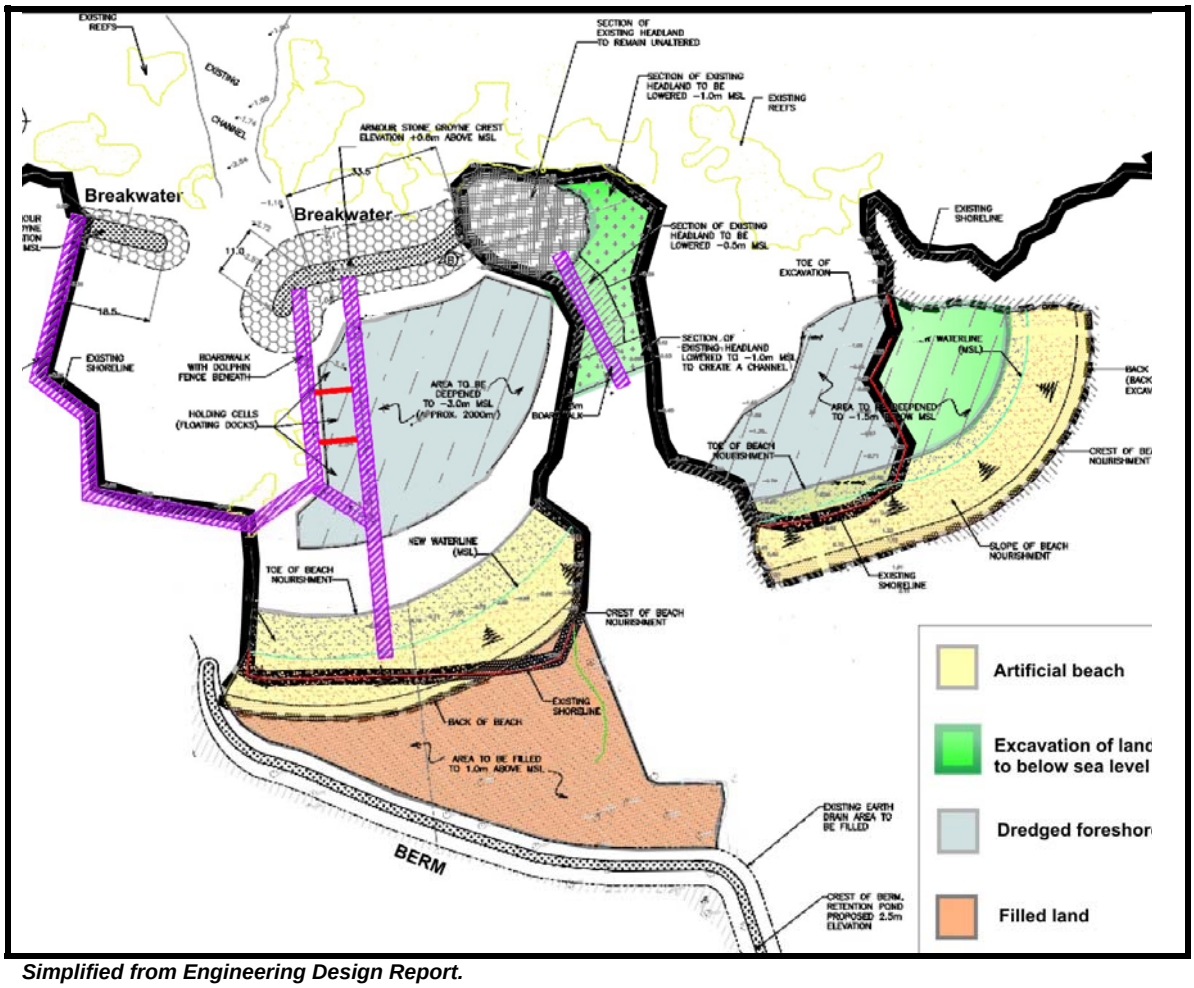
1.1.1 Planned Coastal Modifications

The design plan utilizes two of the three bays (shown in Figure 3) as part of the marine attraction. Specific planned modifications are given in Table 1 and Figure 1. Dolphin enclosures typically comprise a combination of boulder groynes and/or breakwaters designed to fit the configuration of the coastline and bathymetry. These structures (size and shape of boulders and footprint of structure on the seafloor) have been designed to withstand storm events, and ensure calm conditions in the lagoon for swimming and safety of the dolphins. Additionally, the design objectives will include low visual impact and maximization of natural flushing of the lagoon.

Table 1 Planned Coastal Modifications.

Proposed Modification	Rationale/Purpose
East Bay:	
1. Excavation of 575m^3 behind the existing shoreline.	Creation of an artificial beach for recreational use. This beach will be protected by a strip of land that will be left in place.
2. Placement of 1508 m^2 of sand.	
Peninsula between East Bay and Central Bay	
3. Excavation of 1270 m^2	Creation of a channel between two bays to improve the flushing in the Dolphin Lagoon.
Central Bay:	
4. Excavation of 2000 m^2 of foreshore to a depth of 2.7 m	Creation of a dolphin enclosure
5. Construction of a boulder breakwater (50 m long)	Protection of the dolphin enclosure
6. Construction of a boulder breakwater (20 m long)	Assurance of relatively calm conditions in the lagoon.
7. Construction of dolphin fence, boardwalks and floating docks as shown in Fig. 3.	Creation of the enclosure, and access the marine areas.
8. Removal of 0.2 ha of mangroves – these will be relocated to the drainage feature and the western bay.	Present drainage into Dolphin Bay will be diverted by channel and blocked from entering the bay by a berm. The mangroves will need to be relocated as the freshwater supply will be diverted from this area.
9. Excavation of underlying organic sediments and replacement with fill.	To improve circulation and eliminate slack water. Creation of a recreational beach

Figure 1 Simplified Coastal Modifications: Central and Eastern Bay



Simplified from Engineering Design Report.

1.1.2 Land Based Facilities

Specific planned land based modifications are given as Table 2 and Figure 2. Once the environmental permits and beach licenses are granted, an architect will be contracted to undertake detailed designing of the layout of site, which will incorporate the following main elements:

1. Recreational Land Use: Reception, reservations, offices and restrooms; Orientation pavilion/observation decks/restaurant/public restrooms; Gift shop and video/photography merchandising sale areas; Beach recreational use; Animal trainers/handlers' lounge and work area (inclusive of locker rooms and bathrooms); Dolphin food cold room and kitchen (designed within specifications).
2. Parking and Access Roads: Approximately 1525 m^2 has been allocated on the eastern side of the property (see Figure 2) for parking. An estimated 550 m of access roadway will be constructed.

3. Storm Drain: Run-off from surrounding areas and the site is now collected via a 1-m culvert that drains to the mangroves in the Central Bay. This system will be modified to prevent drainage to the main dolphin enclosure and thus maintain suitable water quality in the main dolphin enclosure. Table 2 below lists the components of the proposed drainage modification concept.

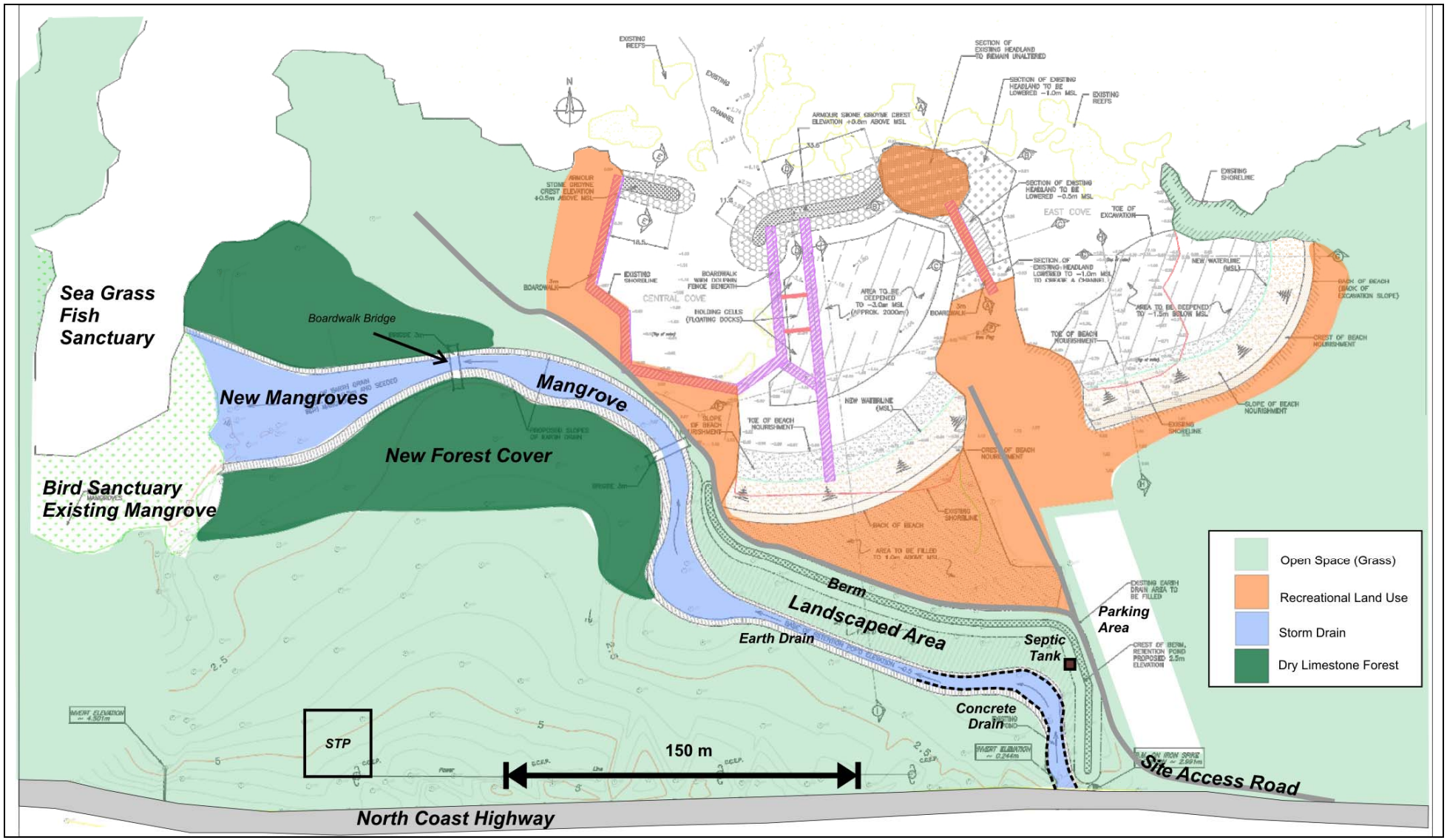
Table 2 Planned Drainage Modifications.

Proposed Modification	Rational/Purpose
Excavation of ~ 350 m drainage channel (12 m to 30 m wide) with a mean depth of -0.5 m. Storm water now exiting into the proposed Central Bay will now be transmitted to West Bay.	Diversion of freshwater flows now entering the site via a 1 m wide culvert at the highway side near the proposed Central Bay. All site run-offs and storm water from the site and the culvert drain will be diverted away from the Central Bay to the Western Bay.
Creation of an 180-m long berm (with crest at 2.5 m asl) at Central Bay behind the artificial beach being created where the mangroves are now located.	This is to ensure there is no run-off from the site into the Central Bay.

4. Sewage Treatment Plant: The Clear Stream Wastewater System will be used, which is a highly efficient "extended aeration" package sewage treatment plant (STP). Approximately 900 m^2 have been allocated to this STP on the south-western side of the property. Additional space is available for this if necessary. A 1500-GPD unit will be installed, and will produce an effluent that compliant with tertiary discharge standards. This effluent will be chlorinated, filtered and evaporated (tile field) out as the developers do not wish to have any discharge of effluents to the marine environment.

   Grey water will not be routed to the STP, but a separate filtration system to remove oil and grease before re-use to irrigate forest and mangrove areas. As the system is electricity-powered, there will be a stand-by generator in the event of failure of the main grid.

Figure 2 Conceptual Site Layout



5. Green areas in the site comprise three main types of ground cover:
    - Open space (grass land as presently covers the site). More than 50% of the site will be left in this natural condition.
    - Dry Limestone Forest: 1.5 to 2 acres of land on the western side of the property has been allocated for conversion to dry limestone forest. This is expected to attract birds and other wildlife, and will be used for a "forest trail experience" consistent with the nature-theme park.
    - Mangrove Stands: a minimum of 0.2 ha (or 0.5 acres) will be replanted along the western end of the storm drain to replace mangroves removed from the Central Bay. Additionally, mangroves on the Western Bay will be preserved and expanded if possible.

1.2 Permitting Requirements

Pursuant to the Natural Resources Conservation Authority (NRCA) Act, Phase 1 of the proposed development falls under the following Prescribed Categories, and will therefore require the respective Environmental Permits: theme park (nature), modification of wetlands; drainage modification and sewage treatment plant. In addition, beach licenses are required for any works to be done in the foreshore, inclusive of any dredging and excavation, and encroachments such as breakwaters and pilings for boardwalks. An Environmental Impact Assessment (EIA) must be submitted in support of the application for these Environmental Permits.

NEPA has determined that the applications made in connection with the proposed development must be supported by an Environmental Impact Assessment (EIA). These Terms of Reference (TOR) outline aspects of the EIA, which when thoroughly addressed, will provide a comprehensive and integrated evaluation of the proposed development, in terms of predicted environmental impacts, needed mitigation strategies, potentially viable alternatives to the project and all related legislation.

A nature tourism project is one that is expected to cater to the demands of the tourism product being offered while conserving the environment of the site proposed for development. Nature tourism projects differ from the other tourism products as the environment is promoted as the primary attraction and environmental resources are utilized as the main tourist product and/or service. Issues of carrying capacity shall therefore be thoroughly explored.

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1.3 The EIA Permitting Process in Jamaica

Environmental permitting systems seek to achieve the following objectives:

(1) Compliance with the environmental laws and regulations of Jamaica, specifically Sections 9 and 10 of the NRCA Act of 1991.

(2) Assurance of all concerned stakeholders that environmental considerations have been taken into account in project planning, particularly in respect of minimization of environmental disturbance, optimization of resource consumption and effective management of waste streams. The success of this may be measured against environmental standards, policies and plans.

(3) Evaluation of the potential for environmental impacts that could arise during the project life-cycle (site preparation, construction, operations and decommissioning phases). This shall include evaluation of the ecological footprint of the project both on-site and off-site (such as downstream, along supply corridors and upon material sources etc.). The document will give a clear statement as to whether there are any significant negative environmental impacts that cannot be cost-effectively managed by implementation of mitigation measures or design modification.

(4) Determination of whether wider societal benefits of the project and the cost-effectiveness of proposed mitigation measures are sufficient to justify environmental costs or trade-offs. This is normally done in the Analysis of Alternatives Section of the EIA.

(5) Preparation of an EIA document to support the granting of the Environmental Permits and Beach Licenses, which:

- Is fully compliant with the approved terms of reference (TOR) for the study.
- Is technically accurate and meets international standards in terms of methodologies and approaches.
- Has followed prescribed procedures and is transparent enough to withstand public scrutiny.
- Highlights opportunities for enhancing operational performance/efficiency or modifying design so that the project will be better aligned with environmental objectives.
- Is professionally produced in a style and format that is consistent with international standards for EIA reporting.

1.4 The Purpose and Scope of the Terms of Reference

This document represents the Terms of Reference (TOR) for the conduct of an Environmental Impact Assessment process in respect of the above-mentioned development proposal. The purpose of the TOR is to set the ground rules for the conduct of the EIA process, which includes the EIA report.

The legal defensibility of the environmental permit and the EIA rests upon:

1. The validity of the project and environmental information provided, in so far as they are representative of the actual plans to build and host environment respectively.
2. The verifiability of the main scientific conclusions of the report.
3. Adherence of the process to accepted norms that promote transparency.

Therefore the TOR shall:

- Be reviewed and accepted by all relevant parties as the representative of the minimum requirements for an acceptable study and shall indicate the process for such consultation.
- Provide sufficient information about the development proposal and the environment to allow for a preliminary scoping of environmental sensitivities.
- Outline the minimum requirements in respect of the scope of the environmental baseline, specifically in terms of the parameters (Valued Environmental Components or VECs) to be investigated, the scale area of investigation for each parameter and the acceptable sources of information. Where primary survey is to be undertaken, the sampling regime is described. The level of environmental investigation is commensurate with the level of concern (that a receptor may be affected by the project). As is the international standard practice in EIA, the geographic areas included in the study are not limited to the project site, but extend to the *sphere of influence* of the project, for the various environmental parameters.
- Outline the basic structure of the EIA Report, outlining the purpose of each of the sections as well as the minimum required scope/content.
- Indicate any other information that is specifically required to facilitate the decision making process.

2 PRELIMINARY ENVIRONMENTAL SCOPING

2.1 Environmental Setting

Setting: The proposed site of the project is given in Figure 1.

Terrain: The site is a low-lying coastal terrace which slopes gently towards the sea with ~800 m of sea frontage on its northern side. Three storm drains cross the North Coast Highway via culverts that empty into earth drains. The drains on property enter the sea via mangrove stands, and are all ephemeral. Ponding over clay lenses within the drainage channel occurs after intense rainfall. The underlying bedrock is a hard impure limestone 1 to 3 m thick, which may overlie less well-indurated carbonates and calcareous siltstones. The overlying soils are thin stony clays developing over limestone bedrock, with thicker alluvial clays along the drainage pathways.

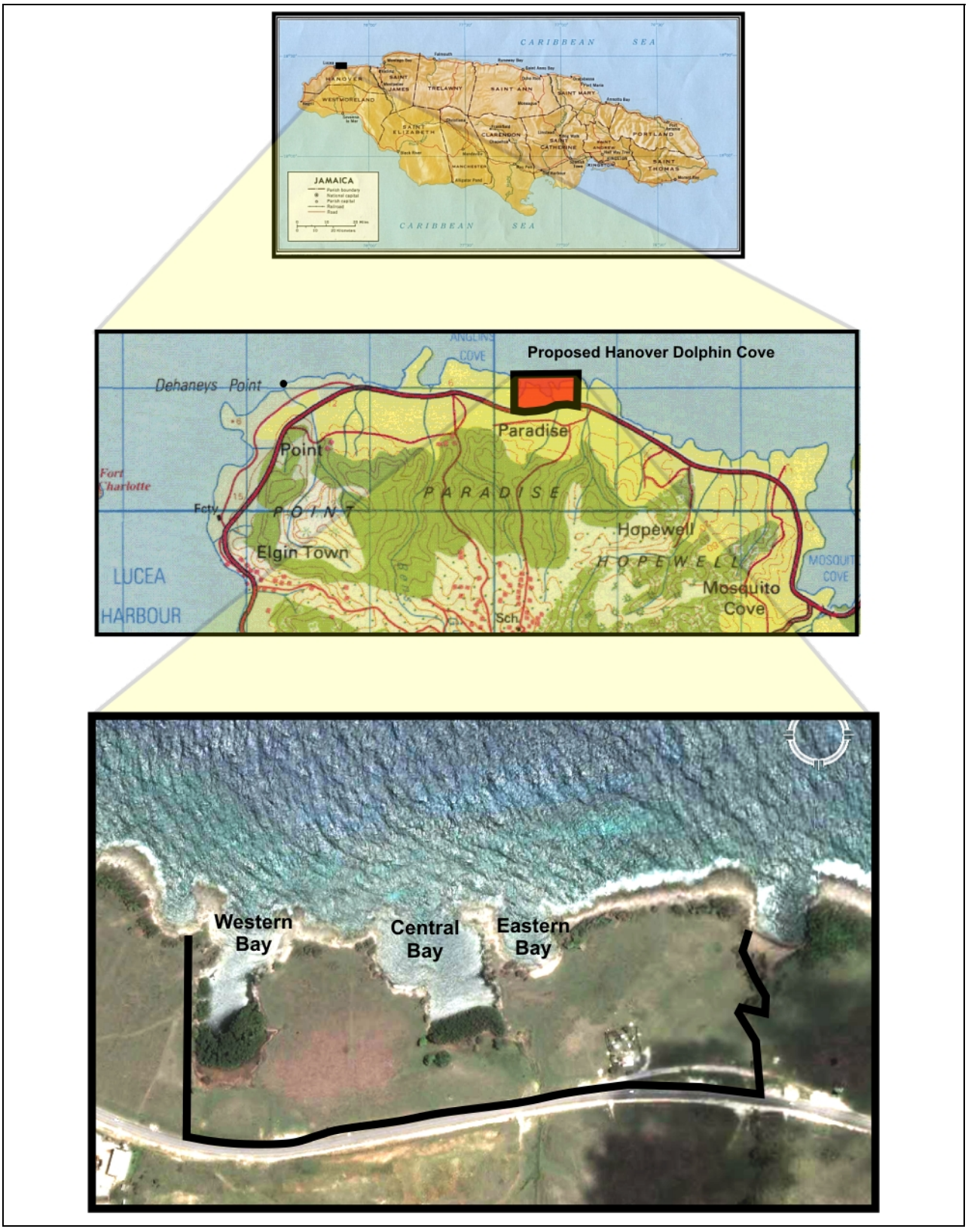
Landuse: The site is generally unoccupied, with the exception of two informal users (one near to the south-eastern corner and another at the promontory between the proposed Dolphin Bay and the proposed Beach Bay). The dominant ground cover at the site is grass, with coastal vegetation along the shoreline.

