DRAFT

ENVIRONMENTAL IMPACT STATEMENT

CONSTRUCTION OF DOLPHIN FACILITY
SANDY POINT, ANGUILLA

DOLPHIN DISCOVERY
P.O. BOX 1472
MEADS BAY, ANGUILLA, BWI

NOVEMBER 2007

APPLIED TECHNOLOGY AND MANAGEMENT, INC.
400 SOUTH AUSTRALIAN AVENUE, SUITE 300
WEST PALM BEACH, FLORIDA 33401

TABLE OF CONTENTS

NONTECHNICAL SUMMARY 1

1.0 INTRODUCTION 1-1

2.0 PROJECT DESCRIPTION 2-1

2.1 Dolphinarium 2-1

2.2 Project Construction 2-2

2.2.1 Equipment 2-3

2.2.2 Pile Driving 2-3

2.3 Project Operation 2-4

2.3.1 Animal Care 2-4

2.3.2 Infrastructure and Utilities 2-5

2.4 Project Alternatives 2-7

2.4.1 Alternative Ocean Location 2-8

2.4.2 Inland Facility 2-8

2.4.3 No-Build Alternative 2-9

3.0 ANGUILLA'S LEGISLATION AND PLANNING POLICIES 3-1

3.1 Physical Policies and Legislation 3-1

3.1.1 Beach Access and Protection 3-1

3.1.2 Cultural and Common Law Practices 3-3

3.1.3 Endangered Species and Native Plants and Animals 3-3

3.1.4 Scenic and Conservation Areas 3-4

3.1.5 Waste Disposal, Noise and Air Quality 3-4

3.2 Policies of Other Ministries 3-5

3.2.1 Tourism Policies 3-5

3.2.2 Real Estate and Land Policy 3-5

3.2.3 Labor and Immigration Policy 3-5

3.3 International Accepted or Scientific Standards Regarding Animals Kept in Captivity 3-5

4.0 DESCRIPTION OF ENVIRONMENT 4-1

4.1 Physical Environment 4-2

4.1.1 Geology 4-2

TABLE OF CONTENTS

		4.1.2 Topography and Physiographic Features	4-2
		4.1.3 Soils	4-2
		4.1.4 Climate	4-3
		4.1.5 Winds	4-4
		4.1.6 Tropical Storms	4-5
		4.1.7 Wave Climate	4-5
		4.1.8 Ambient Air Quality	4-7
		4.1.9 Surface and Groundwater Hydrology	4-8
		4.1.10 Coastal and Marine Features	4-8
		4.1.11 Quality of Receiving Water	4-9
		4.1.12 Sediment Quality	4-16
	4.2	Biological Environment	4-18
		4.2.1 Marine Flora and Fauna	4-18
		4.2.2 Rare Marine Species	4-23
		4.2.3 Sensitive Marine Habitats	4-23
		4.2.4 marine Species of Commercial Significance	4-25
		4.2.5 Terrestrial Flora and Fauna	4-25
		4.2.6 Sensitive terrestrial Habitats	4-28
		4.2.7 Protected Terrestrial Species	4-29
		4.2.8 terrestrial Species of Commercial Significance	4-29
	4.3	Transportation	4-29
5.0		ASSESSMENT OF ENVIRONMENTAL IMPACTS AND RISKS OF THE PROPOSED DEVELOPMENT	5-1
	5.1	Methodology for Impact Assessment	5-1
	5.2	Physical Impacts	5-1
		5.2.1 Coastal Water Quality Focus	5-1
		5.2.2 Long Shore Sand Movement	5-5
		5.2.3 Topographic and Bathymetric Changes	5-6
		5.2.4 Coastal and Other Soil Erosion	5-6
		5.2.5 Oceanography	5-7
		5.2.6 Geology Including Caves and Sinkholes	5-7
		5.2.7 Noise	5-7

TABLE OF CONTENTS

		5.2.8 Waste Disposal	5-11
		5.2.9 Air Pollutants	5-12
		5.2.10 Quality of Bathing and Drinking Water Collected (Potable Water Quality)	5-13
		5.2.11 Conflict with Other Land Uses	5-13
		5.2.12 Landscape /Seascape	5-13
		5.2.13 Visual Impact	5-14
		5.2.14 Transportation	5-14
	5.3	Ecological Impacts	5-17
		5.3.1 Direct Impacts to Marine Ecological Resources	5-17
		5.3.2 Direct Impacts to Terrestrial Ecological Resources and Vegetation	5-20
	5.4	Risks Of Accidents And Hazardous Development	5-21
		5.4.1 Dolphin Safety	5-21
		5.4.2 Human Safety	5-22
	5.5	Sediment Quality	5-23
	5.6	Increased Passenger and Boating Traffic	5-23
	5.7	Facility Comparison	5-23
6.0	MITIGATION MEASURES		6-1
	6.1	Management Plan	6-1
	6.2	Public Education Programs	6-1
	6.3	Construction Best Management Practices	6-2
7.0	PROGRAMME FOR MONITORING IMPACTS		7-1
	7.1	Beach Profile Monitoring	7-1
	7.2	Water Quality Monitoring	7-1
	7.3	Seagrass Monitoring	7-1
	7.4	Coral Monitoring	7-2
	7.5	Monitoring Report Schedule	7-3
8.0	CONCLUSIONS		8-1
9.0	REFERENCES		9-1

TABLE OF CONTENTS

APPENDICES

Appendix A	Government of Anguilla Correspondence (Terms of Reference and Sphere of Influence)
Appendix B	Socioeconomic Report
Appendix C	Engineering Drawings and Descriptions
Appendix D	International Regulations Concerning Animal Care
Appendix E	Marine Ecology Report
Appendix F	Terrestrial Ecology Report
Appendix G	Blue Flag Beach Criteria Data Sheet
Appendix H	Hydrodynamic Flushing Analysis
Appendix I	Veterinarian Statement
Appendix J	Water Quality Statement

LIST OF TABLES

4-1 Meteorological Summary from Wallblake Airport

4-2 Extreme Offshore Waves

4-3 Summary of Wave Conditions

4-4 Sample Locations

4-5 Temperature, pH and Salinity

4-6 Total Suspended Solids and Turbidity

4-7 Dissolved Oxygen and Biological Oxygen Demand

4-8 Nutrients

4-9 USEPA Recommended Criteria for Metals of Concern

4-10 Metals

4-11 Sample Locations

4-12 Sediment Quality Guidelines for Metals of Concern

4-13 Sediment Quality Summary

4-14 Fauna Observed

4-15 Marine Flora Observed

4-16 Marine Benthic Habitats and Bottom Cover Types near the Dolphin Discovery Project