Marine Area: The shoreline in this area is predominantly rocky, periodically indented with small, shallow embayments. Reefs occurs outside the bays in this area, a few hundred meters from the shoreline, offering protection from the direct impact of high wave energy. The eastern bay is significantly less indented than the central bay and possesses a sandy shore (pocket beach) with no mangrove. The central bay is the largest, the western side of which is very shallow and rocky. In this bay, reef structures occur at depths of -2 m+, and are broken by a marine channel with a south-easterly orientation. The western bay is the most deeply incised bay. The innermost areas of the latter two bays are areas of net sediment accretion, due to the presence of slack water. The maximum tidal range in this area is of the order of about 30 cm.

Terrestrial/Coastal Ecology: A small mangrove ~0.2 ha in area occurs along the shoreline at the deepest part of the Dolphin Bay, which is fed by a freshwater flow from the small adjacent catchment. This is exclusively red mangrove *Rhizophora* mangle with a low canopy at ~4 m. A second mangrove ~0.4 ha (also red mangrove) in area is found along the shoreline at the deepest part of the western bay. Moderate densities of mangrove crab (*Ucides cordatus*) burrows were encountered flanking mangrove areas. There are extensive grasslands throughout this area.

Marine Ecology: The bays contain healthy seagrass meadow habitat at shallow depths of 1-2 m. The submerged rocky shoreline is dominated by encrustations of various macroalgae. The intertidal zone contained several species of grazers (*Chiton* sp. and *Nerites* sp). Small patches of coral occur to the margins. There were also patches of dead coral that were encrusted in crustose coralline algae and fleshy macroalgae.

Figure 3 Site Location



2.2 Environmental Sensitivities

The following is a preliminary list of environmental concerns that have been identified for assessment in the EIA process:

1. Environmental effects arising from the proposed physical changes and design footprint of the facility:
    a. Changes to hydrological conditions and flood potential arising from the proposed drainage modifications and site run-offs.
    b. Changes to natural features and visual aesthetics (landscape) arising from drainage and excavation works.
    c. Modification of natural habitats, and niches, including changes to the benthic environment in the bays (from foreshore encroachments, dredging and beach nourishment).
    d. Off-site impacts arising from sourcing of sand for nourishment.
    e. Increased vulnerability of the lagoons and facilities to (a) storm surges given design life of structures and coastal set-back (b) seismicity (c) coastal erosion.

2. Potential for pollution of coastal or ground water, particularly in relation to:
    a. Dredging and excavation works (plumes).
    b. Disposal of dredge spoil if material is not suitable for on site beneficial use options (beach nourishment or land fill).
    c. The capacity and design parameters of proposed sewage treatment facility.
    d. Presence of marine mammals given predicted flushing rates and patterns (arising from the combination of tidal currents and waves). The efficiency of the flushing needs to be evaluated against the predicted and recommended residence time for waters in the dolphin facility.
3. Disturbance/use of protected species and other species:
    a. Mangroves: The plan calls for removal of Less than half of an acre of mangroves. However a no net loss plan is proposed, wherein mangroves will be transplanted to the western lagoon and along the last 175 m of the drainage feature that is being created.
    b. Sea grasses: Sea grass beds seaward of the excavation area will be protected with silt screens during excavation. The plan calls for removal of ~3152 m2 of sea grass in order to deepen the bays to the required depths. The main species impacted (Thalassia and to a lesser extent Syringodium), are very common in this area. The plan calls for allowing sea grasses to re-colonize the central bay after modification to minimize net loss, and protection of sea grass beds during excavation by the use of silt screens.

c. Corals: The plan indicates that any coral heads greater than 5 cm in the proposed dredge area will be relocated, and no breakwaters will be located on the outer reef structures.
d. Dolphins: sources, species, numbers, age and sex are required.
e. Effects of creation of a "dry limestone forest" in this area. This should include consideration of any impacts of topography/drainage change or soil remediation. Species to be planted as well as the expected succession for the forest should be described. The effect of proposed grey water irrigation system receiving areas should be considered.
f. Other species of interest to the project: scientific names, sources, numbers, age and sex.

4. Potential impacts on the human environment:
    a. Earning opportunities for Hanover residents including provision of new jobs.
    b. Effects on regional tourism: numbers of tourists, foreign exchange revenues, recreational opportunity diversification
    c. Alignment with regional land uses (e.g. Fiesta hotel) and physical planning objectives for the area.
    d. Effects on municipal services: solid waste disposal capacity and emergency services.
5. The EIA will describe off-site and on-site effects on the environment caused by any foreseeable developments engendered by the implementation of this project.

This preliminary list of impacts shall be supplemented further to stakeholder consultation, technical evaluation of the host environment and the project and a review of the effects of similar projects in this type of environment.

2.3 Stakeholders

The following stakeholders shall be apprised of the proposed development, and included in the EIA consultative process:

1. Relevant government agencies:
    - National Environment and Planning Agency (NEPA)
    - Water Resources Authority (WRA)
    - Hanover Parish Council
    - National Works Agency (NWA)
    - Office of Disaster Preparedness and Emergency Management (ODPEM)
    - Ministry of Tourism
    - Tourism Product Development Corporation (TPD.Co.),
    - Environmental Health Unit (EHU)
    - National Solid Waste Management Authority (NSWMA)

2. Non-Governmental Organizations and community based organizations with an interest in the area, including the Jamaica Hotel and Tourism Association (JHTA), Attractions Association of Jamaica Ltd. (AJAL).
3. Occupiers/Owners of adjacent lands:
4. Communities around the site.

2.4 EIA Preparation Team

Based on the preliminary scoping of the EIA the following specialists shall be included on the EIA preparation team:

1. EIA specialist with particular experience in monitoring the environmental impacts of dolphin enclosures, and marine water and sediment quality.
2. Environmental geologist.
3. Oceanographer/Coastal engineer.
4. Coastal ecologist with expertise in mangrove eco-systems and associated faunas (including but not limited to avi-fauna and crustaceans).
5. Marine ecologist with expertise in coral reef, sea grass and benthic macro-infauna ecology as well as general fisheries.
6. Social impact specialist and environmental planner.
7. Analytical facilities (water and sediment quality) with appropriate quality control systems in place.
8. Field technician to assist

3 MINIMUM SCOPE OF WORK (TASKS TO BE COMPLETED)

3.1 Task 1 Conduct of the EIA Process

The EIA process shall be conducted as follows:

1. Submission of the Draft TOR for the EIA to NEPA.
2. Posting of the 1st Public Notice of the availability of the Draft TOR for public review.
3. Finalization of the TOR based on comments received.
4. Conduct of the EIA as prescribed in the TOR by qualified environmental consultants within 3 months of receiving an approved TOR.
5. Submission of 11 copies of the EIA Report to NEPA for review.
6. Posting of the 2nd Public Notice advising on (1) the availability of the EIA for public review and (2) the venue and time for the public meeting.
7. Distribution of review copies of the EIA within one week of receipt of the EIA to the review panel.
8. Conduct of the Public Meeting within 3 weeks of the 2nd Public Notice.
9. Submission to NEPA of the Town Meeting Report within 7 days of the meeting.
10. Review of the project application in light of the EIA by NEPA's Internal Review Committee (IRC) and the inter-agency review panel, the Technical Review Committee (TRC).
11. Collation of review comments and submission of these to the Consultant by NEPA.
12. Submission of an Addendum Report addressing review comments by the Consultant
13. Review and acceptance of the review comments by specific reviewers.
14. Further response by the Consultant if necessary.
15. Recommendation of a decision by NEPA to the Board of the NRCA.
16. Notice to the Applicant of the Board's decision.

All EIA documentation may be placed online (NEPA's website and the consultant's website to facilitate the review process).

After the submission of the EIA for review, neither the applicant nor consultant shall contact NEPA before the review report has been submitted to the consultant.

3.2 Task 2 Stakeholder Consultation

The EIA process will only be considered valid if there are meaningful and valid opportunities for public scrutiny of the environmental effects of the project as proposed, including:

1. During the course of preparation of the EIA Report, direct written communication from the EIA preparer to relevant public agencies, NGOs and adjacent land owners/occupiers advising them of the project, and seeking their concerns about it as they relate to potential environmental impacts.
2. Survey of the communities within proximity to the site in respect of:
    a. General acceptability of the proposed project, with consideration of the community-based stakeholders' willingness to make trade-offs, given the potential benefits of the project to the local and national economies.
    b. Fears and expectations about the specific project, including any anticipated social conflict and crime.
    c. Perceptions and attitudes of present community-based resource users, e.g., fishermen, squatters, recreational beach users.
    d. General health, safety and environmental concerns related to the project
3. Public Meeting held in Lucea three weeks after the EIA is made available for review. This meeting shall include presentations outlining the project, its possible environmental impacts, and proposed mitigations.
4. Availability of all EIA documents for public review, inclusive of: (1) these Terms of Reference (2) the EIA inclusive of all supporting technical appendices (3) the Public Meeting Report (containing presentations, summary, verbatim report of question and answer session and the register of attendance) and (4) Addendum Report (i.e. written response to EIA review comments).

3.3 Content of the EIA Report

The following scope and content shall be satisfied by the EIA report. This scope of work shall be accomplished by the following tasks.

3.3.1 Task 3 Project Description

The aim of this task is to provide a comprehensive description of the project, noting 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 and positive) on the environment. This shall involve the use of maps, site plans, aerial photographs and other graphic aids and images, as appropriate.

This section will include at a minimum:

1. Project overview (main design elements) and justification.
2. Project area. This includes all lands subject to direct disturbance from the Project and associated infrastructure, including access and utility corridors. A map showing the area proposed to be disturbed in relation to existing topographic features, settlements, wetlands, watercourses, water bodies, other tours and attractions, airports, ports, etc.
3. Site Plan: property boundaries, project footprint; areas to be landscaped or conserved. Location of parking and access roads, routes, visitor amenities, structures (including marine structures), sewage treatment, and any other infrastructure. A layout plan that identifies the site boundaries, the footprints of buildings, locations of all proposed development activities (site or master plan) and set backs shall be included.
4. The proposed schedule for development of the various design components of the project.
5. Design and planning specifications: scale and capacity of proposed operations; design concepts and proposed technologies. This shall also include details of spatial allotments for various proposed land uses (buildings, parking, roadway, green space, water features, boardwalks etc.) as well as design specifications for off-shore structures and earthworks.
6. Tourism Concept: general outline of design elements, expected visitor capacity and availability.
7. Impact-causing aspects of activities conducted during both expected and upset conditions shall be evaluated in terms of:
    - Activities and equipment usage, including proposed construction methodologies for dredging, coral, sea grass and mangrove relocation, placement of boulder breakwaters, sediment sorting and sand placement on the beaches. Operational considerations include: sourcing and transportation of dolphins, considerations for maintaining the dolphin population, use of other species (both marine and terrestrial) in tourism related displays, and all operational activities.
    - Resource usage: water, power, communications, labor, building materials (lumber, steel, pipe, concrete etc.).
    - Waste streams: air emissions, noise emissions, calculated site run-offs and discharges, solid waste generation.

If a permit is issued, it will be tied to what is disclosed here so the information about the project shall be as close to final-stage as possible. **Where design or technology options are still being considered, the discussion of these shall be done under the "*Analysis of Alternatives*" Section.**

3.3.2 Task 4 Analysis of Alternatives

The purpose of this section of the EIA is to examine feasible alternatives to the project and, shall highlight the benefits of and general rationale for the project that need to be considered against any potential environmental cost. It shall outline in balanced way, the wider societal benefits of the development proposal that could arise if the environmental permit is granted.

Feasible land use options shall be compared in terms of lowest costs and most benefits criteria: environmental impacts, social acceptability, economics (including productivity of land use) and engineering feasibility. The following land use options shall be considered: (1) leaving the land as is (*status quo*); (2) the proposed tourism attraction (3) golf course (4) housing development.

The selection criteria for the following proposed aspects of the development shall also be discussed, with reference to feasible alternatives that were considered: (1) drainage design (2) Sewage treatment plant (STP): technology, capacity, location and effluent disposal (3) sand sources for beach nourishment (4) design options to promote maximum flushing of the bays while allowing a reasonable degree of wave protection (5) proposed enclosure versus any feasible expansion options for multiple enclosures in future expansion of the facility.

Criteria for locating the attraction at this site should be presented, carefully outlining the relative advantages of this site.

3.3.3 Task 5 Legal and Institutional Framework

The objective of this task is to provide an outline the relevant environmental regulations, policies and standards/guidelines governing the construction and operation of a dolphin park as proposed. Relevant international guidelines, conventions and protocols shall be described.

This shall include a regulatory controls and institutional frameworks with jurisdiction over the following main areas as they relate specifically to this site and project:

1. Development & Operational Control:
    - Permitting: environmental permits, beach and discharge licenses, drainage and sewage discharge permits, planning permission and other operational permits, including national and international policies, guidelines and standards for the operation of Dolphin parks.
    - Construction (including building codes and site management controls) and subsidiary inputs (concrete, lumber, etc.)
    - Tour operations.
    - Public safety and vulnerability to natural disasters
    - Physical planning controls (National Tourism Master Plan, Water Resources Master Plan, National Physical Plan, plans for road and infrastructural development and other planned development projects for the area).

2. Environmental Conservation:
    - Forestry, wildlife and biodiversity (including marine resources). This shall include review of the national policies in respect of coral reefs, wetlands and sea grass management.
    - Importation, collection or possession of species listed in the schedules of the Endangered Species (Protection, Conservation and Regulation of Trade) Act and the Wild Life Protection Act.
    - Relevant Jamaican and international guidelines and policies regulating the use of marine species for public display (including importation, transportation and operational controls).
    - Water resources (freshwater and coastal waters).
    - Heritage and cultural resources.
    - Location relative to areas declared protected under the Natural Resources Conservation Authority, Wild Life Protection, Beach Control, Fishing Industry, Forestry and the Jamaica National Heritage Trust Acts or Ramsar Sites designated under the Convention on Wetlands.
3. Waste Management:
    - Air quality
    - Public health and sewage
    - Storm water.
    - Noise levels
    - Solid waste
    -

In all cases the roles of agencies with responsibility for implementing legal mechanisms will be described. Where Jamaican standards or policy are insufficient, international standards and policies will be outlined. This section shall summarize (thematically) the key regulatory controls on the project (including environmental quality criteria, physical planning restrictions, building codes etc.). The degree of compliance with these controls (general acceptability) is a key criterion used in determining of the relative significance of environmental impacts.

3.3.4 Task 6 Description of the Environment (Baseline)

The purpose of this section is to describe sensitive environmental receptors in terms of pre-project status and trends (if the project is not implemented). This therefore provides a baseline against which future monitoring data can be compared to determine whether and how a project is actually impacting specific receptors (Table 3). It also allows for evaluation of contributions to environmental degradation from other sources (or cumulative impacts), and the carrying capacity of the environment in respect of specific stresses. The most basic use of the data is terms objectively determining the effect level of impacts, using a classification system.

3.3.5 Task 7 Summary of the Stakeholder Consultation Process

This section shall summarize the key environmental concerns arising during the stakeholder consultations done prior to submission of the EIA. The degree of public concern with specific issues (and general acceptability of the impact given proposed mitigation) is a key criterion used in determining of the relative significance of environmental impacts.

3.3.6 Task 7 Assessment of Impacts and Mitigation Measures

The purpose of this task is to identify the major environmental and public health issues of concern and indicate their relative importance to the design of the project and the intended activities. Both positive and negative project impacts are identified using the following methods:

1. Stakeholder consultation.
2. Technical inputs from environmental specialists on the EIA team.
3. Review of the possible impact-causing aspects of the project.
4. Review of impact assessments done for similar projects.
5. Regulatory criteria governing aspects of the environment likely to be impacted.
6. The sensitivity of valued environmental components (VECs) likely to be impacted by the project.
7. Review of the risks arising from the project and the range of environmental consequences that could arise under upset conditions.

Each identified impact is classified according to the assessed effect level (no impact, minor, moderate or major). Each identified impact shall be assessed using the following criteria:

1. Scale: this refers to the magnitude of the adverse effect in terms of the geographic extent of influence arising from frequency and magnitude of the causative action. This allows higher assessment of impacts with a wider sphere of influence.
2. Affected Numbers: this considers the numbers of individuals (organisms, people etc.) from a valued population that stand to be impacted. This parameter can refer to indicator species or general receptor populations.
3. Secondary Effects: This parameter looks at the impact as a trigger mechanism for other effects, particularly those manifesting downstream of a pathway emanating from a project component, latent effects that could occur in the future, such as bioaccumulation of heavy metals in the food chain, or effects on future generations.

Table 3 Scope of the Baseline Section

VEC	SCALE/AREA	DATA SOURCES/METHODS/OUTPUT
PHYSICAL BASELINE		
Climate	Regional (Montego Bay)	**Literature Review**: Existing Meteorological Office data. This shall described prevailing winds, temperature and humidity, and rainfall (mean annual distributions).
Hydrology	Site specific and regional	**Literature Review and Field Observations:** Interpreted from existing reports, rainfall and geology. This shall include descriptions of (a) the water management unit in which the area falls, as well a map showing the location of the development site in relation to the watershed boundaries (b) the hydro-geological classification and characteristics of the site (c) the likely depth to groundwater (wet and dry season) (d) the hydrological controls on the adjacent wetlands (e) the influence of tides on the wetlands and water table (f) surface drainage features (including estimated peak spontaneous flows into the adjacent wetlands from the site in its present condition) and associated civil structures
Topography	Site specific	**Literature Review and Field Observations:** Description of the site based on published reports on the geomorphology of the areas. A geomorphic map with the classified landforms/processes and elevations at the site shall be included
Geology	Site specific and regional	**Literature Review and Field Observations:** Published reports/maps, remote sensing and geotechnical report. Descriptions of the following shall be included: (a) the regional geological setting, inclusive of stratigraphy and structure (n.b. this shall extend to adjacent marine areas) based on a review of all relevant literature (b) available core hole data and field observations of the site (c) field observations of the sediments comprising the beach along the shoreline of the property, estimates of the quantity and source of the sand, and sediment dynamics.
Soils	Regional	**Literature Review:** Review of available soils literature and data (including soil boring and geotechnical report), and reference to the Rural Physical Planning Soils Classification. Soils shall be discussed in terms of their genesis, texture, internal drainage, pH and colour as well as capability and erosion hazard
Land Use	Regional	**Literature Review and Field Observations:** Published reports/maps, remote sensing and site investigation. A map showing the cover by various categories shall be included.
Physical Oceanography:	Regional	**Literature Review:** Coastal Engineering Design Report would be the main source of this information, in addition to other literature for western Jamaica. This shall include a general description of the sea floor off the site and its physiographic features with a more detailed description of the area near to the proposed development site, as well as tides, waves, currents affecting the area.

Chemical Oceanography:	5 stations - wet season	**Primary Survey:** Multi-parameter meter: basic descriptions of salinity, dissolved oxygen (DO), temperature, pH values compared to ambient harbour conditions.
Natural hazards:	Regional	**Literature Review:** Existing data and engineering design report (SWIL) and other available literature shall be reviewed to describe the historic occurrence (magnitude, frequency and likely effects) and remedial actions previously taken in respect of (a) earthquakes (b) hurricane winds (c) coastal flooding as a result of storm surge or tsunamis (d) flooding from intense rainfall (e) shoreline and top-soil erosion. In each case recommendations shall be given to minimize loss, including reference to the applicable standard practices and codes.

POLLUTANT BASELINE		
Coastal Water Quality:	5 stations with 3 replicates, sampled twice (wet and dry season)	**Primary Survey:** Samples will be collected and tested according to standard methodologies. Descriptions of the average values compared to ambient concentrations and criteria shall be included for each of the following: Biological oxygen demand (BOD), total suspended solids (TSS), nitrates and phosphates, total nitrogen, total phosphorus, faecal coliform, and oil and grease. The analytical methods applied will be as recommended by Standard Methods for the analysis of Water and Waste Water 19th Edition upwards.
Foreshore sediments	2 stations (see diagram) with 3 replicates, sampled in the wet season (for screening purposes)	**Primary Survey:** Heavy metals (cadmium, copper, lead, nickel, zinc) concentration levels shall be described from within area slated for dredging. These shall be correlated with the benthic biodiversity indicators to determine the existing effect of pollution on the diversity of benthic macro invertebrate fauna.
Air Quality	Site Specific	**Field Observations:** Description of sources of pollution
Ambient Noise Levels	Regional	**Literature Review and Field Observations:** Description of sources of pollution
Solid waste	Site Specific	**Field Observations:** Description of status, and factors affecting the deposition on shoreline.