4-17 Terrestrial Fauna Observed

4-18 Terrestrial Flora Observed

4-19 Terrestrial Habitats, Land Cover Acreage, and Environmental Condition

4-20 Traffic Count Summary

5-1 Amplitude and RMS Data for Ambient Conditions and Various Boats Operating in Blowing Point Harbour

5-2 Projected Traffic Volumes

5-3 Dolphinarium Footprint Impacts on Marine Benthic Habitats

LIST OF TABLES

5-4 Potential for Impact at Dolphin Discovery, Anguilla Compared to Dolphin Cove, Jamaica

8-1 Impact Summary

LIST OF FIGURES

1-1 Location Map for Dolphin Discovery Site

1-2 Location Map Detail for Dolphin Discovery Site

2-1 Satellite Image of Dolphin Discovery Site with Project Boundary and Sphere of Influence

2-2 Dolphin Discovery Proposed Master Plan October 2007

2-3 Proposed Upland Development

2-4 Proposed Open-Water Dolphinarium

2-5 Dolphin Facility on Isla Mujeres, Mexico

2-6 Rendering of Proposed Dolphin Facility at Blowing Point

2-7 Conceptual Construction Plan

2-8 Conceptual Construction Schedule

2-9 Dolphin Discovery Veterinarians and Technicians Caring for Dolphins in a Mexican Facility

2-10 Existing Facility in Mead Bay

4-1 Sphere of Influence for Dolphin Discovery Site as Provided by the Land Development Control Committee

4-2 Proposed Site Existing Conditions

4-3 Storm Tracks for Tropical Systems that Passed near Anguilla, 1964-2004

4-4 WIS Data Transformed to Offshore of the Reef Adjacent to the Project Site

4-5 Existing Bathymetry at the Dolphin Discovery Site

4-6 Water and Sediment Sample Sites

4-7A Marine Habitat Map (Immediate Project Area)

4-7B Marine Habitat Map (Sphere of Influence)

4-8 *Diploria, Montastraea annularis, Montastraea faveolata* and *Siderastraea siderea*, and Other Hard Corals are rarely found in Blowing Point Harbour

4-9 Rock and Rock with Small Encrusting Corals and Sponges

LIST OF FIGURES

4-10 Elkhorn Corals, Soft Corals, and Sparse Coral Cover on Rock

4-11 Sand Bottom and Area with Sparse Algae and Seagrass, Anchor and Chain

4-12 Rock with Macroalgae, and Rock Crevices with Spiny Lobster

4-13 Mixed Algae and Seagrass, Seagrass in the Project Area, Seagrass, and Algae with Fishtrap in Background

4-14 Field Methods for Benthic Habitat Mapping

4-15 Commercial Fisheries in the Harbour and Fish Traps and Spiny Lobsters in a Crevice

4-16 Terrestrial Habitat Map

4-17 Terrestrial Habitat Types: Beach, Beach Dune, and Coastal Coppice

4-18 Traffic Count Locations

5-1 Simulated Waste Concentration in the Dolphin Pen versus Time

5-2 Simulated Waste Concentration outside the Dolphin Pen versus Time

5-3 Maximum Waste Concentration in the Model Domain

5-4 Field Methods for Recording Hydroacoustic Data and the Hydrophone

5-5 Example Time Series of Ambient Conditions and Power Spectral Density Analysis of Ambient Conditions

5-6 Time Series Data from Acoustic Recordings of a 55-Foot Inboard Motor Boat Operating at a Distance of Approximately 90 Feet from the Proposed Project Site and Average Spectrum

5-7 Existing Public Beach Access to Remain Unchanged

7-1 Sand, Seagrass, and Coral Monitoring Sites for Pre- and Post-Construction

NONTECHNICAL SUMMARY

The Government of Anguilla requires an Environmental Impact Statement (EIS) for the proposed Dolphin Discovery facility at Blowing Point Harbour. Therefore, Applied Technology and Management was retained by Dolphin Discovery (the Developer) to complete an EIS for this project. The project includes construction of submerged pens and upland exhibits and support facilities.

This EIS has been prepared in compliance with the approved Terms of Reference (TOR), which are included as Appendix A. The new proposed development site is located on an approximately 2-acre parcel of coastal land at Sandy Point, in Blowing Point Harbour. To the south of the proposed project lies the sea, to the north lies vacant undeveloped land, and to the east and west lie beachfront villas. Approximately 0.25 miles to the east of the proposed project site, is the Blowing Point ferry terminal.

The proposed project construction will take place both in the open water and on the upland. The water side of the project includes submerged pens with fencing to contain the dolphins, boardwalks and stationary docks supported by pilings, and a pier to access the over-water facility. On the upland, construction includes various support, commercial and recreational facilities, including a warehouse, restaurant, guest lockers, restrooms, swimming pools, and veterinary/staff buildings. The restaurant will be accessible by guests and the public. Parking, reception, first aid, retail, accommodations, and restrooms are discussed in the project description in Section 2.0. Recreational activities to be offered include swimming with dolphins, sunbathing, snorkeling, swimming, viewing the garden, fountains, and bird exhibit and dining.

Predictions of infrastructure requirements are based on the facility previously operated by the Developer in Meads Bay. That Dolphin Discovery facility operated for over ten years before closure due to land redevelopment by another party. For the Blowing Point project, 25,000 visitors are expected with an annual increase of 10 percent, based on data from the site in Meads Bay.

According to the Developer, the facility will remain open to the public during normal business hours, 365 days of the year. The Developer has demonstrated that they will ensure the animals' welfare and veterinarians will monitor the dolphins' health and provide appropriate care.

Anguilla's legislation and policies related to this project include the setback policy for coastal structures and waste management. International regulations applicable to this project include the Convention on International Trade in Endangered Species (CITES). Dolphins, while not endangered, are listed under Appendix II for management under CITES. The project will conform to the laws and treaties to which Anguilla is a party.

This EIS does not address the ethical aspects or marine mammal harvest issues related to keeping dolphins captive, a subject that was not included in the Terms of Reference. However, the dolphins in this facility will be transferred from other sites (including Meads Bay), and future expansion will be done through captive breeding and transfer from other facilities. Summaries of public meetings and consultation will be provided in the socioeconomic report, Appendix B.

Environmental concerns include but are not limited to how the pen structure may affect the beach, water quality changes from dolphin wastes, attraction of sharks to swimming areas, dolphin health concerns, emergency management measures, and visual impacts. All questions initially posed to the Developer during the sphere of influence meeting with the Anguillan government on October 5th 2007 are listed in Appendix A. The cultural and socioeconomic concerns were addressed by Young's Consultancy Services and their report is included as Appendix B. However, visual and traffic impacts as addressed by ATM are discussed in the body of this report.