BIOLOGICAL BASELINE		
Terrestrial Eco-systems		
Vegetative cover	Wetlands and coastal vegetation	**Literature review, satellite image interpretation and site observations**. Types described in terms (a) aerial coverage, (b) community structure and maturity, (c) relative species abundances and identification of important species (protected/endangered, rare, endemic, commercially or ecologically important) and (d) ecological functions.
Faunas	Coastal areas including wetlands	**Literature review** to describe the bird**,** butterflies, reptiles, molluscs and crustaceans population in terms of important ecologically species (protected/endangered, rare, endemic, commercially or ecologically important) that have the potential to occur in this geographic area, and ecological dependencies (habitat, food, breeding, environmental sensitivities etc.). Migratory and invasive alien species will also be described.
Marine Eco-systems		
Benthic Cover	Regional and site specific	**Literature Review:** A review of the available literature on sea grasses, epiphytes, and stony corals in the area.
	Benthic grab samples from 2 marine stations in triplicate twice (wet and dry seasons)	**Field Benthic Survey**: 1. A benthic survey of the foreshore (to a depth of 5 m) of the proposed development site. The benthic survey area shall be described in terms of (a) aerial coverage (bare sand/rock, muddy bottom, sea grass, coral reef etc.), (b) relative species abundances and identification of important species (protected/endangered, rare, endemic, commercially or ecologically important). A photo inventory shall be prepared to catalogue the benthic dive transects and quadrats used to characterise the benthos. 2. The macro benthic invertebrate fauna shall be sampled and species identified to the lowest possible identification levels (LPIL). Biodiversity indices shall be calculated using standard methods.
Marine Fauna	Regional/National	**Literature Review and Field Observations:** Available literature for marine mammals, marine reptiles, and fish. Each of these groups shall be described in terms of (1) important ecologically species (protected/endangered, rare, endemic, commercially or ecologically important) that have the potential to occur in this geographic area, and ecological dependencies (habitat, food, breeding, environmental sensitivities etc.).

SOCIO-ECONOMIC BASELINE		
Socio-economic setting	Site specific and regional (Lucea area)	**Literature Review and Field Observations:** Identification of the project's area of influence in terms of its potential social, economic and cultural impacts. This must include major communities around in the town of Lucea that may be affected by the project. Attention shall also be given to identifying specific resource users within the study area, such as owners of adjacent lands (including the highway), fishermen, squatters on the property, persons who traditionally use the lands, access routes to the coastal area and the coastal area itself. In general, all community-based stakeholders shall be identified, and a basic description of their location and the reason why they are considered stakeholders in the project shall be given. A settlement pattern map showing the proposed survey area must be prepared.
Tourism Trends	Montego Bay and Negril	**Literature Review:** This shall examine recent trends in tourism (e.g., number of cruise ship visitors, airline passengers, occupancy rates) as they relate to the potential viability of the development.
Demographic Profile:	Hanover	**Literature Review and Field Survey**: Census data available from Statistical Institute (STATIN) for the Enumeration Districts for of the communities identified above. Where possible, this shall be accomplished using published information (e.g., Statistical Institute of Jamaica, Census and other relevant data) and primary survey data. Parameters must include: population size and growth trends, age distribution of the population, male to female ratios, workforce (dependency ratio), income, education levels, and employment levels. Additionally, there shall be an estimated of the transient population (commuting workforce) to the area.
Municipal resources:	Regional	**Survey**: interviews with agencies and a literature review shall inform a description of the present availability and scope for expansion of resources such as utilities (telecommunications power, water supply), solid waste disposal capacity, and facilities (public transportation, housing stock, and emergency response services such as fire, medical, protective, disaster relief). Basic crime statistics for Hanover shall also be discussed.
Land use	Regional	**Literature review, satellite image interpretation and site observations** Available literature, remote sensing and map interpretation shall be used to describe historical and present use of surrounding lands, e.g., recreational/open space, wetlands, hotel site etc.. Economic activities in the area shall also be described in relation to the regional land use.

Heritage resources:	Site specific (including marine area)	**Literature Review:** Published data and interviews with Jamaican National Heritage Trust (JNHT) shall describe potential for archaeological resources to occur on the site and any cultural aspects of the site.
Traffic:	Survey station – two 12-hour surveys	**Literature Review and Field Survey** Traffic survey and a review of available NWA data for the area shall inform the description of the baseline (ambient) levels of traffic along routes to be used during construction and operational phases of the project. The traffic survey shall be consistent with the National Works Agency methodology, and shall document: ▪ 12-hour traffic flows into and out of the area. ▪ the percentage of flow disaggregated by frequency and types of vehicles.
Socio-cultural aspects	Regional	**Field Survey:** A community stakeholder questionnaire shall be developed, which shall be administered to at least 10% of the population identified in Task 1 above, or 100 households (whichever is greater). The sampling regime for administration of the questionnaire must also be described, and a map showing the area and routes included in the survey must be given. The following information shall be determined from the population survey: The values that the local communities place on the area; Their quality of life indicators; Perceived problems, and fears; Nuisances and complaints; Social organization: membership in voluntary organizations, churches, clubs and Linkages outside of the community. The socio-economic baseline report must contain a description of the methods used including analytical, statistical and any other standard approaches, as well as a review of existing literature. A list of all references must be included. Map overlays (depicting the communities within the area of potential impact) shall be used to provide a spatial portrayal of socio-economic data. Field studies shall be undertaken to update information that may no longer be current. Appropriate sampling methods shall be employed for the conduct of these studies/surveys

4. Resilience: This criterion examines ecological resilience/sensitivity (ability of a population to cope with effect). Existing stresses and variability of sensitivity (spatial or seasonal) shall be considered. Resilience/sensitivity can be determined by eco-toxicological response, dose/response relationships and exposure of the population given effect pathways.
5. Persistence: This addresses the frequency and duration of effects in the environment. In general, chronic (persistent) or acute (short-term but severe) effects are regarded as more significant.
6. Reversibility. This criterion evaluates the extent to which an effected receptor can be returned to its pre-project state.
7. Baseline change: This relates to any model or prediction of the extent of change that can be expected. This shall compare predicted levels of change with normal fluctuations as well as trends in the parameter without the effect of the project.
8. Extent to which the impact can be mitigated: This addresses the feasibility (ease of implementation and cost-effectiveness) of measures to prevent or reduce environmental costs. It shall also consider the benefits or moderating circumstances given these environmental costs.
9. Uncertainty: This allows for disclosure of the level of scientific confidence in the predicted outcomes, and the general reliability of the data and models used to predict impacts.
10. Acceptability to stakeholders: This examines the willingness to make trade-offs and the degree of objection, given potential benefits of the project. This also includes planning constraints and scientific criteria (maximum allowable limits).

Using these criteria, **a significant negative environmental impact** is defined as one that:

- Is located in proximity to any sensitive or protected areas and has been determined to impact negatively on these.
- Is extensive over space or time (scales must be appropriately defined)
- Is intensive in concentration (i.e. exceeding recommended criteria) or in relation to assimilative capacity (as appropriated to the affected receptor).
- Is not consistent with national plans for the general use of the area.
- Contributes to the endangerment of threatened species.
- Reduces the stocks of commercially important species.
- Permanently damages habitat quality or creates ecological barriers.
- Threatens cultural or heritage resources.
- Alters community lifestyles or requires long-term adjustments of local people in respect of traditional values and resource use.
- Represents a long-term nuisance or significant safety risk to other users.

Cumulative impacts are caused by (a) activities unrelated to the proposal being evaluated but are likely to occur at the same time that the project activities are occurring and (b) several activities associated with the implementation of the project as proposed. External activities form part of the baseline condition, and are taken into account in the examination of the baseline, as well as divergence from the baseline that might be expected to arise from project implementation. In respect of internal aggregations of impacts on specific VECs that may individually be assessed as having a “minor” effect, but that may collectively have a significant combined effect, the resultant cumulative effects are evaluated collectively where multiple project activities contribute to the same effect (however, these shall be treated separately when the activities are spatially separated).

This section must conclude with the preparer’s statement on whether, based on the various investigations and assessments of the project that were done as part of the EIA process, there is a Finding of No Negative Significant Impacts (FONSI). If the study finds that the project has the potential to result in significant negative environmental impacts that cannot be cost effectively mitigated, and which require project modification (in terms of design, site, technology use or scale/footprint), this must be clearly disclosed.

3.3.7 Task 8 Environmental Management Plan

The Environmental Management Plan (EMP) outlines the following:

- Environmental performance objectives for the project based on the specific impacts identified during site preparation, construction and operational stages of the proposed development.
- Summary of proposed mitigation measures, identifying the best timing for implementation, responsibilities and any required commitments of resources.
- General guidelines for activities during construction and operational phases of the project to improve the project’s overall environmental performance (e.g., in respect of waste management, water and energy conservation, marine conservation, community development, etc.).
- Requirements for post-permit plans and approvals.
- Outline monitoring plan.
- Methodologies for: (a) mangrove replanting (2) sea grass relocation (3) coral relocation.

The environmental permit will outline compliance requirements with respect to monitoring of sensitive environmental receptors and implementation of mitigation measures.

3.4 Additional Information

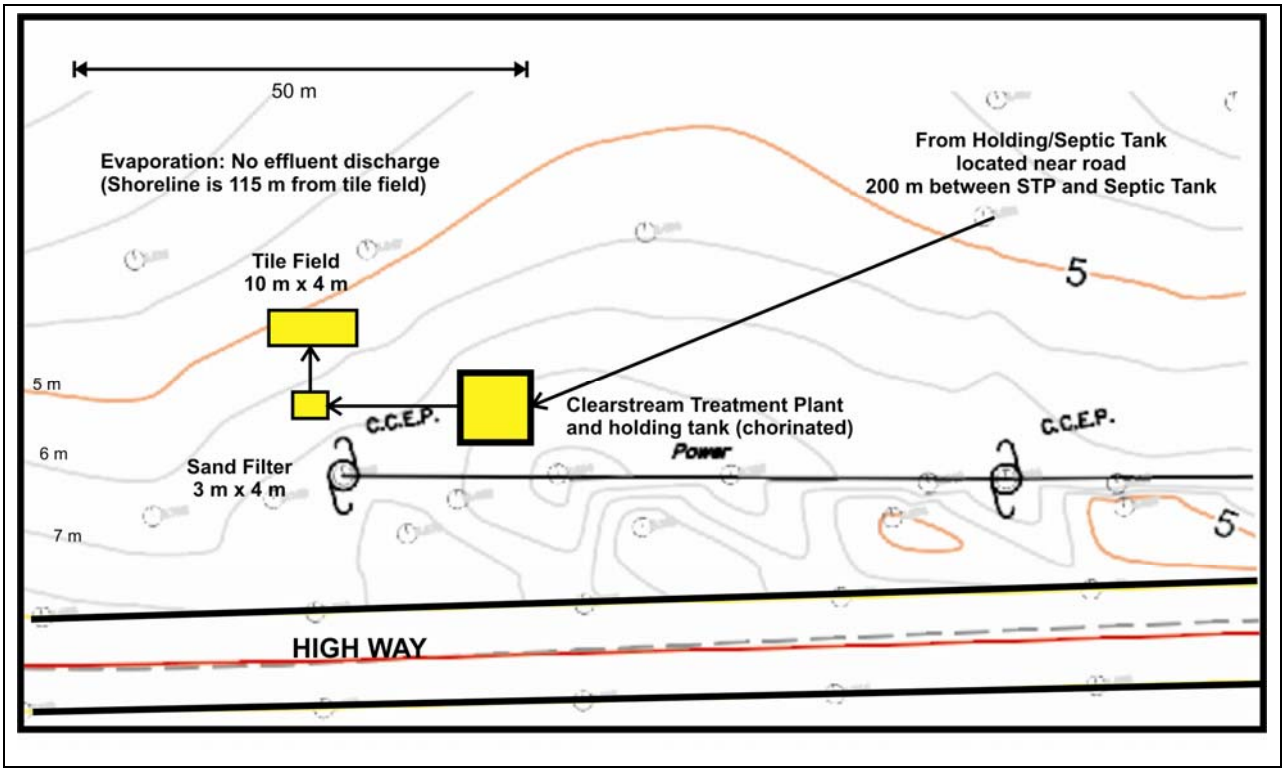
The EIA preparer shall observe the following guidelines:

- Professional opinions shall not be presented as statement of fact, and shall be avoided unless they can be substantiated by published references as is the norm in technical scientific writing.
- All bibliographic references used to substantiate statements in the report shall be listed.
- The report shall include appendices with items such as the approved TOR; raw data; and Water Quality Lab Certificates, maps, site plans, photographs, and other relevant information.
- A list of EIA preparers (including analytical facilities) and their credentials must be included.

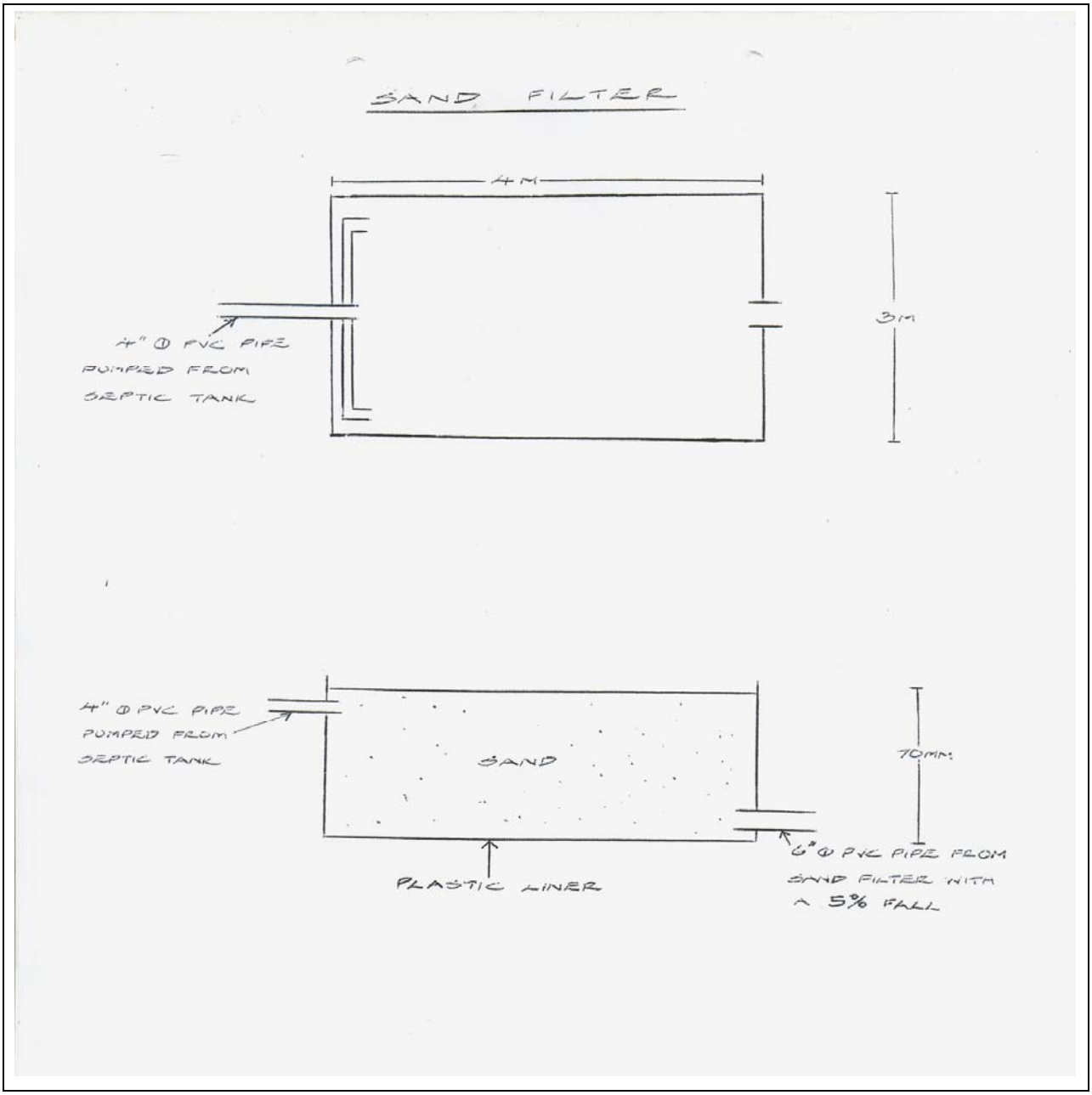
PROCESS FLOW – HANOVER STP (DOLPHIN COVE)

1. Sewage from toilets will be gravity fed to a buried 1000 gallon septic tank located with easy access to the road (for maintenance purposes).
2. Overflows from the septic tank will be collected in a holding tank and pumped up to the Clear Stream system for treatment.
3. Effluent from system will then be collected in another 1000 gallon holding tank, at which point it will be chlorinated.
4. After chlorination, the effluent will be pumped to a 4 x 3 m sand filtration system.
5. After sand filtration, the effluent will be sent to an evaporation tile field.

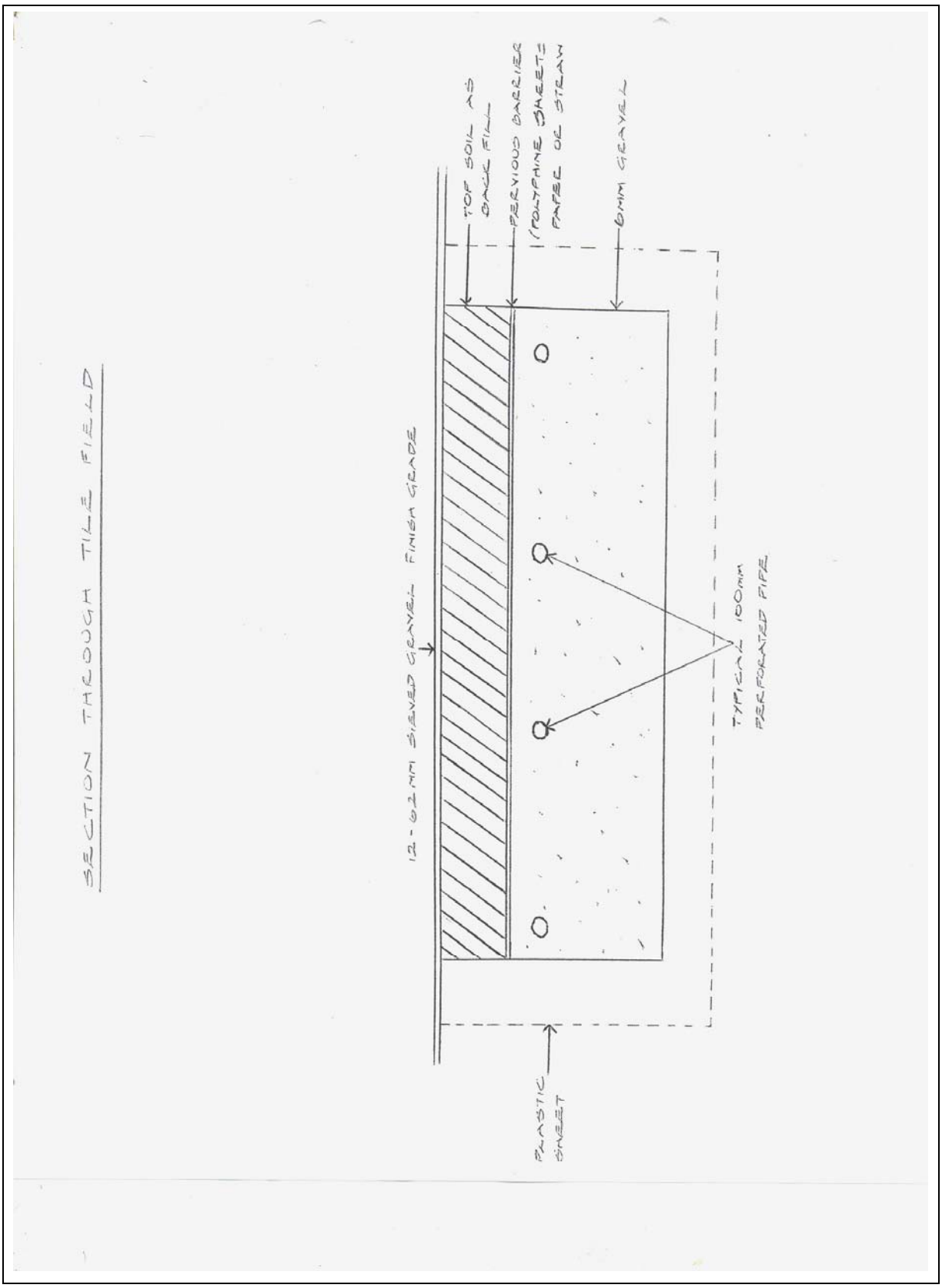
Schematic 1 (Process Flow)