The physical and biological effects should be low if the construction and operation of the facility follows the guidelines in this document. The project is not located in proximity to particularly sensitive or protected areas, nor significantly threatening the extinction of endangered species. It does change the level of general use of the area from residential and recreational to commercial and low density recreation. It also will impact terrestrial and limited marine habitats, affect adjacent landowners and visitors of the adjacent beach villas, and create an aesthetic change due to the new structures on the beach, sea and land. Visual impacts will occur, but the structures are low profile and will be minimally obtrusive in terms of lighting and architecture. The effect on coastal water quality during the operational phase should not be significant, but may be moderate during construction (pile driving). Monitoring and best management practices are proposed to mitigate the effects of the project on the environment. Shoaling risks should be

evaluated by monitoring the adjacent beaches for evidence of coastal erosion or accretion due to the project.

There will be positive effects in terms of job and educational opportunities for residents of Anguilla. While socioeconomic aspects are addressed in Appendix B, traffic and public access are addressed in this volume. The change in traffic will be an approximately 1 to 2 percent increase in cars, and public access will be altered by a new beach feature. Because most visitors to the new facility will be engaged in dolphin activities, additional user pressure on the beach will be low.

The permanent impact to the area's environment will be the conversion of the upland undeveloped lot to a recreational amenity and construction of the ocean pen. To affirm these limited impact findings, there are recommended monitoring plans for sediment transport, downstream beach effects, water quality, and seagrass and coral. In addition, the project impact will be mitigated by providing recreational and educational facilities to which the public is welcome.

It should be noted that ATM did not complete any engineering design work for this project. The Developer utilized other engineering firms for the design of the proposed project. Based on available information, including that provided by the Developer, it appears that the project will not have a significant negative impact.

1.0 INTRODUCTION

Dolphin Discovery proposes to construct a new dolphinarium attraction in Blowing Point Harbour. Figures 1-1 and 1-2 provide general and specific location maps for the new dolphin facility. The purpose of the project is to entertain and educate visitors to Anguilla, using encounters with bottlenose dolphin in a natural habitat. The Developer, Dolphin Discovery, needs the project because it must relocate their existing dolphin encounter business from an inland location on Meads Bay to a new facility. The existing facility houses its dolphins in tanks and offers dolphin interactions and an aviary.

The scoping process for this Environmental Impact Statement (EIS) was initiated by Dolphin Discovery early in the planning process. The Developer's application to the Planning Department (dated June 12, 2007) began the formal process for consultation. The government response included the Terms of Reference for this EIS. The letter (from Vincent Proctor, undated) stated that the "EIA must assess the proposed development; highlighting the likely impacts on the terrestrial and marine ecosystems, and the effects the proposal may have on the socio-cultural activities in the immediate surroundings. In addition, it should seek to make any recommended mitigation measures."

A draft sphere of influence (SOI) was submitted to Planning on October 1 by the Developer. The SOI was discussed at a meeting on October 4th and the response was prepared on October 10. The expanded sphere of influence and all correspondence is shown in Appendix A.

Site visits in September and October 2007 have included field surveys, meetings with the Government of Anguilla and nongovernmental organizations and stakeholders such as the Anguilla National Trust. Other stakeholder involvement includes phone and email correspondence with Government agencies throughout the development of the EIS.

The following sections describe the project, alternatives to the project, the site selection process, existing conditions within the SOI, potential impacts within the SOI, how the proposed project relates to other projects in the area, and other specific requested information detailed in the TOR.

2.0 PROJECT DESCRIPTION

The proposed new Dolphin Discovery facility includes a large, open-water dolphinarium located in Blowing Point Harbour. The dolphinarium will provide a number of underwater fenced dolphin pens and will be accessed by a pier that will extend from the beach. Figure 2-1 provides a satellite image of the project site and the surrounding area. For reference, the site boundary and conceptual master plan, including the dolphinarium footprint, are included on the satellite image (Figure 2-1).

The proposed overall development will include construction of an approximately 1.49 acre open water dolphinarium and 1.82 acres of upland support, commercial, and recreational areas (Figure 2-2). The proposed upland master plan is shown in Figure 2-3. Based on the conceptual master plan, the back-of-house facilities will include a 1,200 square foot warehouse. The warehouse will be constructed at the northwest corner of the property. A building adjacent to and south of the warehouse will house a veterinary laboratory, feed preparations, and trainer facilities. Guest facilities will also include a locker room equipped with multi-stalled restroom facilities. A retail shop will be located at the center of the upland development area and a restaurant will be located towards the northeastern corner. The restaurant's maximum capacity is estimated to be 200 persons.

Visitors to the proposed Dolphin Discovery facility will have access to a pool, two Jacuzzis, fountains, and a lounge area. To construct the pool, material will be excavated to a depth of 4 feet, which is above the water table. This means that excavated material will not need to be dewatered. Excavated material is to be used on site or removed from the site as the project's needs require. There will also be an area to house and display seven birds and a red footed tortoise.

2.1 DOLPHINARIUM

The focal point of the Dolphin Discovery project will be an open water dolphinarium. As proposed, the dolphinarium will provide a number of fenced pens for the dolphins, including one large main pen and seven smaller holding pens (Figure 2-4). Figure 2-5 shows photographs of a similar facility in Mujeres, Mexico. Figure 2-6 is an artist's rendering of the proposed facility, as seen from shore.

The dolphinarium will be accessed by a 208-foot-long pier, and the entire structure will extend outward from the shoreline approximately 340 feet. Overall, the dolphinarium will measure approximately 282 feet by 226 feet. The dimensions of the main pool will be approximately 262 feet by 140 feet. The seven holding pens will be of equal size and will measure approximately 34 feet by 62 feet. The depths in the main pen will vary from 8 to 15 feet, with an approximate average depth of 12 feet. Depth in the smaller pens will vary from 10 to 16 feet depending on location. No excavation will be required to obtain and maintain this depth. More detail is provided in Appendix C.

Docks constructed out of wood will border all the pens. The main dock surrounding the overall perimeter of the dolphinarium will be 10 feet wide, which is the same width as the dock leading out to the dolphinarium.

The main pool and smaller pens will be enclosed with fencing extending from the underside of the docks down to the sea bottom. The fencing will be standard chain link fence (approximately 2-inch mesh) that will be coated with a green-colored vinyl. The top of the pen fencing will be secured underneath the decks or from the pen cross braces. The pen fencing will be held to the sea bottom using concrete weights. To accomplish this, the fence will be cut to a length approximately 5 feet longer than the water depth, so that the last 5 feet of fencing will form an apron that will lie on the bottom, with the apron bending toward the inside of the structure. Concrete weights in the form of 15-foot-long concrete beams (10 by 10 inches square in cross-section) will be placed and secured on top of the fence apron. Figure 2-7 depicts the construction plans for the dock structure.

Once in place, the fencing will not restrict water flow or endanger the integrity of the pen structure. The staff will inspect the fencing daily and any debris will be removed manually. The fencing will be replaced approximately every 2 years.

2.2 PROJECT CONSTRUCTION

Project construction includes driving piles for the dock structure, constructing the docks, and upland siteworks. A conceptual construction schedule is shown in Figure 2-8.

2.2.1 EQUIPMENT

The following types of equipment may be used during the development of the project.

Standard Equipment and Machinery

- Tracked excavators
- Graders
- Backhoes
- Pile-driving equipment
- Dump trucks
- Pickup trucks
- Concrete pumps
- Motor mixers
- Concrete cutting equipment
- Rebar bending machines
- Welding equipment
- Materials hoist
- All other standard construction equipment

Marine Transport and Equipment

- Crew vessel
- Marine pile-driving equipment

Non-Mechanical

- Levels and setting out equipment
- Scaffolding
- Ladders
- Personal safety equipment
- Environmental compliance materials (turbidity curtains, silt fence, etc.)

Specialist Equipment

- Cement storage silo
- Concrete batching plant
- Ready mixed concrete trucks
- Aggregate storage bins
- Lumber racks
- Testing equipment

Additional machinery to be permanently located onsite includes a backup generator and heating, ventilation and air conditioning (HVAC) units.

2.2.2 PILE DRIVING

The process of sinking pilings will be carried out by placing the output of a motorized water pump at the end of the piling and aimed down into the sand. The water pressure created by the pump will excavate the sand and enable the sinking of the piling under its own weight. If, during pile-driving operations, hard substratum is encountered, a pneumatic jackhammer will be operated underwater to facilitate the passage of the piling. If the substratum is such that significant jack-hammering is required, a 4-foot-square hole will be excavated to a depth of 2 feet and concrete will be poured to secure the piling at the ocean bottom. It should be noted that

the perimeter of the area where the proposed dolphinarium is to be built has already been tested and no more than 5 percent of the piling installations may require jack-hammering. Also, proper turbidity control methods will be used during these operations.

2.3 PROJECT OPERATION

2.3.1 ANIMAL CARE

Initially, eight dolphins will be kept in the new open water facility. However, it is expected that an active reproductive program will increase those numbers to 15 over the next few years. All dolphins will spend the majority of their time (approximately 90 percent) together in the main pool. During programs (30 minutes long), some animals may be kept in holding pens. A pregnant female may be separated for 3 to 4 weeks towards the end of her pregnancy. She and her calf would be reintroduced to the group 2 to 3 weeks after the birth.

Ongoing observations will occur daily by both the behavior and medical staff. An experienced contract veterinarian accompanied by either a staff veterinarian or a local contract veterinarian will conduct monthly evaluations. The Dolphin Discovery project will employ numerous highly qualified professionals with experience in the area of marine mammal care. Complete physical examinations, including cytology and blood chemistry, will be conducted at least every 6 months. Behavioral records, feeding records, and medical and laboratory records will be kept on file for both research and inspection purposes. All relevant staff members will be trained on animal evaluation, including diseases, pathogens and injuries that are known to occur in captive bottlenose dolphins. Figure 2-9 shows Dolphin Discovery veterinarians and technicians caring for dolphins in a Mexican facility.

Cleaning, food preparation and personal hygiene procedures such as hand washing and the use of footbaths will be taught to each staff member. Medical staff and assistants will be trained on surgery room cleanliness procedures, and pre-operation and post-operation cleaning procedures.

All feeding and food preparation protocols, as well as cleaning protocols, will be drafted and followed as part of a written Operations Manual. The bulk food supply will be stored off site in a cold storage facility (location currently undetermined). At least a two-week supply of food will be maintained onsite, in a freezer storage unit that is designated for animal use. Daily rations will undergo a dry-thaw process and will be weighed and stored in individual animal buckets. All

buckets will be thoroughly iced and stored in refrigeration units. All food preparation equipment (including buckets, sinks, scales, etc.) and facilities will be cleaned and disinfected daily or more often as needed. The project will follow the US Department of Agriculture's regulations for preparation of food (Appendix D).

The aviary will include two cockatoos, blue and gold macaw, two eclectus parrots, a blue-fronted parrot, and a toucan. The diet for the birds is based on seeds, croquettes, fresh fruits and vegetables. The croquettes (Mazuri) contain all the nutrition facts required by each bird, and the fruits, vegetables and seeds are selected to offer the best food quality. They also eat apples, bananas, pears, mangos, beets, carrots, soy beans, oranges, tangerines, papaya, and pumpkin. They have water available at all times. Bird cages consist of wooden framed cages protected by metal fence and sandy floor. At night the cages are covered with tarps to protect them from the wind. In the cages there are natural perches with a specific place for the food and water.

The facility's red-footed tortoise eats vegetables such as carrots, lettuce, green beans, and canned food. It lives on a sandy floor enclosure with small wooden walls and a roof. All cages are cleaned daily and the sand is changed once per month. Veterinary care includes routine preventive medicine, daily checks on the animals, areas, kitchen, diet, and monthly laboratory checks for diseases and parasites.

2.3.2 INFRASTRUCTURE AND UTILITIES

The proposed project does not include a desalination plant or onsite wastewater treatment. The source of potable water will be municipal water. Wastewater will be collected and contained in storage tanks, and will be regularly removed by a local contractor for proper disposal. There may be a limited amount of gasoline stored onsite for generator use. There should not be significant impacts from off-gassing.

Chemicals stored and used at the proposed facility will be typical and will include those related to general cleaning, pool maintenance, and landscape care. The storage and use of these chemicals will be such that vapor discharges will not adversely affect air quality or human health.

The Terms of Reference requires specific material descriptions for what the facility uses as well as generates. During operations, materials consumed include:

- Food for dolphins (frozen fish)
- Restaurant supplies
- Consumables: toilet paper, detergents, office supplies
- Merchandise: craft and souvenir items, etc.
- Electricity
- Potable water
- Telecommunications

Outputs include:

- Air emissions: emissions from vehicular traffic
- Operational noise: sound levels during daylight hours
- Dust from routine maintenance of the facilities
- Storm runoff and grey water wash basins, showers and kitchens. These will be filtered to remove oil and grease and routed to the drainage swale.
- Solid waste collection: Solid waste is expected to include office waste, restaurant waste (organic waste, plastic bottles, tin cans) and shop packaging materials, etc. A collection facility will be located onsite near the parking lot. It will be constructed of concrete to allow for easy cleaning, and will be designed to facilitate truck access. An approved contractor will be contracted to take the solid waste to the nearest landfill.
- Sewage, which will be collected and then transported to a sewage treatment plant. There will be no discharge of sewage effluent.