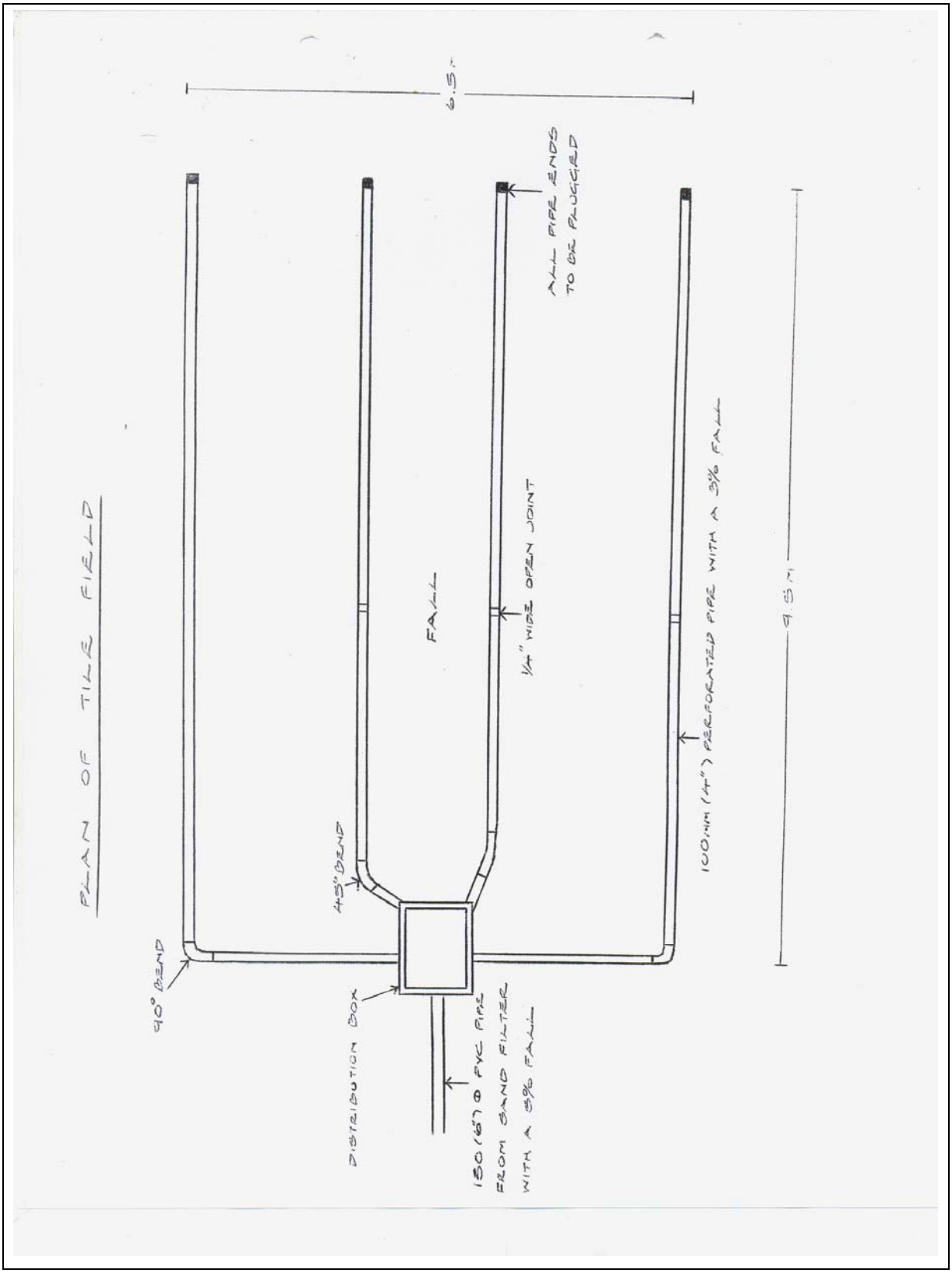
Schematic 2 (Sand Filter)



Schematic 3 (Tile Field Section)



Schematic 4 (Tile Field Plan View)



CLEARSTREAM®
WASTEWATER SYSTEMS, INC.

P. O. Box 7568 • Beaumont, Texas 77726-7568
(409) 755-1500 • Fax: (409) 755-6500 • www.clearstreamsystems.com

OWNER'S MANUAL • PARTS LIST • OPERATING MANUAL
FLOW DIAGRAM • INSTALLATION INSTRUCTIONS
DESIGN DRAWINGS AND SPECIFICATIONS
SERVICE POLICY • LIMITED WARRANTY

MODEL 500N	500 G.P.D.
MODEL 600N	600 G.P.D.
MODEL 750N	750 G.P.D.
MODEL 1000N	1000 G.P.D.
MODEL 1500N	1500 G.P.D.

NSF®

CLASS I
ANSI/NSF 40

INTRODUCTION

The Clearstream System is one of the finest aerobic wastewater systems available today. Our system converts the sewage from your residence or business into a clear, odorless liquid. This high degree of treatment is accomplished at a remarkable low operating cost per month. The system has been simplified over the years to make it as inexpensive to operate and as low in long term maintenance as possible. Homeowners who have lived with the nuisance of a septic odor lingering in their neighborhood will truly appreciate the pleasure of owning a Clearstream System. Clearstream Model N and NC* Systems used without or, in conjunction with, Clearstream Model 1100 Spin Filter comply with NSF Standard 40 for Class I systems.

PROCESS DESCRIPTION

The Clearstream Wastewater Treatment System operates in the extended aeration mode of the activated sludge process.

Wastewater enters the aeration chamber of the system through a 4" Sch. 40 PVC inlet pipe. The wastewater is then mixed throughout the aeration chamber by releasing compressed air near the bottom of the chamber through a fine bubble diffuser. The rising air bubbles transfer oxygen to the wastewater which allows aerobic organisms to thrive and ultimately decompose the incoming waste matter.

The turbulence caused by the rising air bubbles also creates a mixing pattern which keeps the sludge in suspension. As incoming wastewater enters the aeration chamber, existing "mixed liquor" from the aeration chamber is displaced into the bottom of the cone-shaped clarifier.

The clarifier chamber allows the water to still so that suspended solids in the "mixed liquor" can settle back into the aeration chamber for further biological breakdown.

The remaining clear water in the upper zone of the clarifier chamber is then discharged through the surge control weir and out the 4" Sch. 40 outlet pipe.

When properly loaded and maintained, the aforementioned process allows the Clearstream Wastewater Treatment System to provide years of satisfactory service for the consumer. Clearstream Models N and NC* systems meet the performance requirements of NSF Standard 40 Class I with a 30 day average of <25 mg/l CBOD and <30 mg/l TSS. Actual NSF test results used to determine if Clearstream met Standard 40 requirements averaged 6 mg/l BOD and 9 mg/l TSS. When Clearstream Model 1100 Spin Filter Assembly was utilized in the Standard 40 Test the results averaged 5 mg/l BOD and 6 mg/l TSS.

*NC models are concrete

OPERATING MANUAL

In the event you experience a problem with your Clearstream Aerobic Wastewater Treatment System or if service is required, you may reference the Clearstream Control Panel Cover for the name, address and phone number of a local service person that can provide service for your Clearstream Unit. After the expiration of your initial two year service policy provided by the system installer, you may obtain a continuing service policy on a yearly basis which will include terms comparable to the initial service policy from a local service person that is trained and certified by Clearstream.

In order for the Clearstream System to function at optimum performance levels, the system will require periodic service. The normally expected service that is associated with the system includes:

1. Repair or replace aerator	2 to 10 years
2. Clean filters on aerator	6 mos. to 2 years
3. Break up scum in clarifier	6 mos. to 2 years
4. Pump sludge from aeration tank	2 to 5 years*
5. Pump sludge from pretreatment tank	2 to 5 years*
6. Check aeration diffusers	annually
7. Check surge control weir	6 mos.

* Any sludge removed from pretreatment tank or Clearstream Unit must be disposed of according to all state, local, and federal regulatory requirements.

To remove solids from pretreatment tank drop pump hose through access opening on top of tank all the way through to the bottom of the tank. Pump out the whole tank volume, then fill the tank back up immediately. To remove solids from aeration chamber, drop hose through access opening in tank all the way to the bottom of the tank. Pump only 1/2 of the total tank volume and fill tank back up with water immediately.

To determine if all system components are functioning properly, look and/or listen to see if the visual/audio alarm system is illuminated or making a buzzing sound. If the alarm is activated, then either the aerator has thrown its breaker or the high level float inside the clarifier is indicating a high water level condition. Verification of either condition can be made by visually monitoring the push button breaker to see if it is in the out position indicating it has been thrown and opening the access opening to the treatment unit to see if the water level inside the clarifier is at alarm level. After inspection of the clarifier, be sure to securely fasten the access cover back in place and tighten the tamper resistant bolt or bolts firmly.

To determine if the system has the desirable “mixed liquor” and effluent characteristics, first remove the access cover. Monitor for odors coming from the tank. If the odor is a sweet or a musty smell, the system is operating in a desirable aerobic condition. If the odor is foul or smells like a rotten egg, then the system is operating in an undesirable anaerobic condition. Visually monitor the “mixed liquor” for color. If the color is a brownish color, then it is operating in a desirable aerobic condition. If it is grey or black in color, it is operating in an undesirable anaerobic condition. The system effluent should be clear with very few noticeable light brown solids suspended in the effluent. The effluent should not be dark or turbid in color or clear with great numbers of light brown suspended solids noticeable. After inspection of the system’s interior, be sure to securely fasten the access cover back in place and tighten the tamper resistant bolt or bolts firmly.

In the event the alarm panel light and buzzer activated, call your local servicing dealer whose name, address, and phone number should be affixed to the face of the panel.

To collect effluent samples from a system, a sample port must be added downstream of the effluent discharge. The sample port should be installed so that effluent cannot remain below the discharge water line and build up solids. A sample bottle should be capable of being lowered into the port on a string and laid on its side in the direct flow line of the discharge and removed when full of effluent.

The expected effluent from the system should be less than 25 mg/l CBOD and less than 30 mg/l TSS with a PH range of 6-9.

For the first two (2) years from the date of installation, your local servicing dealer (from whom you purchased your Clearstream System) will make periodic inspections of your system to make sure it is functioning properly. The dealer will perform necessary maintenance to the system at no charge unless the required maintenance is not warranty related. Pumping of the system is not included. After the first two (2) years, the dealer will offer a continuing service policy for a nominal annual fee. The two (2) year service policy and the continuing service policy are minimum requirements of the NSF International. If local service requirements are greater than those of NSF, or if the local regulations require others to perform the service on these units, Clearstream's limited warranty will still be honored.

For the Clearstream Aerobic Wastewater Treatment Unit to function properly it must be used for the treatment of domestic wastewater from residences or other waste flows with similar loading characteristics. Typical domestic wastewater consists of the flow from toilets, lavatories, sinks, bathtubs/showers, and washing machines. To prevent malfunctions of your Clearstream Unit, the following guidelines should be followed:

1. Any sewage system, whether aerobic or septic, should not have inorganic materials (plastics, cigarette butts, throwaway diapers, feminine napkins, condoms, etc.), that the bacteria cannot consume, discharged into the system.

2. Large amounts of harsh chemicals, oil, grease, high sudsing detergents, discharge from water softeners, disinfectants or any other chemical or substance that kills bacteria should not be discharged into the system.

3. Excessive use of water, over the design flow of the system, or organic overloading in excess of design parameters will cause the system not to perform to its fullest capabilities.

4. The proper operation of this or any other sewage treatment system depends upon the proper organic loading and the life of the micro-organisms inside the system. Clearstream is not responsible for the in-field operation of a system, other than the mechanical and structural workings of the system itself. Field abuse and overloading of the system can only be cured by the user of the system.

5. When wastewater discharge, into a Clearstream Unit, is seasonal or intermittent to a point that the owner wishes to turn off the electricity (for more than three (3) months) to the aerator, the aerator inlet and outlet should be sealed to keep out moisture until the unit is ready to be restarted.

CLEARSTREAM INSTALLATION INSTRUCTIONS

Before installation of the Clearstream Treatment Tank, first install a pretreatment tank (septic tank) with a volume of not less than 50% of the gallon per day rating of the Clearstream Unit. Pretreatment tanks shall comply with minimum sizing specifications outlined in the Clearstream specifications section.

CLEARSTREAM TANK INSTALLATION

1. Prepare an excavation having minimum dimensions of at least one (1) foot larger than the diameter of the tank. Make sure the depth of the excavation is deep enough to allow gravity flow to the inlet of the system and that the excavation bottom is level. Never install the Clearstream tank deeper than a depth that will require more than a maximum of 18 inches of riser depth. The access cover shall always be above final grade after tank installation. In applications where more than the maximum 18 inches of riser is required, install a lift pump upstream of the Clearstream tank in order to pump the pretreatment tank effluent to the Clearstream tank at normal grade. In these special applications where a lift pump is required, contact Clearstream for more details as to pump size, maximum dosages and maximum flow rates.

2. Set the Clearstream tank in a prepared excavation that has a solid, level bottom that will eliminate tank settling. The excavation bottom should have no rocks or sharp objects present.

3. When lowering a fiberglass tank into the prepared excavation use the lifting eyes, which are bolted into the tank top. When lowering a concrete tank into the prepared excavation use a spreader bar or nylon sling. Only spreader bars and other lifting devices, that have been designed and tested for lifting Clearstream concrete tanks, should be used. Never lift fiberglass or concrete Clearstream tanks unless they are empty of all liquids.

4. Make sure the inlet 4” Sch. 40 PVC pipe is aligned properly to incoming sewage line and that the outlet 4” Sch. 40 PVC pipe is aligned to the downstream discharge line. Before setting the tank in the prepared excavation, open the access cover and verify that the inlet and outlet pipes are aligned correctly.

5. For the Clearstream Unit to function properly, the tank must be level. To properly level the tank, remove the access cover and lay a three (3) foot level across the access opening in several directions. Shift the tank in the hole, as necessary, to make the tank level in all directions. The tank may be slightly out of level, but it should not be out of level enough to cause tank malfunctions.

6. Fill the tank with water, checking periodically to make sure the tank remains level.

7. Connect the 4” Sch. 40 PVC Clearstream inlet pipe to the outlet pipe from the pretreatment tank. Make sure the pretreatment tank outlet pipe is level with or higher than the inlet pipe to the Clearstream Unit. The 4” Sch. 40 PVC outlet pipe from the Clearstream Unit should now be connected to the discharge line. The Clearstream Unit should only be connected to a plumbing system from a wastewater source which has been properly trapped and vented in compliance with State and Local plumbing codes.

8. Back fill the excavation in layers with back fill material that will settle properly around the tank. Tamp the back fill material as each layer is placed around the tank. If necessary, use water to help settle the soil around the tank. Special care should be taken to either tamp soil under where inlet and outlet pipes are bridging the excavation or use some other method of supporting pipes across the excavation. Do not back fill with heavy clay or large rocks.

9. Before completing the back fill, be sure the signal wire conduit from the alarm float to the Control Panel has been laid underground.

10. For below normal grade installations a Clearstream 20 inch diameter riser may be used on all models except the 1500 G.P.D. unit. The 1500 G.P.D. unit must use a 32 inch diameter riser. In no case shall more than 12 inches of additional riser depth be used on a single Clearstream Unit to bring the access cover above final grade. All risers must be sealed with silicone to prevent ground water intrusion before back fill is completed.

11. Before leaving excavation site, be sure to securely fasten the Clearstream access cover in place with the tamper resistant bolt(s). Tighten bolts firmly to keep unauthorized personnel from gaining access to the inside of tank.

CLEARSTREAM AERATOR AND CONTROL PANEL INSTALLATION

1. Mount one of the Clearstream Control Panel Model series CS-114 in a location that can be easily noticed by the occupants.

2. Wire 115 Volt, 60Hz power from an electrical disconnect to Clearstream Control Panel. Wire from Control Panel to Aerator and High Level Alarm Float. When discharge pump is used, wire power to pump tank and pump tank alarm float. Use wiring diagram provided for each version of the Clearstream Control Panel Model series. All electrical wiring should be installed by a qualified person in compliance with applicable section of the National Electrical Code or other more stringent local codes.

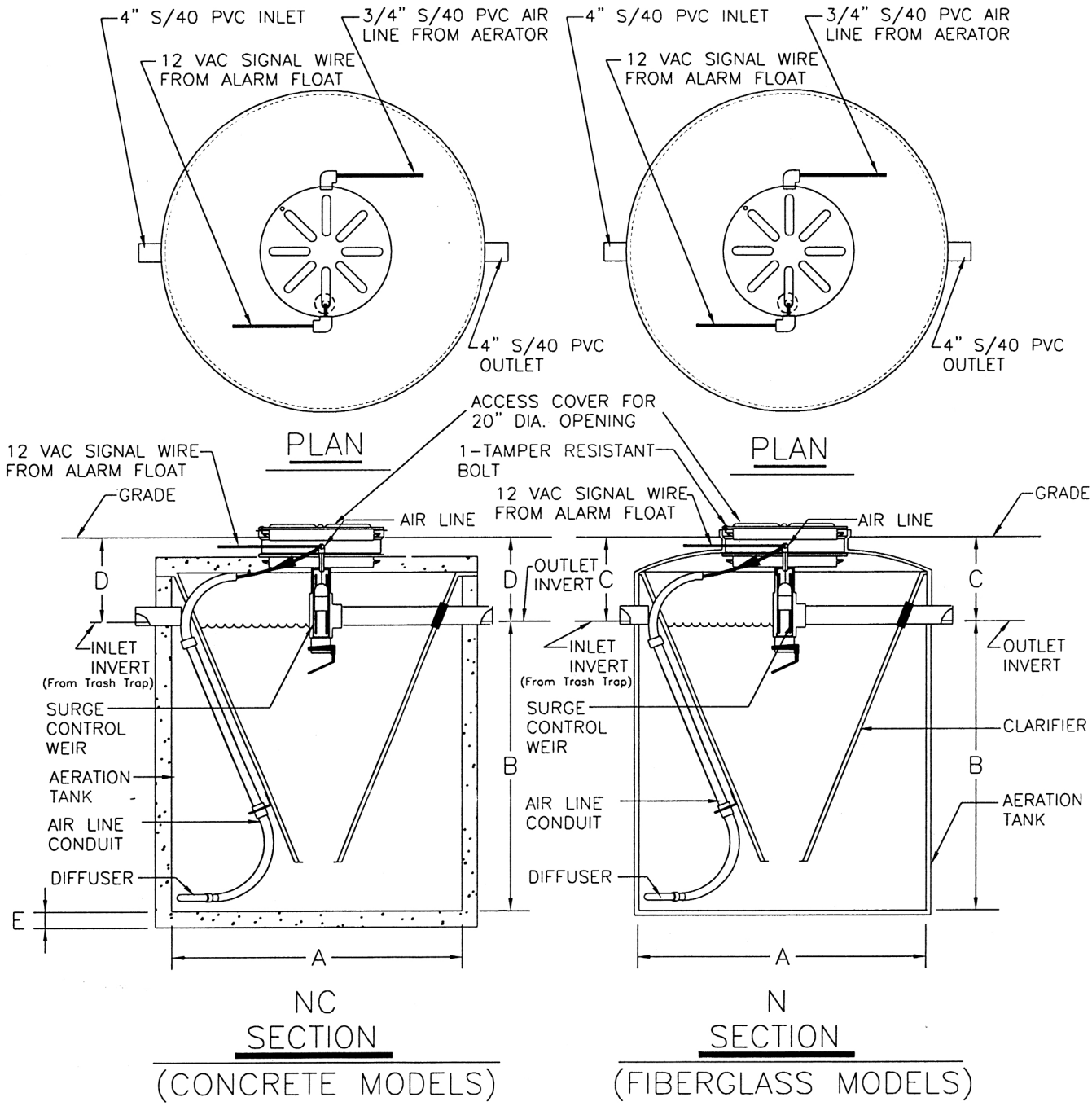
3. Install Aerator Model CS-103 as close as practical to the tank, but in no case greater than one hundred (100) feet away (50’ on 1500 G.P.D. unit). Run 3/4” Sch. 40 PVC air line from aerator connector to air line connection at Clearstream tank. Be careful to back fill underground air line in manner which will not cause air line to leak. Aerator must be installed in a location that is dry, non-dusty, and highly ventilated.

4. Turn power on at electrical disconnect and check for proper system operation.

COMPLIANCE WITH LAWS

The Clearstream Unit must never be installed without first obtaining all permits and approval from the local regulatory body. In areas that do not have local control over environmental activities, all applicable State and Federal environmental codes must be adhered to as well. Only properly licensed and trained individuals should install Clearstream equipment.

DESIGN DRAWINGS



MODEL	A	B	C	D	E
500N/NC	5'-3"	5'-3"	1'-7½"	1'-4¾"	3"
600N/NC	6'-4"	4'-7"	1'-5½"	1'-5¾"	3"
750N/NC	6'-4"	5'-5"	1'-7½"	1'-5¾"	3"
1000N/NC	6'-4"	7'-3"	1'-5¾"	1'-5¾"	3"
1500N/NC	8'-0"	6'-10"	2'-0"	1'-7¾"	4"

U.S. Patent Numbers
5,221,470
5,770,081
5,785,854

SPECIFICATIONS
Clearstream Units

Model 500N

Treatment Capacity	500 G.P.D.
BOD Loading	1.25 lbs. BOD
Aerator (Model CS-103EL)	2.4 scfm
✷Aerator (Model CS-103E)	2.4 scfm
Control Panel (Model CS-114A,AP,AT,AN)	Raintight
Electrical	115v./60Hz/.75 amps/82 watts
✷Electrical	115v./60Hz/3.8 amps/151 watts

Model 600N

Treatment Capacity	600 G.P.D.
BOD Loading	1.5 lbs. BOD
Aerator (Model CS-103EL)	2.8 scfm
✷Aerator (Model CS-103E6)	2.8 scfm
Control Panel (Model CS-114B,BP,BT,BN)	Raintight
Electrical	115v./60Hz/.75 amps/82 watts
✷Electrical	115v./60Hz/3.8 amps/157 watts

Model 750N

Treatment Capacity	750 G.P.D.
BOD Loading	1.85 lbs. BOD
Aerator (Model CS-103FL)	3.6 scfm
✷Aerator (Model CS-103F)	3.6 scfm
Control Panel (Model CS-114C,CP,CT,CN)	Raintight
Electrical	115v./60Hz/1.05 amps/120 watts
✷Electrical	115v./60Hz/4.7 amps/195 watts

Model 1000N

Treatment Capacity	1000 G.P.D.
BOD Loading	2.5 lbs. BOD
Aerator (Model CS-103G)	4.8 scfm
Control Panel (Model CS-114D,DP,DT,DN)	Raintight
Electrical	115v./60Hz/4.7 amps/220 watts

Model 1500N

Treatment Capacity	1500 G.P.D.
BOD Loading	3.75 lbs. BOD
Aerator (Model CS-103H)	7.2 scfm
Control Panel (Model CS-114E,EP,ET,EN)	Raintight
Electrical	115v./60Hz/6.58 amps/425 watts

Pretreatment Tank

Minimum Capacity	½ Plant design flow
Minimum Liquid Depth	30 inches
Four Inch Inlet Tee Baffle Discharge	6 inches below liquid level
Four Inch Outlet Tee Baffle Intake	25% to 50% of liquid level

Inlet flow line must be a minimum of two (2) inches higher than the outlet flow line.

✷Alternate aerator option

PARTS LIST AND FLOW DIAGRAM

PART NAME	PART NUMBER
1. AIR SUPPLY HOSE ASSEMBLY	CS-101
2. ALARM FLOAT	CS-102
3. ROTARY VANE AERATOR (OPTIONAL)	CS-103(E,E6,F,G,H)
4. LINEAR AERATOR	CS-103(EL,FL)
5. EXTERNAL AIR FILTER	CS-104
6. INTERNAL AIR FILTER	CS-106
7. TINNERMAN FASTENER (1500N ONLY)	CS-110
8. FRP 32" DIA. EXTENSION (1500N ONLY)	CS-115
9. NAMEPLATE	CS-107
10. ACCESS COVER	CS-108
11. TAMPER RESISTANT BOLT	CS-109
12. CHECK VALVE	CS-105
13. FLOW CONTROL WEIR	CS-111(A,B,C,D,E)
14. TANK	CS-112
15. DIFFUSER	CS-113
16. ALARM PANEL	CS-114(A,B,C,D,E)
17. POLY 20" DIA. EXTENSION	CS-116(A,B,C)

COMPONENT PARTS MAY BE OBTAINED FROM:
YOUR LOCAL SERVICING DEALER:

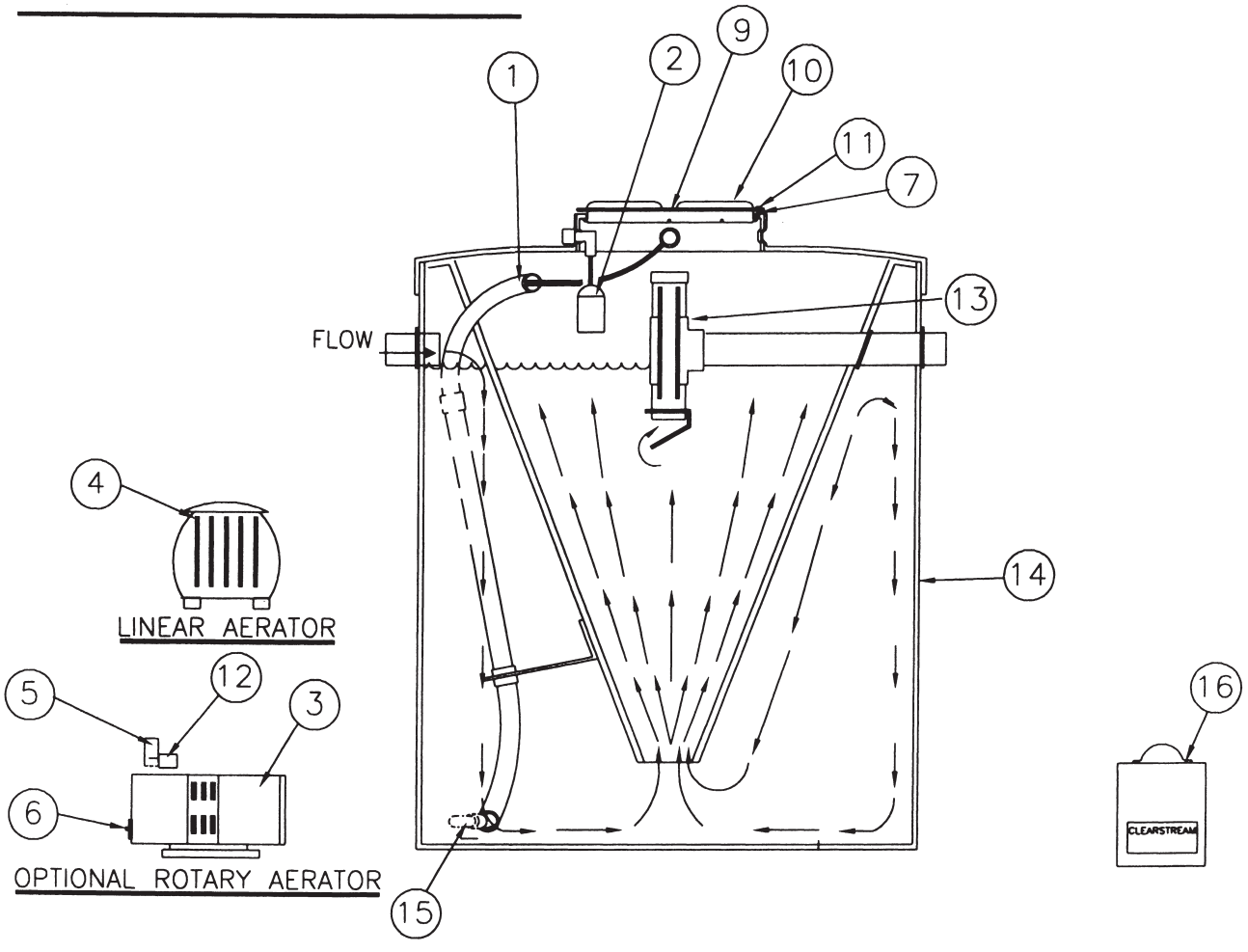
_____

_____

_____

OR

CLEARSTREAM WASTEWATER SYSTEMS, INC.
PO BOX 7568
BEAUMONT, TEXAS 77726-7568
409-755-1500 FAX: 409-755-6500



TWO YEAR INITIAL SERVICE POLICY

Date_____

Our firm, _____, will inspect and service your Clearstream System for the first two years from the date of installation. There will be _____ inspections made each year for this initial two year period. Effluent quality inspection will include a visual inspection for color, turbidity, sludge build up, scum overflow, and odor. Mechanical and electrical inspection and service include: inspecting aerator, air filter, and alarm panel and replacing or repairing any component not found to be functioning correctly.

Upon expiration of this policy, our firm will offer a continuing service policy on a yearly basis to cover labor for normal maintenance and repairs on a year by year basis.

Violations of warranty include: shutting off the electric current to the system for more than 24 hours, disconnecting the alarm system, restricting ventilation to the aerator, overloading the system above its rated capacity, or introducing excessive amounts of harmful matter into the system, or any other form of unusual abuse.

THIS POLICY DOES NOT INCLUDE PUMPING
SLUDGE FROM UNIT IF NECESSARY.

Service Dealer: Owner:

_____ _____

_____ _____

_____ _____

LIMITED WARRANTY

Clearstream Wastewater Systems, Inc. warrants each Clearstream Aerobic Wastewater Treatment System to be free from defects in material and workmanship for a period of two (2) years from the date of sale to the original retail consumer when properly registered with Clearstream. Clearstream's sole obligation under this warranty is as follows: Clearstream shall fulfill this warranty by repairing or exchanging any component part, F.O.B. Factory, that shows evidence of defects, provided said component part has been paid for, warrantee has notified Clearstream of the defect complained of and the component is returned through an authorized Purchaser, transportation prepaid. There is no informal dispute settlement available under this LIMITED WARRANTY.

No warranty is made as to the field performance of any system. This LIMITED WARRANTY applies only to the parts manufactured by Clearstream and does not include any portion of the plumbing, drainage, disposal system or installation of the systems. Site specific designs of treatment and disposal systems, including treatment plant and disposal system sizing is not the responsibility of Clearstream and is not covered by this LIMITED WARRANTY. Accessories supplied by Clearstream, but manufactured by others, are warranted only to the extent of and by the terms and conditions of the original manufacturer's warranty. In no event shall Clearstream be responsible for delay or damages of any kind or character resulting from, or caused directly or indirectly by, defective component or materials manufactured by others.

Recommendations for special applications will be based on the best available expertise of Clearstream and published industry information. Such recommendations do not constitute a warranty of satisfactory performance.

The LIMITED WARRANTY extends to the original retail consumer of the product. As herein, original retail consumer is defined as the purchaser who first has the plant installed, or in the case of a system designed for non-permanent installation, the purchaser who first uses the system. It is the purchaser's, or any sub-vendee's, obligation to make known to any other consumer the terms and conditions of this warranty.

This warranty is a LIMITED WARRANTY and no claim of any nature shall be made against Clearstream unless and until the original retail consumer, or his legal representative, notifies Clearstream in writing of the defect complained of and delivers the product and/or defective part(s), freight prepaid, to Clearstream or an authorized service station.

Clearstream reserves the right to revise, change, or modify the construction and design of the Clearstream Aerobic Treatment System, or any component part or parts thereof, without incurring any obligation to make such changes or modifications in equipment previously sold. Clearstream also reserves the right, in making replacements of component parts under this warranty, to furnish a component which, in its judgement is equivalent to the part replaced.

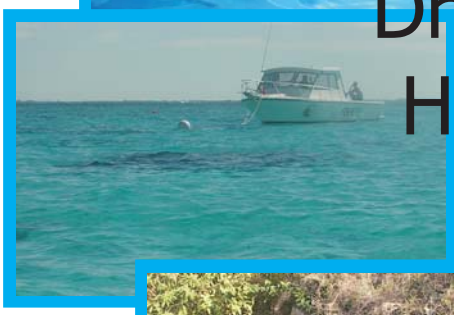
To the extent that the LIMITED WARRANTY statements herein are inconsistent with the locality where Purchaser used the Clearstream system, the warranties shall be deemed to be modified consistent with such local law. Under such local law, certain limitations may not apply. For example, some states in the United States and some jurisdictions outside the United States may: (i) preclude the disclaimers and limitations of these warranties from limiting the rights of a consumer; (ii) otherwise restrict the ability of a manufacturer to make such disclaimers or to impose such limitations; or (iii) grant the consumer additional legal rights, specify the duration of implied warranties which the manufacturer cannot disclaim, or prohibit limitations on how long an implied warranty lasts.

In no event and under no legal theory, including without limitation, tort, contract, or strict product liability, shall Clearstream or any of its suppliers be liable to the other party for any indirect, special, incidental, or consequential damages of any kind, including without limitation, damages for loss of goodwill, or any other kind of commercial damage, even if the other party has advised Clearstream of the possibility of such damages.

CLEARSTREAM WASTEWATER SYSTEMS, INC.
P. O. Box 7568 • Beaumont, Texas 77726-7568
Phone: (409) 755-1500 • Fax: (409) 755-6500 • www.clearstreamsystems.com

Report

on the



Drainage Aspects of the Hanover Dolphin Cove Development

Submitted to

Dolphin Cove Ltd.

By

SMITH WARNER INTERNATIONAL
COASTAL ENVIRONMENT

In association with
Beckford and Dixon Ltd.

March 2007

Table of Contents

1. Introduction

The purpose of this hydrologic study is to determine the level of protection offered by the proposed drainage swale through the Dolphin Cove development in Hanover, in conjunction with the 2.5m high berm, for a number of storm events. Of prime concern in this evaluation is the fact that the contributing watershed is presently characterised by rural pasture and woodlands, and that development of this area is likely to occur over time. As such, the watershed has been analysed for existing and future conditions, in order to determine the effectiveness of the proposed swale.

The proposed Dolphin Cove site in Paradise, Hanover is bound by the Caribbean Sea to the north, the Montego Bay to Lucea highway to the south and drainage ditches leading into the small coves on the east and west. The watershed contributing runoff to Dolphin Cove (Figure 1) covers approximately 32 hectares of pasture or grassland with large trees in the upper reaches. This runoff crosses the highway in three culverts, the easternmost and largest being 900mm in diameter, and the other two 600mm in diameter. The watershed was divided into three sub watersheds for computational purposes.

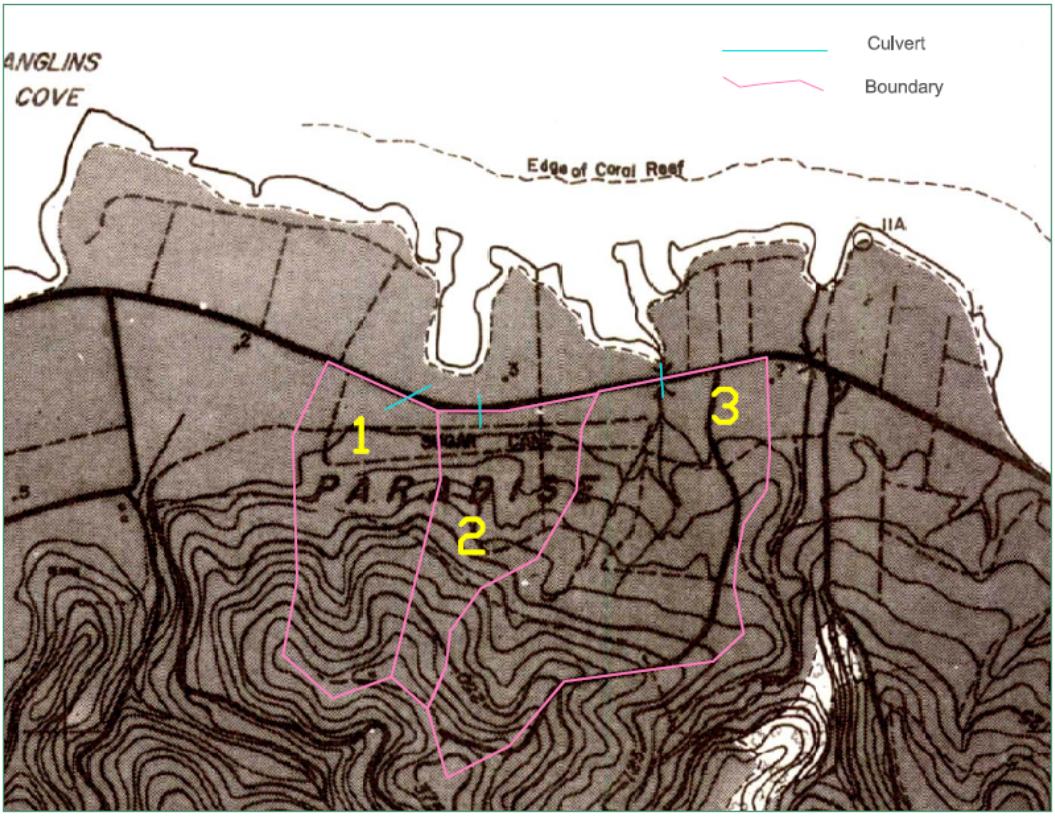


Figure 1: Watershed Boundaries

2. Hydrology

The soil types within this watershed are Hall's Delight Channery Clay Loam in the upper reaches and Highgate Clay in the lower section closer to the highway. The Clay Loam experiences rapid internal drainage, while Highgate Clay has very slow internal drainage. The existing soil characteristics and vegetative cover lead to a composite Curve Number (CN) of 58 Antecedent Moisture Condition II. This curve number is used with the Jamaica II method for determining the time of concentration. Based on the small watershed area, the Rational Method is used with the Sangster International Airport intensity-duration frequency curves to determine the peak discharge through each culvert.

The Jamaica 1:12,500 map series (21C with 25 foot contour intervals) was used to determine the watershed boundaries and slopes.

Table 1: Rational Method - Flow Computations

Sub-Watershed	Area (Hectares)	Time of Concentration (min)	Q_5 m^3/s	Q_{10} m^3/s	Q_{25} m^3/s	Q_{50} m^3/s
1	8.34	36	0.86	1.03	1.2	1.35
2	6.68	35	0.72	0.84	1.0	1.09
3	16.81	39	1.67	1.99	2.36	2.6

The sub watersheds were also analyzed using the Soil Conservation Service Technical Release 20 method (SCS TR-20); using the curve number lag time for Time of Concentration and Type II rainfall distribution curves. Hydrographs were produced for each of the design storms, and the peak discharges are listed in Table 2 using this latter method.

Table 2: SCS TR-20 - Flow computations

Sub-watersheds	Area (Hectares)	Time of Concentration (min)	Q_5 m^3/s	Q_{10} m^3/s	Q_{25} m^3/s	Q_{50} m^3/s
1	8.34	27	0.76	1.14	1.67	2.1
2	6.68	24.7	0.65	0.97	1.42	1.78
3	16.81	29.9	1.44	2.15	3.15	3.95

The times of concentration predicted by the CN lag time method are shorter than those predicted by the Jamaica II method and the peak discharges predicted by both methods for the five year (5 yr) and ten year (10 yr) events are within twenty percent (20%) of each other. The SCS method yields a higher peak discharge for the larger storm events (25 and 50 yr).

3. Culvert Performance

The performance of the in-place culverts has been estimated, since the inlet elevations of the culverts were estimated based on their distances below the road surface.

Figure 2: Inlet of Culvert 1 (600mm in diameter, East of Bosung yard)

The outlet for sub- watershed 1 is a 600mm diameter reinforced concrete pipe (RCP) with headwall. The culvert inlet is approximately 3m below the road and discharges into the West Cove. Depression storage at the inlet was not taken into account in the computations. Based on a headwater of 3m, this culvert should be able to convey 1.22 m^3/s without overtopping the road. If the discharge is larger than the culvert can handle, it is likely that some runoff will fill up the ditches then flow to the east to be picked up by the other culverts conveying flow from sub watersheds 2 and 3. Although it discharges into the West Cove, it should have little influence on the performance of the proposed swale as it should flow into low spots on the south and west sides of West Cove.

The outlet for sub watershed 2 also flows directly into West Cove. This RCP culvert is approximately 20m long and 600mm in diameter. The inlet elevation is estimated at 5.93 m and will convey 0.90 m^3/s without overtopping the road. Any discharge in excess of this will likely flow towards culvert 3 before overtopping the road.

Figure 3: Outlet of Culvert 2 (600mm in diameter) - to West Cove

Figure 4: Inlet of culvert 3, 900mm in diameter

The outlet for Sub watershed 3 is approximately 11m long and 900mm in diameter. The outlet was partially submerged during the field visit. This culvert is expected to convey close to 2.32 m^3/s without overtopping the road.

Figure 5: Submerged outlet of culvert 3

If accurate inlet elevations are used, it is possible that culverts 2 and 3 are expected to convey the 25 year peak discharges predicted by the rational method computations. The road elevation does not provide the head water requirements to prevent overtopping of the road during the 50-yr storm.

4. Proposed Swale

In order to evaluate the performance of the proposed swale it is necessary to rout hydrographs through the culverts and into the swale. The swale was analyzed as a retention pond with banks 2.5m above mean sea level (AMSL) and a rectangular weir outlet at 0.3m AMSL to adjust for tail water effects of the mangrove. The culverts were also analyzed as catch basins (limited storage ponds) with pipe outlets and no overtopping.