Specialized materials which are used at the facility such as feed, medicine, and other items (including cleaning chemicals), include:

- Mazuri Vit
- Megace
- Ulsen
- Rimadil
- Augmentin
- Ceporex
- Azantac
- Ciproxina
- Unival
- Valium

- Flagil
- Alcohol
- Palmolive dish soap
- Bleach
- Fabuloso

Additional details on construction materials will follow. The following sections describe wastewater and sewage as specifically requested by the Terms of Reference (Appendix A.)

2.3.2.1 Wastewater and Sewage

Wastewater sources will include the restroom facilities, feed preparation room(s), veterinary laboratory, and restaurant. These sources will generally be more active during daytime hours. Wastewater generated by the Dolphin Facility will be collected and transferred to a cistern/holding tank located at a utility site within the development. The collection tank is estimated to be 3,000 gallons in size. Based on the existing collection cycle, the average annual volume of sewage produced is approximately 36,000 gallons per year. Any required analysis of the raw sewage collected in the underground storage tanks will be carried out by a local, licensed contractor.

The wastewater collection and transmission systems will transport the wastewater via gravity in order to minimize the use of pumps and mechanical equipment which require additional maintenance and power.

The wastewater collection system will be designed to handle estimated peak hourly flow conditions such that even during peak conditions, the wastewater will be transported away from the event/entertainment areas in order to eliminate any potential nuisance from overflows and backups in the system.

The sewage system will be operable continuously throughout the year. The frequency of pump-outs for transport off site may vary depending on the amount of sewage generated during low to high occupancy. Current operations average one pump-out per month.

2.4 PROJECT ALTERNATIVES

Alternatives to the proposed project which were considered include no build, alternate ocean location, and an inland location. Required criteria for the site include visitor access, which in the case of the proposed project is provided by the ferry landing and existing road system, clean

clear water and sand bottom for the ideal setting for tourists and dolphins, and sufficient protection from wind and waves to allow for swimming and comfortable living for the dolphins.

2.4.1 ALTERNATIVE OCEAN LOCATION

A Sandy Ground alternative was considered but construction was halted based on Government input.

2.4.2 INLAND FACILITY

The existing Dolphin Discovery facility at Meads Bay uses tanks to house the dolphins, instead of the open water dolphinarium proposed for the new facility. Figure 2-10 shows the existing facility. Other site options include another pool facility, which could be located inland. In developing the initial design concepts for the new facility at Blowing Point, the fundamental consideration was whether to use a tank system or to design the new facility around an open-water dolphinarium. The decision was made to use the dolphinarium, which offers a number of advantages over tanks. The primary benefits afforded by the dolphinarium are more space and better water quality for the dolphins. The large, open water pens within the dolphinarium will provide a more natural, enriching environment, which will contribute to a very well balanced lifestyle for the dolphins. The presence of other marine life around the dolphin pens, as well as daily fluctuations in local weather and sea conditions will also provide excellent physical and mental stimuli for the dolphins. In addition, the natural marine water that will flow through the dolphinarium will preclude the need for chemical additions to maintain water quality.

Dolphin Discovery is committed to provide high quality, educational, and entertaining interactive experiences to its guests. The natural marine setting provided by the dolphinarium is more conducive to achieving the Dolphin Discovery company mission: “We bring happiness to our guests while making their dreams come true.” The larger space provided by the dolphinarium will allow bigger groups to participate in interactive programs, as well as provide more flexibility in managing the interactive sessions.

There is also a substantially lower energy requirement to operate a natural facility versus an artificial pool. This energy savings and conservation benefit has even greater importance on a small island such as Anguilla.

2.4.3 NO-BUILD ALTERNATIVE

Dolphin Discovery currently operates an existing facility on Anguilla at Meads Bay, an operation that has been a substantial contributor to the tourist-based Anguilla economy. However, the Meads Bay site must be vacated by mid-2008 and, consequently, the dolphin facility must be relocated. Without approval for a new site, the Dolphin Discovery facility on Anguilla will be forced to cease operation. If Dolphin Discovery ceases operations on Anguilla, the resident dolphins would be relocated to other Dolphin Discovery facilities in other countries. However, except for a few management positions that would also be reassigned to other Dolphin Discovery facilities, the majority of the staff from the Meads Bay facility would be terminated.

In addition to the economic losses that would result from the loss of the Dolphin Discovery operation on Anguilla, the local economy would also not realize the net gain that would result from the new, expanded dolphin facility proposed at Blowing Point. The new facility will be larger than the existing Meads Bay facility and will house a larger group of dolphins. The larger facility and more dolphins provide the opportunity to host more visitors per year than the current Meads Bay facility. The increased number of visitors will necessitate a larger staff, which will, in turn, provide more employment opportunities within the local economy.

If Dolphin Discovery ceases operations at the existing facility, and does not build the proposed project, no environmental effects will occur.

3.0 ANGUILLA'S LEGISLATION AND PLANNING POLICIES

3.1 PHYSICAL POLICIES AND LEGISLATION

Applicable legislation and policies in Anguilla pertaining to land and planning include the following.

- **Land Development (Control) Act & Regulations** –*sets out planning and building requirements and restricts the development of land (including ponds) without firstly obtaining Planning Permission from the Land Development Control Committee (LDCC) which is set up under the Act.*
- **Registered Land Act & Regulations** – *governs and regulates the registration of lands including registrations of transfers, charges, mortgages, leases, easements and appurtenances. Governs ownership, possession and acquisition of property generally.*
- **Building Act & Regulations** – *governs requirements for erection, re-erection, alteration of buildings and inspections relating to fitness of structure and restricts building without firstly obtaining Building Permission from the Building Board which is set up under the Act.*
- **Condominium Act & Regulations** – *governs development of condominiums and strata corporations and applicable rules pertaining to the use of common property.*
- **Alien Landholding Regulation Act** – *governs restrictions on acquisition of land by Aliens, and providing for any acquisition to be obtained on application and with grant of a license after payment of the applicable fee and stamp duty.*
- **Access to Beaches Act** – *grants rights of public access to any beach and stipulates penalties for any hindrance or wrongful interference with rights of access.*
- **Beach Control Act** – *governs the foreshore determined to be owned by the crown as well as the floor of the sea, which may not be used for any commercial purpose without a license from the crown.*
- **Beach Protection Act** – *prohibits the removal of sand, stone and gravel from a beach, and additionally empowers the Governor to declare any beach to be protected.*

3.1.1 BEACH ACCESS AND PROTECTION

The Access to Beaches Act defines a beach as including “the land adjoining the foreshore of Anguilla and its islands and extending not more than 100 feet beyond the landward limit of the foreshore”. The Beach Protection Act, however, provides that a beach includes “the foreshore

and the land adjoining the foreshore extending to a distance of 200 feet beyond the landward limit of the foreshore". What may be considered as a more suitable definition of beach may be found in the Physical Planning Bill 2005 (which is not law). According to this Bill, a beach means the area of the coastal zone from the seaward line of the foreshore running inland to the line of permanent vegetation or other natural barrier, whichever is closer.