Table 3: Proposed Swale

Return period	peak inflow m^3/s	peak outflow m^3/s	lag time (min)	peak elevation (m)
5-yr	2.77	2.67	3.4	0.69
10-yr	4.15	4.01	3.3	0.81
25-yr	6.05	5.86	3.2	0.96
50-yr	7.6	7.35	3.3	1.062

The evaluation indicates that the proposed swale should accommodate the discharges of all four storm events as long as the outlet is free and tail water effects produced by the cove are not above 1 m.

5. Future Development

If the watershed were to become urbanized, the runoff will increase. Because the land is likely to become residential, the composite runoff coefficient (Rational Formula) could increase from 0.5 to 0.75. The channel velocities will increase and reduce the Times of Concentration. Estimates of the peak discharges produced in the sub-watersheds are shown in Table 4.

Table 4: Rational Method – Future Peak Discharges

Sub-watersheds	Area (Hectares)	Time of Concentration (min)	Q_5 m^3/s	Q_{10} m^3/s	Q_{25} m^3/s	Q_{50} m^3/s
1	8.34	18	1.91	2.27	2.72	3.06
2	6.68	16	1.64	1.94	2.3	2.61
3	16.81	20	3.64	4.41	5.17	5.83

Any future development should be accompanied by improvements to the culvert outlets. The proposed swale was analyzed for one future development scenario using SCS TR-20 method (CN of 82) and showed the following peak elevations. It can be seen that the berm height of the swale will be adequate to accommodate the flood flows generated in this scenario.

Table 5: SCS TR-20 - Future Peak Discharges

Sub-watersheds	Area (Hectares)	Time of Concentration (min)	Q_5 m^3/s	Q_{10} m^3/s	Q_{25} m^3/s	Q_{50} m^3/s
1	8.34	18	2.53	3.17	3.99	4.6
2	6.68	16	1.76	2.21	2.77	3.02
3	16.81	20	5.04	6.29	7.92	9.16

Table 6: Proposed Swale – Future development

Return period	peak inflow	peak outflow	lag time (min)	peak elevation (m)
5-yr	6.69	6.33	3	0.99
10-yr	8.79	8.3	3	1.126
25-yr	11.53	10.88	3	1.286
50-yr	13.67	12.88	3.1	1.402

6. Effects of Upstream Watershed

The effects of the upstream watershed depend both on the culvert capacity and the road profile in the vicinity of Dolphin Cove. Presently, the carrying capacity of all three culverts is close to the 25-yr peak discharge. Any additional discharge will overtop the roadway at its lowest point which appears to be close to the existing 900mm culvert. The discharge from sub-watershed 1 that is not conveyed by the culvert will flow along the ditch to sub watersheds 2 and 3 before overtopping the road at the low-point. The excess discharge from sub-watershed 2 will also flow along the ditch to sub-watershed 3 before overtopping the road. The culverts may carry the 25-yr flows but will not carry the 50-yr peak discharge.

If the watershed is urbanized, the existing culverts will not be able to handle the 5- yr storm event. If the watershed is urbanized and capacity improvements are made to the outlet structures (increased culvert size and capacity and/or significant watershed storage) then it is expected that the proposed swale and berm will protect the Dolphin Cove from the discharge under the road. If no capacity improvements are made to the outlet structures then the road will act as a weir and the overtopping flows may not be controlled by the berm as it is approximately 0.4m below the road surface. In order to protect Dolphin Cove from overtopping flows the berm should be tied into the bank of the road where the profile is rising, close to the 3.239m spot height by the bench mark shown in the diagram below. This will allow the sag to convey the flows into the swale.

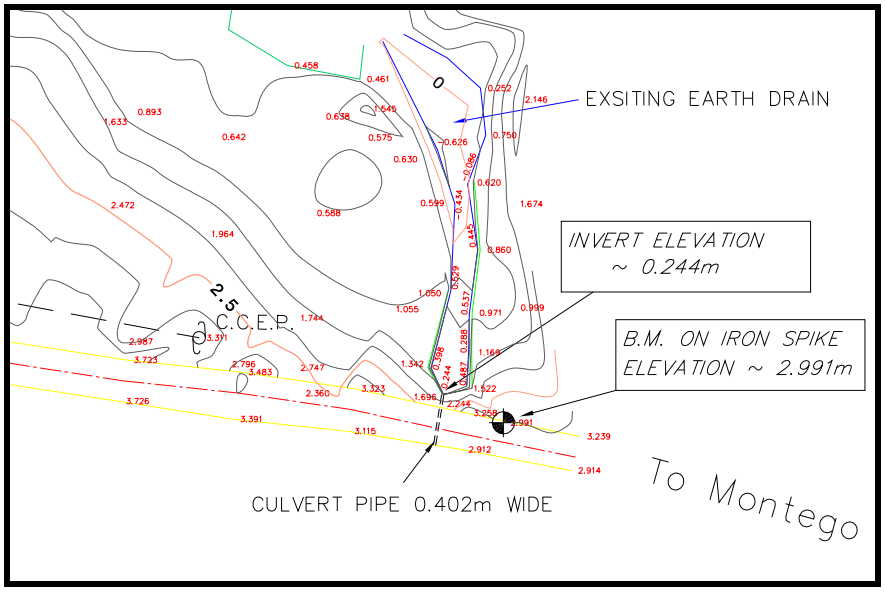


Figure 6: Elevations at road low point

Appendices

CURRENT DATE: 03-22-2007 FILE DATE: 03-22-2007

CURRENT TIME: 14:23:34 FILE NAME: WEST COVE

FHWA CULVERT ANALYSIS

HY-8, VERSION 6.1

SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
INLET ELEV. (m)	OUTLET ELEV. (m)	CULVERT LENGTH (m)	BARRELS SHAPE MATERIAL	SPAN (mm)	RISE (mm)	MANNING n	INLET TYPE
NO. 1	5.93	4.50	21.05	1 RCP	600	600	.012	CONVENTIONAL

SUMMARY OF CULVERT FLOWS (m3/s) FILE: WEST DATE: 03-22-2007

ELEV (m)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
7.47	0.9	0.8	0.0	0.0	0.0	0.0	0.0	0.00	30
7.51	1.0	0.9	0.0	0.0	0.0	0.0	0.0	0.00	30
7.55	1.0	0.9	0.0	0.0	0.0	0.0	0.0	0.00	30
7.58	1.1	0.9	0.0	0.0	0.0	0.0	0.0	0.00	30
7.61	1.1	0.9	0.0	0.0	0.0	0.0	0.0	0.24	28
7.61	1.2	0.9	0.0	0.0	0.0	0.0	0.0	0.30	8
7.61	1.2	0.9	0.0	0.0	0.0	0.0	0.0	0.30	2
7.61	1.3	0.9	0.0	0.0	0.0	0.0	0.0	0.42	9
7.61	1.4	0.9	0.0	0.0	0.0	0.0	0.0	0.48	7
7.61	1.4	0.9	0.0	0.0	0.0	0.0	0.0	0.53	6
7.62	1.5	0.9	0.0	0.0	0.0	0.0	0.0	0.59	6
7.60	0.9	0.9	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: WEST DATE: 03-22-2007

HEAD ELEV (m)	HEAD ERROR (m)	TOTAL FLOW (m3/s)	FLOW ERROR (m3/s)	% FLOW ERROR
7.47	-0.001	0.90	0.06	6.26
7.51	-0.001	0.96	0.10	10.80
7.55	-0.001	1.02	0.15	14.71
7.58	-0.001	1.08	0.20	18.22
7.61	0.000	1.14	0.01	0.87
7.61	0.000	1.20	0.01	0.90
7.61	0.305	1.20	0.01	0.90
7.61	0.000	1.32	0.01	0.88
7.61	0.000	1.38	0.01	0.78
7.61	0.000	1.44	0.01	0.94
7.62	0.000	1.50	0.01	0.89

<1> TOLERANCE (m) = 0.003 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 03-22-2007 FILE DATE: 03-22-2007

CURRENT TIME: 14:23:34 FILE NAME: WEST

PERFORMANCE CURVE FOR CULVERT 1 - 1(600 mm BY 600 mm) RCP

DIS- CHARGE FLOW (m3/s)	HEAD- WATER ELEV. (m)	INLET CONTROL DEPTH (m)	OUTLET CONTROL DEPTH (m)	FLOW TYPE <F4>	NORMAL DEPTH (m)	CRIT. DEPTH (m)	OUTLET DEPTH (m)	TW DEPTH (m)	OUTLET VEL. (m/s)	TW VEL. (m/s)
0.84	7.47	1.54	1.54	5-S2n	0.30	0.58	0.33	-4.50	5.32	0.00
0.86	7.51	1.58	1.58	5-S2n	0.30	0.58	0.33	-4.50	5.32	0.00
0.87	7.54	1.62	1.62	5-S2n	0.30	0.59	0.34	-4.50	5.38	0.00
0.88	7.58	1.65	1.65	5-S2n	0.30	0.59	0.34	-4.50	5.37	0.00
0.89	7.61	1.68	1.68	5-S2n	0.30	0.59	0.34	-4.50	5.37	0.00
0.89	7.61	1.68	1.68	5-S2n	0.30	0.59	0.34	-4.50	5.37	0.00
0.89	7.61	1.68	1.68	5-S2n	0.30	0.59	0.34	-4.50	5.37	0.00
0.89	7.61	1.68	1.68	5-S2n	0.30	0.59	0.34	-4.50	5.37	0.00
0.89	7.61	1.68	1.68	5-S2n	0.30	0.59	0.34	-4.50	5.37	0.00
0.89	7.61	1.68	1.68	5-S2n	0.30	0.59	0.34	-4.50	5.37	0.00
0.89	7.61	1.69	1.69	5-S2n	0.30	0.59	0.34	-4.50	5.37	0.00

El. inlet face invert 5.93 m El. outlet invert 4.50 m

El. inlet throat invert 0.00 m El. inlet crest 0.00 m

***** SITE DATA ***** CULVERT INVERT **************

INLET STATION	0.00 m
INLET ELEVATION	5.93 m
OUTLET STATION	21.00 m
OUTLET ELEVATION	4.50 m
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0681
CULVERT LENGTH ALONG SLOPE	21.05 m

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	600 mm
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE WITH HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 03-22-2007 FILE DATE: 03-22-2007

CURRENT TIME: 14:23:34 FILE NAME: WEST

TAILWATER

CONSTANT WATER SURFACE ELEVATION

0.00

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	8.84 m
CREST LENGTH	200.00 m
OVERTOPPING CREST ELEVATION	7.60 m

CURRENT DATE: 03-21-2007 FILE DATE: 03-21-2007

CURRENT TIME: 15:37:08 FILE NAME: DOLPHIN COVE

FHWA CULVERT ANALYSIS

HY-8, VERSION 6.1

	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
CULVERT NO.	INLET ELEV. (m)	OUTLET ELEV. (m)	CULVERT LENGTH (m)	BARRELS SHAPE MATERIAL	SPAN (mm)	RISE (mm)	MANNING n	INLET TYPE
1	0.70	0.24	11.01	1 RCP	900	900	.012	CONVENTIONAL
2								
3								

SUMMARY OF CULVERT FLOWS (m3/s) FILE: DOLPHIN DATE: 03-21-2007

ELEV (m)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
2.32	1.8	1.8	0.0	0.0	0.0	0.0	0.0	0.00	1
2.41	1.9	1.9	0.0	0.0	0.0	0.0	0.0	0.00	1
2.51	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.00	1
2.62	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.00	1
2.73	2.1	2.1	0.0	0.0	0.0	0.0	0.0	0.00	1
2.84	2.2	2.2	0.0	0.0	0.0	0.0	0.0	0.00	1
2.95	2.3	2.3	0.0	0.0	0.0	0.0	0.0	0.00	1
2.97	2.4	2.3	0.0	0.0	0.0	0.0	0.0	0.00	30
2.99	2.4	2.3	0.0	0.0	0.0	0.0	0.0	0.00	30
3.01	2.5	2.3	0.0	0.0	0.0	0.0	0.0	0.18	19
3.01	2.6	2.3	0.0	0.0	0.0	0.0	0.0	0.26	7
3.00	2.3	2.3	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: DOLPHIN DATE: 03-21-2007

HEAD ELEV (m)	HEAD ERROR (m)	TOTAL FLOW (m3/s)	FLOW ERROR (m3/s)	% FLOW ERROR
2.32	0.000	1.80	0.00	0.00
2.41	0.000	1.88	0.00	0.00
2.51	0.000	1.96	0.00	0.00
2.62	0.000	2.04	0.00	0.00
2.73	0.000	2.12	0.00	0.00
2.84	0.000	2.20	0.00	0.00
2.95	0.000	2.28	0.00	0.00
2.97	-0.001	2.36	0.07	2.99
2.99	-0.001	2.44	0.13	5.52
3.01	-0.000	2.52	0.02	0.98
3.01	-0.000	2.60	0.02	0.91

<1> TOLERANCE (m) = 0.003 <2> TOLERANCE (%) = 1.000

PERFORMANCE CURVE FOR CULVERT 1 - 1(900 mm BY 900 mm) RCP

DIS-CHARGE FLOW (m3/s)	WATER ELEV. (m)	HEAD-CONTROL DEPTH (m)	INLET CONTROL DEPTH (m)	FLOW TYPE <F4>	NORMAL DEPTH (m)	CRIT. DEPTH (m)	OUTLET DEPTH (m)	TW DEPTH (m)	OUTLET VEL. (m/s)	TW VEL. (m/s)
1.80	2.32	1.62	1.62	5-S2n	0.42	0.77	0.54	0.06	4.48	0.00
1.88	2.41	1.71	1.71	5-S2n	0.43	0.79	0.56	0.06	4.51	0.00
1.96	2.51	1.81	1.81	5-S2n	0.44	0.80	0.58	0.06	4.58	0.00
2.04	2.62	1.92	1.92	5-S2n	0.45	0.82	0.59	0.06	4.63	0.00
2.12	2.72	2.03	2.03	5-S2n	0.46	0.83	0.60	0.06	4.71	0.00
2.20	2.84	2.14	2.14	5-S2n	0.48	0.85	0.61	0.06	4.79	0.00
2.28	2.95	2.26	2.26	5-S2n	0.48	0.86	0.62	0.06	4.83	0.00
2.29	2.97	2.27	2.27	5-S2n	0.49	0.86	0.63	0.06	4.84	0.00
2.31	2.99	2.29	2.29	5-S2n	0.49	0.87	0.63	0.06	4.87	0.00

```
    2.31      3.01    2.31    2.31 5-S2n    0.49    0.87    0.63    0.06    4.88    0.00
    2.32      3.01    2.31    2.31 5-S2n    0.49    0.87    0.63    0.06    4.88    0.00
```

El. inlet face invert	0.70 m	El. outlet invert	0.24 m
El. inlet throat invert	0.00 m	El. inlet crest	0.00 m

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	0.00 m
INLET ELEVATION	0.70 m
OUTLET STATION	11.00 m
OUTLET ELEVATION	0.24 m
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0418
CULVERT LENGTH ALONG SLOPE	11.01 m

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	900 mm
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE WITH HEADWALL
INLET DEPRESSION	NONE

TAILWATER

CONSTANT WATER SURFACE ELEVATION

0.30

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	7.01 m
CREST LENGTH	200.00 m
OVERTOPPING CREST ELEVATION	3.00 m

Link to USGS Home Page

NEIC: Earthquake Search Results

U N I T E D S T A T E S G E O L O G I C A L S U

E A R T H Q U A K E D A T A B A S E

FILE CREATED: Sat Mar 17 22:38:45 2007
Geographic Grid Search Earthquakes= 108
Latitude: 19.000N - 17.000N
Longitude: 76.000W - 79.000W
Catalog Used: PDE
Data Selection: Historical & Preliminary Data

CATALOG SOURCE	D A T E YEAR	MO	DA	ORIGIN TIME	***COORDINATES** LAT	LONG	DEPTH km	pP	STD DEV	*****M A G N I T U D E S mb	OBS	Ms	OBS	CONTRIB VALUE
PDE	1977	05	24	022923.50	17.740	-78.744	28	D		4.7		3.4Z		
PDE	1977	05	24	111436	17.606	-78.630	33	N		4.8				
PDE	1978	02	26	050720.80	18.170	-76.450	15			4.8		3.9Z		
PDE	1980	11	16	094444.10*	18.139	-76.200	10	G						
PDE	1981	02	15	075221.80*	18.423	-76.768	10	G						
PDE	1981	02	15	102336 *	18.058	-76.686	17							
PDE	1981	02	26	233737.50*	18.131	-76.688	16							
PDE	1981	03	24	041700.80	18.043	-77.547	10	G						
PDE	1981	04	16	170733 *	18.111	-76.754	25							
PDE	1981	05	18	110423.10*	18.068	-76.778	33							
PDE	1981	06	24	194742.86*	17.972	-77.664	10	G	0.72					
PDE	1981	07	17	045658.73%	17.908	-77.184	18		0.09					
PDE	1988	05	09	162359.74	18.090	-76.500	10	G	0.97	4.5	7	4.0Z	2	
PDE	1988	09	02	062617.64*	17.559	-78.279	17	D	7 1.32	4.3	4	3.5Z	1	
PDE	1988	11	12	033448.65	18.068	-76.597	16	D	26 1.09	5.4	57	4.7Z	3	
PDE	1989	08	24	021722.84?	17.986	-76.964	10	G	1.58					
PDE	1990	12	12	210524.61?	18.089	-76.680	10	G	0.45					
														2.60MDTR
PDE	1991	05	29	103905.53?	17.577	-78.371	10	G	0.51					
														3.40MDJS
PDE	1991	06	05	181125.25?	18.149	-76.014	5	G	0.81					
PDE	1991	06	15	052009.87?	18.045	-76.883	10	G	0.28					
														2.60MDJS
PDE	1991	07	20	233136.08?	17.848	-76.732	10	G	0.36					
														2.40MDJS
PDE	1991	09	06	095742.05%	18.298	-77.174	10	G	1.19					
														2.50MDJS
PDE	1991	10	10	235039.23?	18.136	-76.264	10	G	0.14					
														2.80MDJS
PDE	1991	10	15	053450.31%	17.847	-77.198	10	G	0.05					
														2.50MDJS
PDE	1991	10	20	040901.57%	18.300	-76.503	10	G	0.12					
														1.80MDJS
PDE	1991	10	31	032158.14%	17.755	-76.847	10	G	1.20					
														1.80MDJS

```
PDE     1991 11 02 031020.53?   18.818  -76.748   10  G    0.66|       |       |
                                                                        |3.70MDJS
PDE     1991 11 24 043318.09?   17.088  -76.492   10  G    0.43|       |       |
                                                                        |3.10MDJS
PDE     1991 12 25 152558.39?   17.933  -78.082   10  G    0.38|       |       |
                                                                        |3.10MDJS
PDE     1992 01 05 080551.90%   18.106  -77.447   10  G    0.07|       |       |
PDE     1992 01 08 214324.10?   18.004  -76.724   10  G    0.16|       |       |
PDE     1992 01 27 202656.97%   18.116  -76.673   10  G    0.71|       |       |
                                                                        |2.60MDJS
PDE     1992 02 01 091817.41%   17.963  -76.824   10  G    0.96|       |       |
                                                                        |2.40MDJS
PDE     1992 03 05 131503.25?   18.267  -76.579   10  G    0.19|       |       |
                                                                        |2.30MDJS
PDE     1992 03 11 123633.69%   18.168  -76.654   10  G    0.95|       |       |
                                                                        |2.30MDJS
PDE     1992 03 15 164639.61?   18.097  -77.565   10  G    0.09|       |       |
                                                                        |2.90MDJS
PDE     1992 03 16 035929.35?   18.056  -77.460   10  G    0.44|       |       |
                                                                        |2.90MDJS
PDE     1992 04 15 022715.27%   18.116  -77.331   10  G    0.32|       |       |
                                                                        |2.20MDJS
PDE     1992 04 21 145236.29%   18.271  -76.776   10  G    0.82|       |       |
                                                                        |2.70MDJS
PDE     1992 04 23 220130.57?   18.802  -76.480   10  G    0.55|       |       |
                                                                        |3.30MDJS
PDE     1992 05 16 093632.22%   18.084  -76.452   10  G    0.14|       |       |
                                                                        |2.10MDJS
PDE     1992 05 19 095410.45?   18.112  -76.639   10  G    0.10|       |       |
                                                                        |2.30MDJS
PDE     1992 05 25 132838.28?   18.018  -76.650   33  N    0.76|       |       |
                                                                        |2.20MDJS
PDE     1992 05 25 172408.84?   18.244  -77.391   10  G    0.10|       |       |
                                                                        |2.40MDJS
PDE     1992 09 06 041825.17%   18.130  -76.923   10  G    0.35|       |       |
PDE     1992 10 01 130250.16*   17.943  -76.756   10  G    0.71|       |       |
                                                                        |2.00MDJS
PDE     1992 10 11 115932.71%   17.977  -76.498   10  G    0.18|       |       |
                                                                        |2.70MDJS
PDE     1993 01 13 171107.57    17.955  -76.583   16  D 39 1.13|5.5  73|4.8Z  20|5.50MwHR
                                                                        |5.70MDUP
PDE     1993 01 13 185205.48%   18.101  -76.650   19  *    0.21|       |       |
                                                                        |3.10MDJS
PDE     1993 01 14 005238.41?   18.116  -76.641   10  G    0.14|       |       |
                                                                        |2.20MDJS
PDE     1993 01 14 014342.20?   18.111  -76.639   10  G    0.06|       |       |
                                                                        |2.30MDJS
PDE     1993 01 14 022716.66%   18.011  -76.677   10  G    0.58|       |       |
                                                                        |2.10MDJS
PDE     1993 01 14 053446.26%   18.136  -76.638   10  G    0.71|       |       |
                                                                        |2.40MDJS
PDE     1993 01 14 095819.41%   18.067  -76.647   10  G    0.35|       |       |
                                                                        |2.40MDJS
PDE     1993 01 15 221750.45%   18.042  -76.684   10  G    0.86|       |       |
                                                                        |2.70MDJS
PDE     1993 01 17 144430.46?   18.253  -76.605   10  G    1.17|       |       |
                                                                        |2.20MDJS
PDE     1993 01 18 081149.21?   18.065  -76.747   10  G    0.02|       |       |
                                                                        |2.40MDJS
PDE     1993 01 18 124656.61?   18.176  -76.696   10  G    0.78|       |       |
                                                                        |2.40MDJS
PDE     1993 01 21 212106.87%   18.077  -76.657   17  *    0.22|       |       |
                                                                        |3.70MDJS
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PDE     1993 01 23 100244.51%   18.112  -76.760   10  G    0.53|       |       |
                                                                              |3.50MDJS
PDE     1993 01 23 155640.81?   18.145  -76.643   10  G    0.60|       |       |
                                                                              |2.30MDJS
PDE     1993 01 27 192206.85?   18.231  -77.061   10  G    0.32|       |       |
                                                                              |2.10MDJS
PDE     1993 02 14 071917.34%   18.049  -76.763   10  G    0.57|       |       |
                                                                              |2.50MDJS
PDE     1993 02 14 094646.53%   18.095  -76.760   10  G    0.56|       |       |
                                                                              |2.50MDJS
PDE     1993 02 19 141357.47?   17.989  -76.775   10  G    0.80|       |       |
                                                                              |3.20MDJS
PDE     1993 03 05 063510.07?   18.116  -76.933   10  G    1.35|       |       |
                                                                              |2.40MDJS
PDE     1993 03 20 181927.74?   18.194  -76.544   10  G    0.27|       |       |
                                                                              |2.40MDJS
PDE     1993 04 14 014023.97    17.689  -78.723   25  D 17 1.09|4.5  21|       |
                                                                              |4.60MDJS
PDE     1993 05 07 083313.47?   18.178  -76.699   10  G    0.44|       |       |
                                                                              |2.40MDJS
PDE     1993 05 27 140914.06?   18.209  -76.693   10  G    1.31|       |       |
                                                                              |2.80MDJS
PDE     1993 06 21 203011.92%   17.905  -76.946   33  N    0.81|       |       |
                                                                              |2.60MDJS
PDE     1993 07 06 032239.38?   18.068  -76.760   10  G    0.74|       |       |
                                                                              |2.00MDJS
PDE     1993 07 08 235018.08%   18.078  -77.389   10  G    0.53|       |       |
                                                                              |3.30MDJS
PDE     1993 07 19 131948.07?   18.146  -76.688   10  G    0.05|       |       |
                                                                              |3.20MDJS
PDE     1993 08 13 043157.89%   18.105  -76.774   10  G    0.57|       |       |
                                                                              |2.50MDJS
PDE     1993 08 13 143218.59?   18.077  -76.705   10  G    0.44|       |       |
                                                                              |3.40MDJS
PDE     1993 08 28 073022.74?   18.208  -76.681   10  G    0.47|       |       |
                                                                              |2.20MDJS
PDE     1993 11 26 235022.36?   18.028  -76.945   10  G    0.19|       |       |
                                                                              |2.10MDJS
PDE     1993 11 28 180435.98    18.128  -76.803   10  G    0.57|       |       |
                                                                              |2.80MDJS
PDE     1994 02 15 225856.86*   17.892  -76.870   10  G    1.56|       |       |
                                                                              |3.90MDJS
PDE     1995 06 03 214241.44?   18.075  -76.744   20  G    1.04|3.8   7|       |
PDE     1995 10 21 174346.70%   18.075  -76.992   10  G    0.33|       |       |
                                                                              |2.40MDJS
PDE     1995 11 03 180916.85%   18.108  -77.587   10  G    0.33|       |       |
                                                                              |2.30MDJS
PDE     1995 11 05 025713.53%   18.055  -77.562   10  G    0.36|       |       |
                                                                              |2.60MDJS
PDE     1995 12 02 211451.31%   18.247  -77.786   10  G    0.52|       |       |
                                                                              |3.10MDJS
PDE     1995 12 06 124438.32%   17.948  -77.667   20  G    0.51|       |       |
                                                                              |3.20MDJS
PDE     1995 12 16 193232.52%   18.225  -77.703   10  G    0.56|       |       |
                                                                              |2.50MDJS
PDE     1996 01 01 103802.07%   18.292  -77.813   10  G    0.74|       |       |
                                                                              |2.70MDJS
PDE     1996 01 02 030242.17%   17.934  -76.613   10  G    0.44|       |       |
                                                                              |2.80MDJS
PDE     1996 01 02 232100.57?   17.931  -76.616   10  G    0.16|       |       |
                                                                              |2.20MDJS
PDE     1996 01 04 014118.05?   17.840  -77.204   10  G    0.74|       |       |
                                                                              |2.30MDJS
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PDE     1996 01 26 074600.84%   17.929  -76.699   10  G    0.46|       |        |
                                                                |2.40MDJS
PDE     1996 01 29 035735.60%   17.955  -76.677   10  G    0.73|       |        |
                                                                |2.70MDJS
PDE     1998 04 18 022341.55HJ  18.225  -76.603   10           |       |        |
PDE     2000 02 05 114825.41HJ  18.404  -77.454   10           |       |        |2.50MDJS
PDE     2000 02 07 001345.75HJ  17.922  -78.088    5           |4.4   9|        |3.80MDJS
PDE     2000 02 07 003951.16HJ  17.940  -78.089    5           |       |        |2.60MDJS
PDE     2001 01 24 035232.96*   18.976  -76.558   33  N    0.67|4.4   2|        |
PDE     2002 05 15 023346.81*   17.591  -78.541   10  G    1.25|       |        |2.80MLSS
PDE     2002 08 10 062210.38    18.043  -76.528   33  N    1.02|4.5  33|        |4.60MDJS
PDE     2002 08 10 063521.19HJ  18.082  -76.607   20           |       |        |2.00MDJS
PDE     2002 08 10 085820.92HJ  17.982  -76.564   15           |4.1  23|        |4.00MDJS
PDE     2002 08 10 085953.58HJ  18.036  -76.671   10           |       |        |3.70MDJS
PDE     2002 08 10 162527.81HJ  17.950  -76.584   10           |       |        |2.40MDJS
PDE     2003 01 30 151352.01?   18.100  -76.671   10  G    0.81|       |        |3.20MDSS
PDE     2003 05 15 015814.88    18.525  -77.636   10  G 39 1.17|3.9  11|        |3.50MDSS
PDE     2004 05 27 194642.35*B  18.282  -76.373   10  G    0.90|3.9   4|        |
PDE     2005 06 13 035801.29 A  18.316  -77.443    2       0.95|5.1  99|4.6Z  91|5.20MwHR
                                                                |5.10MDJS
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USGS National Earthquake Information Center

	Margalef's Species Richness	Pielou's Evenness	Shannon-Wiener Diversity Index
1a	0.449	0.9525	1.0464
1b	0.4604	0.9649	1.06
1c	0.4865	0.9395	1.0322
MEAN	0.465	0.952	1.046
STD DEV	0.019	0.013	0.014
4a	0.7486	0.4472	0.6199
4b	0.8078	0.6387	0.8854
4c	0.7556	0.6055	0.8395
MEAN	0.771	0.564	0.782
STD DEV	0.032	0.102	0.142
3a	0.8341	0.7828	0.86
3b	0.8341	0.9432	1.0362
3c	1.0189	0.8197	1.1363
MEAN	0.896	0.849	1.011
STD DEV	0.107	0.084	0.140
2a	1.2427	0.9602	1.0549
2b	1.6743	0.8962	1.2425
2c	1.1162	0.9206	1.0114
MEAN	1.344	0.926	1.103
STD DEV	0.293	0.032	0.123
5a	0.4662	0.7369	0.8096
5b	0.4774	0.8897	0.9774
5c	0.4692	0.8677	0.9533
MEAN	0.471	0.831	0.913
STD DEV	0.006	0.083	0.091

Number of specimens in each sample

		Polychaeta	Gastropoda	Bivalvia	Crustacea	Echinoidea	
OE	1a	30	39	17	0	0	86
	1b	16	30	31	0	0	77
	1c	19	30	12	0	0	61
Bay 3	4a	45	7	2	1	0	55
	4b	29	7	2	3	0	41
	4c	39	7	5	2	0	53
Bay 2	3a	7	0	3	1	0	11
	3b	4	2	5	0	0	11
	3c	11	3	3	2	0	19
Bay 1	2a	2	1	0	2	0	5
	2b	3	1	1	0	1	6
	2c	1	3	0	0	2	6
OW	5a	8	51	14	0	0	73
	5b	11	37	18	0	0	66
	5c	12	42	17	0	0	71

Approximate benthic percentages in the three Bays

	Eastern Bay	Central Bay	West Central Bay	Western Bay
Sand	9	5.8	2	0
Coral	0	0	0	0
Rock	1.2	1	0.8	2.8
Algae	0.8	1.4	0.4	0.2
Sponge	0	0	0	0
Seagrass - Thallasia	85	87.4	94.6	95
Seagrass - Syringodium	4	4.4	2.2	2
TOTAL	**100**	**100**	**100**	**100**

Average blade length (cm) of seagrass blades in the three Bays

	Eastern Bay	Central Bay	West Central Bay	Western Bay
Thallasia	14.3	21.5	20.3	30.2
Syringodium		28.3	24.3	35.0

Diversity Indices Calculations – Marine Assessment

Eastern Bay			shannon-weiner diversity index			margalef's species richness		
Organisms	Census	i	pi	ln pi	pi ln pi	s-1	ln(N)	s-1/ln(N)
West Indian sea egg	11	1	0.478261	-0.7376	-0.3527647	3	3.135494	**0.956787**
Sun anemone	1	2	0.043478	-3.13549	-0.1363258			
Blueheaded wrasse	5	3	0.217391	-1.52606	-0.3317514			
Grunt	3	4	0.130435	-2.03688	-0.2656803			
Juvenile fish	3							
Total	23			**Hs**	**1.08652217**			
Central Bay								
Blueheaded wrasse	4	1	0.190476	-1.65823	-0.315853	5	3.044522	**1.642294**
West Indian sea egg	4	2	0.190476	-1.65823	-0.315853			
Grunt	7	3	0.333333	-1.09861	-0.3662041			
Reef urchin	4	4	0.190476	-1.65823	-0.315853			
Snapper	1	5	0.047619	-3.04452	-0.1449773			
Bearded fireworm	1	6	0.047619	-3.04452	-0.1449773			
Total	21			**Hs**	**1.60371752**			
Western Bay								
Brittlestar	1	1	0.032258	-3.43399	-0.1107738	0	3.433987	**0**
Juvenile fish	30							
Total	31			**Hs**	**0.11077378**			

Plate AEastern Bay showing slack water

Plate BCentral Bay – viewed from the west

Plate CMangroves of the Western Bay

Plate DWestern Bay shoreline

Plate E Boats docked in central and western bays

Diversity Indices Calculations – Benthic Assessment

		shannon-weiner diversity index			margalef's species richness		
Sample	Before 01	pi	ln pi	pi ln pi	s-1	ln(N)	s-1/ln(N)
Poly	30	0.3488	-1.0531	-0.3674	2	4.45435	**0.44899957**
Gast	39	0.4535	-0.7908	-0.3586			
Bival	17	0.1977	-1.6211	-0.3205			
Crust	0	0.0000					
Echino	0	0.0000					
Total	86		**Hs**	**1.0464**			
	Before 02						
Poly	16	0.2078	-1.5712	-0.3265			
Gast	30	0.3896	-0.9426	-0.3672	2	4.34381	**0.46042578**
Bival	31	0.4026	-0.9098	-0.3663			
Crust	0	0.0000					
Echino	0	0.0000					
Total	77		**Hs**	**1.0600**			
	Before 03						
Poly	19	0.3115	-1.1664	-0.3633	2	4.11087	**0.48651456**
Gast	30	0.4918	-0.7097	-0.3490			
Bival	12	0.1967	-1.6260	-0.3199			
Crust	0	0.0000					
Echino	0	0.0000					
Total	61		**Hs**	**1.0322**			
	Eastern 01	pi	ln pi	pi ln pi	s-1	ln(N)	s-1/ln(N)
Poly	45	0.8182	-0.2007	-0.1642	3	4.00733	**0.74862754**
Gast	7	0.1273	-2.0614	-0.2624			
Bival	2	0.0364	-3.3142	-0.1205			
Crust	1	0.0182	-4.0073	-0.0729			
Echino	0	0.0000					
Total	55		**Hs**	**0.6199**			
	Eastern 02						
Poly	29	0.7073	-0.3463	-0.2449	3	3.71357	**0.80784752**
Gast	7	0.1707	-1.7677	-0.3018			
Bival	2	0.0488	-3.0204	-0.1473			
Crust	3	0.0732	-2.6150	-0.1913			
Echino	0	0.0000					
Total	41		**Hs**	**0.8854**			
	Eastern 03						
Poly	39	0.7358	-0.3067	-0.2257	3	3.97029	**0.75561195**
Gast	7	0.1321	-2.0244	-0.2674			
Bival	5	0.0943	-2.3609	-0.2227			
Crust	2	0.0377	-3.2771	-0.1237			

Echino	0	0.0000					
Total	53		**Hs**	**0.8395**			
	Central 01	pi	ln pi	pi ln pi	s-1	ln(N)	s-1/ln(N)
Poly	7	0.6364	-0.4520	-0.2876	2	2.3979	**0.83406478**
Gast	0	0.0000					
Bival	3	0.2727	-1.2993	-0.3543			
Crust	1	0.0909	-2.3979	-0.2180			
Echino	0	0.0000					
Total	11		**Hs**	**0.8600**			
	Central 02						
Poly	4	0.3636	-1.0116	-0.3679	2	2.3979	**0.83406478**
Gast	2	0.1818	-1.7047	-0.3100			
Bival	5	0.4545	-0.7885	-0.3584			
Crust	0	0.0000					
Echino	0	0.0000					
Total	11		**Hs**	**1.0362**			
	Central 03						
Poly	11	0.5789	-0.5465	-0.3164	3	2.94444	**1.01886982**
Gast	3	0.1579	-1.8458	-0.2914			
Bival	3	0.1579	-1.8458	-0.2914			
Crust	2	0.1053	-2.2513	-0.2370			
Echino	0	0.0000					
Total	19		**Hs**	**1.1363**			
	Western 01	pi	ln pi	pi ln pi	s-1	ln(N)	s-1/ln(N)
Poly	2	0.4000	-0.9163	-0.3665	2	1.60944	**1.24266987**
Gast	1	0.2000	-1.6094	-0.3219			
Bival	0	0.0000					
Crust	2	0.4000	-0.9163	-0.3665			
Echino	0	0.0000					
Total	5		**Hs**	**1.0549**			
	Western 02						
Poly	3	0.5000	-0.6931	-0.3466	3	1.79176	**1.67433188**
Gast	1	0.1667	-1.7918	-0.2986			
Bival	1	0.1667	-1.7918	-0.2986			
Crust	0	0.0000					
Echino	1	0.1667	-1.7918	-0.2986			
Total	6		**Hs**	**1.2425**			
	Western 03						
Poly	1	0.1667	-1.7918	-0.2986	2	1.79176	**1.11622125**
Gast	3	0.5000	-0.6931	-0.3466			
Bival	0	0.0000					

Crust	0	0.0000					
Echino	2	0.3333	-1.0986	-0.3662			
Total	6		**Hs**	**1.0114**			
	After 01	pi	ln pi	pi ln pi	s-1	ln(N)	s-1/ln(N)
Poly	8	0.1096	-2.2110	-0.2423	2	4.29046	**0.46615054**
Gast	51	0.6986	-0.3586	-0.2506			
Bival	14	0.1918	-1.6514	-0.3167			
Crust	0	0.0000					
Echino	0	0.0000					
Total	73		**Hs**	**0.8096**			
	After 02						
Poly	11	0.1667	-1.7918	-0.2986	2	4.18965	**0.4773663**
Gast	37	0.5606	-0.5787	-0.3244			
Bival	18	0.2727	-1.2993	-0.3543			