Anguilla's policies regarding beach and coastal protection extend upland of the beach to account for storm surge, hurricane effects, erosion, sea level rise, and the inherently variable nature of beaches. Setback policies use the line of permanent vegetation as the baseline, not the mean high water mark, as the vegetation line is more constant than the shifting boundary where the sand meets the sea.

Development setback requirements have been designated on a case-by-case basis for each of the island's beaches. Each beach requirement is developed by a methodology that considers the following three components (Roberts-Hodge, 2000 and Cambers, 1997).

1. Changes in coastline position based on recent and historic patterns;
2. Changes in the position of the dune line/coastline resulting from a major (Category 4) hurricane; and
3. Changes in the position of the coastline resulting from coastal recession because of predicted sea level rise over the next 30 years.

Blowing Point Beach is a protected beach, as defined by the Beach Protection Orders, Revised Regulations of Anguilla, B25. The setback at Sandy Point has yet to be defined for this specific project. General recommendations for resort developments are to have a setback of 75 to 100 feet landward from the permanent vegetation line. The exception to this rule applies to beach bars and restaurants, which may be 25 feet from the vegetation line if they are wooden and on piles. To comply with the recommendations of the Government of Anguilla's policy towards beach development, a setback of 75 feet from the beach vegetation line will be preserved between buildings where possible. This will protect buildings from storm surges, decrease erosion problems along the beach, and reduce risks to buildings from sea level rise, as advised by the Government.

3.1.2 CULTURAL AND COMMON LAW PRACTICES

Anguilla has always been a community that depends on fishing and boating. Access to the beach and the sea for fishing and recreation has always been a common practice among Anguillians over the years. Access easements ensure continued access to the beach and water. The development plan ensures open and free access to the beach and coastline with the exception of the pier structure and pen.

3.1.3 ENDANGERED SPECIES AND NATIVE PLANTS AND ANIMALS

Legislation in Anguilla regarding environmental management and conservation is very limited. The Anguilla National Environmental Management Strategy and Action Plan for 2005 to 2009 recognizes these limitations and has recommended the implementation of St. George's Declaration of Principles for Environmental Sustainability in the OECS, 2001, which Anguilla signed in April 2001. Pursuant to the Anguilla Environment Charter, signed on 26 September 2001, the Government committed to promote and encourage environmental awareness, considerations, legislation and policies.

The Anguilla National Trust (ANT), Department of Fisheries and Marine Resources, and Department of the Environment implement protection of Anguilla's endangered species, including reptiles such as the endemic Anguillian racer, as well as internationally endangered sea turtles. The project team has consulted with ANT throughout the planning process.

The Native Plant and Animal Habitat Conservation (Biodiversity) Policy was approved by Executive Council on 4 October 2001. The Policy concerns protection of key habitats and species through establishing national parks and other protected areas. The Policy also refers to the Government taking necessary measures to control the escape or introduction into the environment of any alien or modified organisms that are likely to adversely impact the environment.

The project may also include eradication of non-ornamental exotic species, which is another goal of the policy. Exotic species removal will be coordinated with the Department of Agriculture, and the project will avoid introduction of invasive species by careful selection of landscape plants.

As an overseas territory of the United Kingdom, Anguilla is party to the Convention of Wetlands of International Importance especially as Waterfowl Habitat, also known as RAMSAR. RAMSAR sites on Anguilla proposed for designation include several salt ponds on the mainland, including Cauls Pond, Cove Ponds, Road Salt Pond, and Savannah Pond. None of these ponds are located within the proposed project area.

3.1.4 SCENIC AND CONSERVATION AREAS

Anguilla's scenic beauty includes clear views of the shoreline and coastal areas. To protect this natural resource, Anguilla's Building Height Policy and Guidelines of 2004 recommends that building height be controlled. Further, it recommends that developments be planned in a manner consistent with the scale of development, neighborhood character, and proportion in the area. Per the 1996 National Land Use Policy and the updated Building Height Policy of 2004, the height of all buildings and structures in the immediate coastal portion of the project area is limited to 42 feet above ground level (Policy HT2).

The Draft Open Space Policy and Guidelines includes salt ponds as open spaces to be conserved for the enjoyment and appreciation of all visitors and residents. By preserving West End Pond under a special management plan, the project will help to achieve the goals of the Open Space Policy. The proposed Physical Planning Bill (under reconsideration, and not considered law), provides that an environmental protection area means any area declared to be one by the Government. No environmental protection areas have been designated within the project area at the time of this report.

The proposed project does not affect any areas designated as protected by the Marine Parks Act. These include Sandy Island, Prickly Pear Cays and Seal Island, Dog Island, Little Bay and Shoal Bay, and Island Harbour, which were designated as marine parks by the Department of Fisheries and Marine Resources in 1993.

3.1.5 WASTE DISPOSAL, NOISE AND AIR QUALITY

Legislation pertaining to waste disposal and noise quality and pollution is very restricted and would not apply to the present development. The Litter Abatement Act pertains to the disposal of general litter and the Sound Amplification Act specifies the amplification of sound.

3.2 POLICIES OF OTHER MINISTRIES

3.2.1 TOURISM POLICIES

Anguilla prides itself on maintaining a high-end, upscale tourism product. The goal of Dolphin Discovery is to provide high quality, educational, and entertaining interactive experiences to its guests.

3.2.2 REAL ESTATE AND LAND POLICY

The area of the project is zoned for Tourism and Resort/Residential according to the National Land Use Plan. The project is also consistent with land policies, which restrict the use of beachfront properties to tourism development and not for single residential use.

3.2.3 LABOR AND IMMIGRATION POLICY

There is a general restriction on the use of non-Anguillian employees except in cases where an Anguillian is neither available nor competent to conduct the tasks. In the latter situation, where possible, an Anguillian understudy must be employed to learn the duties of the non-Anguillian.

3.3 INTERNATIONAL ACCEPTED OR SCIENTIFIC STANDARDS REGARDING ANIMALS KEPT IN CAPTIVITY

There are no local standards for dolphins that are kept in captivity that apply to this project. The Developer will comply with accepted standards for other Caribbean nations as presented by the Government of Anguilla. Minimum suggested standards to use are the human swimming water quality criteria used in the state of Florida. Secondary guidance from similar facilities such as in Ocho Rios, Jamaica, include ensuring that the water quality criteria that are maintained are within human criteria as these are considerably more stringent than those established for dolphins.

The pens are exposed to the open ocean and, as such, water quality is refreshed by the tidal cycle. Rather than a pen or enclosed bay, the dolphins have the most open pen practicable to simulate their natural environment. This allows for maximum natural space and sensory stimulation. The proposed ocean pen environment will provide a higher quality of life for the dolphins currently housed at the Meads Bay facility. Dolphinaria industry standards are that an average adult dolphin has 290 cubic meters of space each for the first four dolphins, plus an additional 125 cubic meters for every 2 additional dolphins. Using these criteria, 8 dolphins would require a minimum volume of approximately 800 cubic meters. Jamaica has established

guidelines for dolphins and space requirements as well. The eight dolphins would require only 250 square meters in captivity, which is roughly equivalent to 0.06 acre. The project exceeds such space requirements for dolphins in captivity by over 10 times, as the facility is approximately 1 acre.

Dolphin Discovery follows the guidelines for international trade in bottlenose dolphins under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The primary source of dolphins will be from captive-bred stock; however, some import from other facilities may be necessary to maintain genetic variability. This program is an international agreement, or convention, between governments. The purpose of CITES is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. It is a convention to which countries voluntarily sign. Signatory countries become Parties to the convention. As a dependency of the United Kingdom, Anguilla is a Party to the convention because the United Kingdom is a signatory.

CITES carries no inherent regulatory authority. However, countries that are Parties to the convention establish a CITES management authority that has regulatory authority within that country, issuing (or denying) import or export licenses as appropriate under the provisions of the convention. In the case of bottlenose dolphins, regulation under CITES Appendix II applies only to export. Persons wishing to transport a captive dolphin from one country to another must obtain an export license, but no import license is required.

4.0 DESCRIPTION OF ENVIRONMENT

The Sphere of Influence (SOI) boundaries are provided on Figure 4-1. The SOI boundaries were determined by the Land Development Control Committee and forwarded to Dolphin Discovery by a letter (with an attached map) from Vincent Proctor, Secretary, Land and Development Control Committee, dated 10 October 2007 (copy included as Appendix A). The SOI includes both a Marine Impact Zone and a landward Sociocultural Impact Zone, as indicated on Figure 4-1. The Marine Impact Zone includes all of Blowing Point Harbour. The Sociocultural Impact Zone includes the entire Blowing Point area, including the adjacent villages of Cul-de-Sac and Rendezvous. Mr. Proctor's letter transmitting the SOI specifically states that the sociocultural aspects of the EIS shall address the effects of the proposed Dolphin Discovery facility on beach users, and the effects of an increase in traffic on the Cul-de-Sac area.

Blowing Point Harbour is a working harbour. To the east of the Anguilla Ferry Terminal there are small ferries and fishing boats anchored in the bay along with fishermen working along a 200 yard stretch of Blowing Point Beach. There is a dock for the ferry, which travels between the marina at Marigot on St. Maarten and Blowing Point. The ferry is a popular means to travel between St. Maarten and Anguilla.

To the west of the ferry terminal is Sandy Point Beach, at the far end of which is the proposed location of the Dolphin Discovery facility. The waters off Sandy Point Beach are less busy with marine traffic than those off Blowing Point Beach. This is likely due to the sand spit that forms on the western point of the harbour, making navigation more difficult. In addition, approximately 300 to 500 feet out from the Sandy Point is a reef system and sand bar.

The project site is currently undeveloped. With the exception of an unpaved beach access road, the site is vegetated with low-growing evergreen trees and shrubs characteristic of coastal coppice/evergreen bushland, as well as typical beach dune vegetation. There is no evidence of past structures that would indicate any recent use of the site.

The upland area of the project site is of low topographic relief vegetated primarily by low-growing evergreen trees and shrubs characteristic of coastal coppice, as well as typical beach dune vegetation. Nearby and adjacent to the upland project area are several hotels, villas, and/or eateries. Figure 4-2 shows the existing conditions from the vantage point of the sea.

4.1 PHYSICAL ENVIRONMENT

4.1.1 GEOLOGY

Anguilla, along with Antigua and Barbuda, is geologically different from the remainder of the Leeward Islands. While most of the Leeward Islands (and Windward Islands) are typical of island-arc volcanic islands associated with active plate boundaries, Anguilla is comprised of the exposed part of a carbonate platform and is a karst (solutionalized limestones/dolomites) landform. Karst landforms are typified by the presence of highly weathered limestones, solutional enlargement of fissures and fractures, sinkholes, vugs (rock cavity/void), and caves. Disappearing streams and/or a lack of land surface drainage ways are also typical of karst landforms because surface water can run underground through the porous bedrock.

Most carbonate banks are comprised of coral detritus, carbonate mud, coral and coralline algal-derived sediments, and oolitic and pelletal sediments. Anguilla is comprised primarily of limestone formed from skeletal coral, marls (carbonate enriched mud), and carbonate sand (possibly oolitic). The exposed and shallow carbonate sequences overlie deeper basement rocks comprised of typical island-arc volcanics.

4.1.2 TOPOGRAPHY AND PHYSIOGRAPHIC FEATURES

Anguilla is generally less rugged and has less topographic relief than most of the other Leeward Islands. Anguilla is characterized by low rolling hills and the maximum elevation on the island is approximately 200 feet mean sea level (msl). Figures 1-1 and 1-2 are developed from the Ordnance Survey 1:25,000 topographic map for Anguilla and provide the topography for the project site and the surrounding area. The project site is located along the shoreline within Blowing Point Harbour, between the ferry dock to the east and Sandy Point to the west. Site elevations range from sea level at the shoreline to approximately 25 feet along the north property boundary.

4.1.3 SOILS

Anguillian soils, being derived primarily from carbonate rocks, are alkaline and may be excessively alkaline. The thin soils developed on limestone may have only one or two soil horizons above bedrock; Anguillian soils would likely be classified as immature, or protosols. There are two major soil groups, pedalfers and pedocals. Pedocals are typical of arid to dry areas and have high calcium content. Anguillian soils would be expected to be pedocals.

Some upland areas of Anguilla may have soils comprised of red clays consisting of insoluble iron and aluminum oxides (laterites). Two soil types comprise the laterites that may be present: aluminous laterite (red loam) and immature aluminous laterite (stony loam). Aluminous laterite contains high concentrations of free sesquioxides and aluminum, humus is absent, and the soil is essentially sterile. Immature aluminous laterites appear as shallow, highly weathered dark brown clay and pebble mixtures with a fair amount of organic material in the upper horizon. The lower horizon has a high concentration of free sesquioxides in a hard, dry, and crumbly texture.

Other soils present on Anguilla include sandy soils (Whiteland) and organic mucks. Whiteland soils are comprised of geologically recent (Holocene) marine calcareous sands. The upper horizon is usually grayish-brown and less than 12 inches thick, and the rest is pure mineral sand. This soil type is usually found as a narrow, discontinuous strip along the coastline. Organic soils are deep peat-rich soils that occur in wide swales and other low-lying areas that are subject to periodic flooding and are usually waterlogged to within a foot of land surface.