Crust	0	0.0000					
Echino	0	0.0000					
Total	66		**Hs**	**0.9774**			
	After 03						
Poly	12	0.1690	-1.7778	-0.3005	2	4.26268	**0.46918841**
Gast	42	0.5915	-0.5250	-0.3106			
Bival	17	0.2394	-1.4295	-0.3423			
Crust	0	0.0000					
Echino	0	0.0000					
Total	71		**Hs**	**0.9533**			

NWA Traffic Data for January 2007 – Point District, Hanover

The following table shows the number of vehicles that travelled **Westbound** in the Point area in the vicinity of the old Bouygues Travaux Publics Plant during the study period. Weekday and full week averages have also been calculated.

National Works Agency Automatic Axle Event Counts

Weekly Vehicle Counts

Site: [81200] Point Hanover, Westbound

Filter time: 13:30 Wednesday, January 24, 2007 =>11:30 Tuesday, January 30, 2007

Method: Count axles divided by two.

	MON	TUE	WED	THU	FRI	SAT	SUN	AVERAGES	
	29 Jan	30 Jan	24 Jan	25 Jan	26 Jan	27 Jan	28 Jan	1-5	1-7
Hour period									
0000-0100	24	25	*	20	31	80	64	25	41
0100-0200	17	6	*	16	24	40	19	16	20
0200-0300	7	5	*	9	21	40	22	11	17
0300-0400	9	7	*	6	32	16	30	14	17
0400-0500	3	7		6	25	27	45	10	19
0500-0600	14	15	*	14	31	44	31	14	22
0600-0700	51	48	*	52	54	74	36	51	53
0700-0800	175	181	*	173	185	128	66	178	151
0800-0900	175	191<	*	196	200<	133	104	191	167
0900-1000	194<	162	*	206<	172	141	139<	184	169
1000-1100	177	168	*	191	179	146	114	178	163
1100-1200	133	128	*	187	179	172<	134	157	156
1200-1300	163	*	*	207	175	232	167	182	189
1300-1400	173	*	68	207	233<	206	162	170	175
1400-1500	186	*	183	199	208	244<	166	194	198
1500-1600	197	*	173	209	203	190	181<	196	192
1600-1700	179	*	228	235<	193	211	153	209	200
1700-1800	217<	*	229<	205	204	188	135	214	196
1800-1900	204	*	211	197	226	159	140	210	190
1900-2000	168	*	159	149	175	172	126	163	158
2000-2100	125	*	137	140	172	123	125	144	137
2100-2200	102	*	126	124	92	109	94	111	108
2200-2300	51	*	68	78	84	96	70	70	75
2300-2400	39	*	38	62	121	62	50	65	62
TOTALS									
12 Hr 7-19	2173	*	*	2412	2357	2150	1661	2314	2151
16 Hr 6-22	2619	*	*	2877	2850	2628	2042	2782	2603
18 Hr 6-24	2709	*	*	3017	3055	2786	2162	2927	2746
24 Hr 0-24	2783	*	*	3088	3199	3033	2373	3023	2895
AM HR	0900	0800	*	0900	0800	1100	0900		
PEAK	194	191	*	206	200	172	139		
PM HR	1700	*	1700	1600	1300	1400	1500		
PEAK	217	*	229	235	233	244	181		

* - No (insufficient) data.

The following table shows the class seperation totals by day for the vehicles that travelled **Westbound** in the Point area during the study period.

*** Wednesday, January 24, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
1330-19	1092	937	3	96	33	11	0	3	8	1	0	0	0	72.4	84.6
1330-22	1514	1313	5	123	45	15	0	3	8	2	0	0	0	72.0	83.9
1330-00	1620	1410	5	128	48	16	0	3	8	2	0	0	0	72.1	83.9
1330-00	1620	1410	5	128	48	16	0	3	8	2	0	0	0	72.1	83.9

*** Thursday, January 25, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-19	2412	2083	7	179	87	27	0	9	13	5	1	1	0	74.4	86.0
06-22	2877	2508	11	203	91	31	1	9	16	5	1	1	0	74.1	85.7
06-00	3017	2636	11	214	92	31	1	9	16	5	1	1	0	74.2	85.7
00-00	3088	2695	11	221	94	31	1	9	18	6	1	1	0	74.3	85.7

*** Friday, January 26, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-19	2357	2029	10	195	64	27	0	6	19	5	0	2	0	75.9	86.8
06-22	2850	2470	11	231	71	32	0	6	21	6	0	2	0	75.6	86.8
06-00	3055	2663	11	239	72	32	0	8	21	7	0	2	0	75.6	86.8
00-00	3199	2795	11	247	75	32	0	8	22	7	0	2	0	75.7	86.8

*** Saturday, January 27, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-19	2150	1809	8	203	74	26	1	8	19	2	0	0	0	75.2	86.0
06-22	2628	2242	8	243	77	27	1	8	19	3	0	0	0	75.0	86.0
06-00	2785	2382	8	259	79	27	1	8	19	3	0	0	0	75.1	86.0
00-00	3033	2608	9	268	86	27	1	8	23	3	0	0	0	75.2	86.0

*** Sunday, January 28, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-19	1661	1471	4	153	10	5	0	4	4	2	0	0	0	73.1	84.6
06-22	2042	1816	4	182	22	5	0	4	6	3	0	0	0	72.6	84.2
06-00	2162	1925	4	191	24	5	0	4	6	3	0	0	0	72.9	84.6
00-00	2373	2118	4	200	30	8	0	4	6	3	0	0	0	73.2	85.0

*** Monday, January 29, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-19	2173	1953	2	141	51	8	0	3	14	1	0	0	0	76.2	87.8
06-22	2619	2359	2	170	56	11	0	4	15	2	0	0	0	75.7	87.1
06-00	2709	2442	2	174	58	12	0	4	15	2	0	0	0	75.7	87.5
00-00	2783	2497	2	181	66	12	1	4	17	3	0	0	0	75.7	87.5

*** Tuesday, January 30, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-12	830	712	3	52	40	7	0	5	9	1	1	0	0	75.8	87.8
06-12	878	753	3	56	43	7	0	5	9	1	1	0	0	75.9	88.2
00-12	943	804	3	60	47	8	1	5	12	2	1	0	0	75.9	88.2

The following table shows the number of vehicles that travelled Eastbound in the Point area in the vicinity of the old Bouygues Travaux Publics Plant during the study period. Weekday and full week averages have also been calculated.

National Works Agency Automatic Axle Event Counts									
Weekly Vehicle Counts									
Site: [81200] Point Hanover, Eastbound									
Filter time: 13:30 Wednesday, January 24, 2007 ->11:30 Tuesday, January 30, 2007									
Method: Count axles divided by two									
	MON	TUE	WED	THU	FRI	SAT	SUN	AVERAGES	
	29 Jan	30 Jan	24 Jan	25 Jan	26 Jan	27 Jan	28 Jan	1-5	1-7
Hour period									
0000-0100	29	17	*	26	32	51	36	26	32
0100-0200	30	11	*	15	16	34	35	18	24
0200-0300	11	5	*	10	19	26	19	11	15
0300-0400	18	7	*	10	15	24	16	13	15
0400-0500	10	10	*	18	25	24	22	16	18
0500-0600	44	27	*	44	50	32	23	41	37
0600-0700	93	97	*	89	96	63	38	94	79
0700-0800	218<	179	*	206<	192<	105	63	189	161
0800-0900	201	179	*	188	182	122	103	188	163
0900-1000	156	184<	*	191	137	144	117	167	155
1000-1100	191	160	*	198	147	174<	120	174	165
1100-1200	156	162	*	180	186	170	142<	171	166
1200-1300	163	*	*	178	190	175	129	177	167
1300-1400	143	*	145	207	208	167	143	176	169
1400-1500	196	*	199	228	222	166	144	211	193
1500-1600	169	*	204	213	237	203	136	206	194
1600-1700	174	*	183	186	248<	180	158	198	188
1700-1800	222<	*	217<	240<	205	200	176<	221	210
1800-1900	182	*	178	208	216	216<	159	196	193
1900-2000	136	*	158	169	175	204	149	160	165
2000-2100	116	*	104	105	139	146	112	116	120
2100-2200	95	*	80	100	95	116	80	93	94
2200-2300	50	*	69	72	82	71	65	68	68
2300-2400	40	*	40	47	73	67	46	50	52
TOTALS									
12 Hr 7-19	2171	*	*	2423	2370	2022	1590	2321	2115
16 Hr 6-22	2611	*	*	2886	2875	2551	1969	2791	2578
18 Hr 6-24	2701	*	*	3005	3030	2689	2080	2912	2701
24 Hr 0-24	2843	*	*	3128	3187	2880	2231	3053	2854
AM HR	0700	0900	*	0700	0700	1000	1100		
PEAK	218	184	*	206	192	174	142		
PM HR	1700	*	1700	1700	1600	1800	1700		
PEAK	22	*	217	240	248	216	176		
* - No (insufficient) data.									

The following table shows the class seperation for the vehicles that travelled **Eastbound** in the Point area during the study period.

*** Wednesday, January 24, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
1315-19	1126	977	0	79	50	9	0	0	10	1	0	0	0	71.9	85.7
1315-22	1468	1270	2	110	62	10	0	0	13	1	0	0	0	72.1	86.4
1315-00	1577	1365	2	114	71	10	0	0	14	1	0	0	0	72.3	86.8
1315-00	1577	1365	2	114	71	10	0	0	14	1	0	0	0	72.3	86.8

*** Thursday, January 25, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-19	2423	2122	4	160	87	30	1	3	14	2	0	0	0	77.4	93.2
06-22	2886	2547	4	188	91	32	1	3	18	2	0	0	0	77.0	93.2
06-00	3005	2652	4	194	94	32	1	3	23	2	0	0	0	76.9	92.9
00-00	3128	2753	4	209	100	32	1	3	24	2	0	0	0	77.0	92.9

*** Friday, January 26, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-19	2370	2108	4	139	69	28	0	1	20	1	0	0	0	78.1	93.6
06-22	2875	2572	4	166	80	26	0	1	23	1	0	0	0	78.1	92.9
06-00	3030	2712	4	178	81	29	0	1	24	1	0	0	0	78.1	93.2
00-00	3187	2852	4	190	83	29	0	1	27	1	0	0	0	78.2	93.2

*** Saturday, January 27, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-19	2022	1726	3	163	93	18	0	1	17	0	0	1	0	78.1	93.2
06-22	2551	2206	3	196	99	20	0	2	24	0	0	1	0	77.6	93.2
06-00	2689	2332	3	208	99	20	0	2	24	0	0	1	0	77.6	93.2
00-00	2880	2511	3	216	101	20	0	2	26	0	0	1	0	77.7	93.2

*** Sunday, January 28, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-19	1590	1417	0	145	22	0	0	1	5	0	0	0	0	75.9	92.2
06-22	1969	1772	0	168	23	0	0	1	5	0	0	0	0	75.1	91.1
06-00	2080	1877	0	173	24	0	0	1	5	0	0	0	0	75.3	91.1
00-00	2231	2008	0	188	29	1	0	1	5	0	0	0	0	75.7	92.2

*** Monday, January 29, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-19	2171	1970	1	124	55	5	0	0	16	0	0	0	0	78.3	93.2
06-22	2511	2301	1	140	59	7	0	0	23	0	0	0	0	77.8	92.9
06-00	2701	2469	1	140	60	9	0	0	23	0	0	0	0	77.7	92.5
00-00	2843	2591	1	151	66	10	0	0	24	0	0	0	0	77.7	92.9

*** Tuesday, January 30, 2007**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Mean	Vpp 85
07-12	864	789	0	42	22	0	0	2	10	0	0	0	0	78.0	94.3
06-12	961	879	1	45	24	0	0	2	10	0	0	0	0	78.5	95.0
00-12	1038	945	1	49	28	0	0	2	13	0	0	0	0	78.4	94.7

Vehicle Classification Scheme

Axles	Groups	Description	Class		Parameters	Dominant Vehicle	Aggregate
2	1 or 2	Short Sedan, Wagon, 4WD, Utility, Light Van	SV	1	d(1)>=1.7m, d(1)<=3.2m & axles=2		1 (Light)
3, 4 or 5	3	Short - Towing Trailer, Caravan, Boat, etc.	SVT	2	groups=3, d(1)>=2.1m, d(1)<=3.2m, d(2)>=2.1m & axles=3,4,5		
2	2	Two Axle Truck or Bus	TB2	3	d(1)>3.2m & axles=2		2 (Medium)
3	2	Three Axle Truck or Bus	TB3	4	axles=3 & groups=2		
>3	2	Four Axle Truck	T4	5	axles>3 & groups=2		
3	3	Three Axle Articulated Three axle articulated vehicle or Rigid vehicle and trailer	ART3	6	d(1)>3.2m, axles=3 & groups=3		3 (Heavy)
4	>2	Four Axle Articulated Four axle articulated vehicle or Rigid vehicle and trailer	ART4	7	d(2)<2.1m or d(1)<2.1m or d(1)>3.2m axles = 4 & groups>2		
5	>2	Five Axle Articulated Five axle articulated vehicle or Rigid vehicle and trailer	ART5	8	d(2)<2.1m or d(1)<2.1m or d(1)>3.2m axles=5 & groups>2		
>=6	>2	Six Axle Articulated Six (or more) axle articulated vehicle or Rigid vehicle and trailer	ART6	9	axles=6 & groups>2 or axles>6 & groups=3		
>6	4	B-Double B-Double or Heavy truck and trailer	BD	10	groups=4 & axles>6		
>6	5 or 6	Double Road Train Double road train or Heavy truck and two trailers	DRT	11	groups=5 or 6 & axles>6		
>6	>6	Triple Road Train Triple road train or Heavy truck and three trailers	TRT	12	groups>6 & axles>6		

Version: 3.16
Last revised: 2005-04-12

ENVIRONMENTAL MANAGEMENT
CONSULTANTS (CARIBBEAN) LTD

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Tuesday, 23 January 2007

Re: Proposed Dolphin Park at Paradise Estate, Point District, Hanover.

Environmental Management Consultants (Caribbean) Ltd. (*emc*^{2}) has been contracted by Dolphin Cove Ltd. to conduct an Environmental Impact Assessment (EIA) for the captioned development as part of their application to the Natural Resources Conservation Authority (NRCA) for an Environmental Permit, under the Natural Resources Conservation Act (1990). A newspaper notice advertising the availability of the terms of reference for the study at the NEPA website (http://www.nrca.org/tors/index.asp) and the Hanover Parish Library appeared in the Gleaner in November 2006. The EIA is presently underway and is scheduled to be completed by February 16th 2007.

As part of the EIA stakeholder consultation process, we are writing to advise you of this development proposal, and invite you to raise any concerns or questions you may have about the *environmental impacts* of the project.

In addition to this opportunity for participation in the EIA process, concerned stakeholders will also be invited to:

- Review the document after it is submitted to the National Environment and Planning Agency when a copy will be sent to the Hanover Parish Library as well;
- Attend a public meeting, which will be held three weeks after the EIA is submitted. The public meeting will be held in the area at a date and venue to be specified in a newspaper advertisement.

A brief overview of the project is included in the Terms of Reference. If you would like to speak to the persons involved in preparing the EIA at *emc*^{2}, please feel free to contact us. We welcome your input and look forward to hearing from you (preferably in writing) by Monday February 12th, 2007

Yours Sincerely

……..
Ravidya Burrowes, Ph.D.
Managing Director

ENVIRONMENTAL MANAGEMENT
CONSULTANTS (CARIBBEAN) LTD

61 Mansfield Meadows, Ocho Rios, St. Ann, Jamaica
Tel/Fax: (876) 974-7423 | Tel: (876) 974-9727 | Email: newbiz@eiacaribbean.com

Tuesday, 23 January 2007

Re: Proposed Dolphin Park at Paradise Estate, Point District, Hanover.

Environmental Management Consultants (Caribbean) Ltd. (*emc*^{2}) has been contracted by Dolphin Cove Ltd. to conduct an Environmental Impact Assessment (EIA) for the captioned development as part of their application to the Natural Resources Conservation Authority (NRCA) for an Environmental Permit, under the Natural Resources Conservation Act (1990). A newspaper notice advertising the availability of the terms of reference for the study at the NEPA website (http://www.nrca.org/tors/index.asp) and the Hanover Parish Library appeared in the Gleaner in November 2006. The EIA is presently underway and is scheduled to be completed by February 16th 2007.

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Ravidya Burrowes, Ph.D.
Managing Director

Title	First Name	Surname	Job	Agency	Address1	Address2	Address3
Mr.	Ronald	Jackson	Chief Executive Officer	Office of Disaster Preparedness and Emergency Management	12 Camp Road	Kingston 4	Jamaica
Mr.	Micheal	Richards		National Solid Waste Management Authority	61 Half Way Tree Rd.	Kingston 10	Jamaica
	Managing	Director		Jamaica Public Service Company Ltd.	6 Knutsford Blvd	Kingston 5	Jamaica
	Managing	Director		National Housing Development Corporation	13 Caledonia Avenue	Kingston 5	Jamaica
	Managing	Director		National Housing Trust	4 Park Boulevard	Kingston 5	Jamaica
	Managing	Director		National Water Commission	28 Barbados Avenue	Kingston 5	Jamaica
	Managing	Director		Cable and Wireless Jamaica	47 Half Way Tree Road	Kingston 5	Jamaica
Mrs.	Yvonne	Jackson	Manager	National Works Agency	15 Hagley Park Road	Kingston 10	Jamaica
Mrs.	Joy	Fyffe		Ministry of Health			
Mr.	Basil	Fernandez	Managing Director	Water Resources Authority	Hope Gardens	Kingston 7	Jamaica
Mr.	Richard	Thompson	Estate Officer Environmentalist	Tourism Product Development Company Ltd.	64 Knutsford Bloulevard	Kingston 5	Jamaica
Mrs.	Laleta	Davis-Mattis	Executive Director	Jamaica National Heritage Trust	79 Duke Street	Kingston	Jamaica
Mrs.	Jennifer	Griffith	Permanent Secretary	Ministry of Tourism	64 Knutsford Boulevard	Kingston 5	Jamaica
Mr.	Peter	Knight	Managing Director	Environmental Health Unit	2-4 King Street	Kingston	Jamaica
				Jamaica Hotel and Tourism Association	2 Ardenne Road	Kingston 10	Jamaica

Schools in Lucea
Businesses in Lucea
Parish Council
Social Development Agency

National Housing Trust

Head Office: Kingston 5, P.O. Box 5000, Tel: 929-6500-9, Fax: 968-6953, E-mail: wecare@nht.gov.jm, Website: www.nht.gov.jm.
BRANCHES: St. Catherine: 16 Martin St., Spanish Town, Tel: 984-8023, **Clarendon:** 47 Manchester Ave., May Pen, Tel: 986-2051, **Westmoreland:** 123 Great George St., Savanna-la-mar, Tel: 955-2877, **St. James:** 42 b&c Union St., Montego Bay, Tel: 952-0063, **St. Ann:** 28 Graham St., Ocho Rios, Tel: 974-4934, **Manchester:** Lot 22 Caledonia Mall, 3 1/2 Caledonia Road, Mandeville, Tel: 962-2549. **SERVICE CENTRES: Hanover:** Uptown Shopping Centre, Moseley Drive, Lucea, Tel: 956-2982, **Trelawny:** 1 Officer's Alley, Falmouth, Tel: 954-3771-2, **St. Mary:** 64 Stennett St., Port Maria, Tel: 994-2216, **St. Thomas:** 2 Georges St., Morant Bay, Tel: 982-9417, **St. Elizabeth:** 109 Main St., Santa Cruz, Tel: 966-2510, **Portland:** 28 Harbour St., Port Antonio, Tel: 993-3863.

2007 February 19

Dr. Ravidya Burrowes
Managing Director
Environmental Management Consultants (Caribbean Limited)
61 Mansfield Meadows
Ocho Rios, St. Ann

Dear Dr. Burrowes:

Proposed Dolphin Park at Paradise Estate, Point District, Hanover – Terms of Reference

We have reviewed the Terms of Reference for the captioned Environmental Impact Assessment dated 2007 January 23. Comments on the document are outlined below:

It is recommended that the project implementers ensure that:

1. A monitoring programme be designed to detect environmental impacts as they occur, primarily to ensure that the risk of unacceptable environmental impacts are minimized;
2. Due care is taken in the relocation of ecosystems;
3. Materials from the silt screens do not damage corals;
4. A clean-up programme for corals is implemented;
5. The Hanover Coast Development Order (1962) is consulted as it forms the basis for material consideration in the approval process despite its age; and
6. The National Housing Trust is listed in the stakeholder analysis, as it is the owner of neighbouring properties.

For clarification on any of the items listed please call the undersigned at telephone number 929-6500-9 extn. 2068.

Yours sincerely

C. Selvyn

Charmaine Selvyn
PROJECT MANAGER
SPECIAL PROJECTS & PLANNING UNIT

c. Mr. Michael Taylor - AGM, Project Management
Miss Tracey-Ann Creary - Senior Project Manager, Special Projects & Planning Unit

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

Please direct your reply to: - Uptown Plaza, Lucea

February 7, 2007

Dr. Ravidya Burrowes
Environmental Management Consultants Ltd.
61 Mansfield Meadows
Ocho Rios
ST. ANN

Dear Dr. Burrowes:

RE: PROPOSED DOLPHIN PARK
Paradise Estate, Point, Hanover

We acknowledge receiving your letter on January 23, 2007 on the captioned matter.

JPSCo has no objection to your proposed Dolphin Park. However, we need to be provided with the load requirement on power to be utilized at the facility.

If you have any further queries, kindly contact the undersigned at telephone no. 956-9733.

We continue to be 'at your service'.

Yours truly,
JAMAICA PUBLIC SERVICE CO. LTD.

.....
ROY MURRAY
Parish Manager, Hanover

*cd

SOCIO-ECONOMIC SURVEY - POINT DEVELOPMENT

ED#_____

Age: _____

Gender: Male [ ] Female [ ]

Housing and Population

1. How long have you lived in area? 1-5 years [ ] 6-10 years [ ] >10 years [ ] always [ ]

2. What are the age groups of the occupants within your household?
   a) 0-9 [ ]
   b) 10-19 [ ]
   c) 20-34 [ ]
   d) 35-49 [ ]
   e) 50-64 [ ]
   f) 65 + [ ]

Employment & Economy

3. Indicate your level of education
   a) Primary [ ]
   b) Primary/All Age [ ]
   c) Secondary/High [ ]
   d) Tertiary [ ]
4. Are you employed? Yes [ ] No [ ]
5. If yes, are you employed in Hanover [ ] out of Hanover [ ]? If you work within Hanover please state where_____
6. What is your occupation? _____
7. Do you posses any skill/ skill training? Yes [ ] No [ ] If yes please state _____
   _____
   _

Social Services /Physical Infrastructure

8. Of the following public services and physical infrastructure, which need improvements?
   a. transportation [ ]
   b. fire [ ]
   c. electricity [ ]
   d. telephone [ ]
   e. water supply [ ]
   f. recreational facilities [ ]
   g. garbage collection [ ]
   h. police [ ]
   i. health (community centre) [ ]

9. What are your preferred methods of entertainment/recreation?
   a. beach/ water sports [ ]
   b. clubs/night clubs [ ]
   c. picnics [ ]
   d. gaming (slot machines) [ ]
   e. other _____

10. Where do you go for entertainment?_____

Awareness of Proposed Development & Community Concerns

11. Did you have prior knowledge of the proposed development? Yes [ ] No [ ] If yes state information known and source. _____
    _____

12. How important is the proposed development to you and the community?
    a. important [ ]
    b. very important [ ]
    c. unimportant [ ]

13. What price range are you willing to pay to enter the proposed facility?
    a. < $ 500 [ ]
    b. $500- $,1000 [ ]
    c. $1,100- $ 1, 500 [ ]
    d. $ 1,600 - $ 2,000 [ ]
    e. > $ 2,000 [ ]

14. Do you think the proposed development will have the following effects on the area?

Positive	Yes/No	Negative	Yes/No
□ Job creation		□ Conflict/competition between locals and newcomers for jobs	
□ Improved utility services (e.g. waste disposal, water, electricity etc.)		□ Increase in crime rate	
□ Improved security (policing), thus decreased crime rate		□ Exclusion of person who currently use the property	
□ Improved living standard		□ Loss of biodiversity (e.g. plants, marine life)	
□ Improved community resources			

15. Do you like the area? Yes [ ] No [ ] If yes, state reason_____