4.1.4 CLIMATE

4.1.4.1 Temperature and Precipitation

Anguilla enjoys a sunny, subtropical climate. The average temperature ranges between 78°F and 85°F, with July and August being the warmest months and January and February being the coolest. Trade winds blow from the southeast to northeast and help moderate the summer heat. Anguilla is generally dry, with no streams or other fresh water sources. The average annual rainfall ranges between 35 and 40 inches, with the majority of that falling during the wet season, from September to December (Island Resources Foundation, 1993).

Table 4-1 provides average monthly temperature and precipitation values collected between 2000 and 2005 (2003 records were missing) at the Wallblake Airport on Anguilla.

Table 4-1. Meteorological Summary from Wallblake Airport

Month	Average Temperature (°F)	Precipitation (inches)
January	78.9	2.4
February	78.1	1.8
March	79.2	1.3
April	81.1	3.6
May	82.3	2.7
June	83.9	3.1
July	84.5	3.5
August	85.0	3.9
September	84.8	3.0
October	84.1	3.8
November	82.1	4.1
December	80.5	3.2
	Average: 82.04	Total: 36.4

Source: Wallblake Airport Monthly Data.

4.1.5 WINDS

Local wind conditions were assessed using two datasets: 1) the U.S. Army Corps of Engineers (USACE) North Eastern Caribbean (NEC) Wave Information Study (WIS) station located at latitude 18.00°N and longitude 64.00°W; and 2) the Davis Vantage Pro inland station. The WIS dataset is an excellent source of hindcast wave climate information generated for specific offshore locations within both the Atlantic, Gulf of Mexico and Caribbean Sea basins. Information provided includes significant wave height, peak wave period and wave direction as well as wind speed and direction. The period of record available at this station begins in January 1980, and continues through December 1999. The NEC WIS station is located approximately 53 nautical miles southwest of the project site and represents open-water conditions, which are naturally more extreme than those experienced at the project site. WIS station wind records present hourly data of average wind speed and direction. Records for the Davis Vantage Pro station date back to May of 2003 and provide directional wind speed at 30-minute intervals.

Both sources display a predominant easterly wind direction. WIS station records indicate that winds blow from between the north-northeast and south-southeast 86 percent of the time, with velocities less than 22 mph 95 percent of the time. The wind gage on Anguilla shows winds

blowing from the east-northeast to southeast 83 percent of the time, with velocities less than 22 mph 86 percent of the time. Both sources show wind blowing from between the west-southwest and north-northwest about 2 percent of the time.

4.1.6 TROPICAL STORMS

Hurricanes and tropical storms are important environmental factors to consider at this site. Hurricane season for the region extends from June through November, with August and September being the most active months (NCDC, 2004). Seventeen named storms passed within 60 miles of Anguilla from 1964 to 2004. Figure 4-3 shows the storm tracks. Many more have affected the area since records have been kept (since 1851), but are not shown for clarity. Hurricanes Luis (1995) and Lenny (1999) are the most significant recent storms to impact the project site, with large battering waves, storm surge and overwash, and extreme wind speeds. Estimated peak sustained winds during Luis were 105 to 115 knots (120 to 132 mph).

The HURDAT database, maintained by the National Hurricane Center, is the official record of tropical storms and hurricanes for the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea. The database has records for all known tropical systems dating back to 1851 and is used for various applications such as determining risk assessment, establishing building codes, estimating potential losses for insurance and business interests, tropical storm forecasting, and climate change studies. The record reflects that the number of hurricanes in a given period fluctuates cyclically with there being “hurricane rich” periods and “hurricane poor” periods. There are numerous meteorological/climatic factors that contribute to making a given period conducive to hurricane development (air and water temperature, water salinity, atmospheric pressure, etc.) and many forecasters are predicting the next 10 years to be a hurricane rich period.

4.1.7 WAVE CLIMATE

An assessment was made of the offshore wave climate to estimate wave conditions at the project site. Both long-term records and extreme wave events were analyzed to evaluate potential wave conditions at the project site. Wave data from the Wave Information Study (WIS) developed by the U.S. Army Corps of Engineers were analyzed to determine the typical/average long-term conditions. Extreme events are based on parameters in the Design Summary and Detailed Engineering Report for Cove Castles (Smith Warner International, Ltd., October, 1999). Table 4-2 provides the offshore wave heights and periods for extreme storm events for given

return periods. The extreme wave conditions are based on a site along the southern coastline of Anguilla in an area similar to the project site, and are deep water values.

For the average conditions, the WIS data from Station 12 were used. The data are based on long-term wind records, and wave data are hindcasted from 1980 through 1999. The station is approximately midway between Anguilla and the U.S. Virgin Islands. The wave data were transformed to the model boundary using linear wave theory. Desktop analyses were scoped for this project, and detailed wave modeling was not performed. The linear transformation of waves from the deep water to the 10-meter contour assumes straight and parallel contours. Numerical modeling would provide a more accurate analyses of wave conditions, but given the overall calm conditions observed at the site, the desktop analyses are suitable for this study.

Figure 4-4 presents the percent occurrence of the average conditions offshore of the reef adjacent to the project site at the 10-meter contour. Based on the WIS data, the prevailing wave direction is from the east and east-southeast (Top of Figure 4-4). From the bottom of Figure 4-4, approximately 70 percent of the waves have a wave height of 1 meter or less, and the waves typically are not larger than 1.5 meters. The wave periods are generally less than 11 seconds (middle of Figure 4-4), and 34.7 percent of the waves have a period between 6 and 7 seconds, but wave periods ranging from 5 seconds to 8 seconds would likely occur, and represent 81.3 percent of the record.

Table 4-2. Extreme Offshore Waves

Return Period (yrs.)	Significant Wave Height (m)	Peak Wave Period (sec.)
10	10.7	13.8
25	12.9	15.0
50	14.4	15.8

At the project site, the wave exposure is limited based on aerial photography. The site is protected by emergent reefs to the southwest, south, and southeast. The primary exposure to the site is from the south-southeast. Based on the WIS data, 0.1 percent of the waves propagate from this direction, and 0.6 percent of the waves propagate from the southeast. The presence of reefs provides protection to the site from southeast waves; however, these waves can refract and enter the entrance channel from the south-southeast. Examination of the WIS data indicates that the most likely wave from the south-southeast and southeast directions has a

height of 1.1 meters at the 10-meter contour, and the wave period would likely be 6.5 seconds. Applying linear wave theory to transform the waves from the 10-meter contour to the project site (with a typical depth of 3 meters), the 1.1-meter, 6.5-second wave at the 10-meter contour has an estimated wave height of 1.25 meters at the project site.

The project site is potentially exposed to long swell conditions, and the WIS data show that a swell state from the southeast occurs. Based on the WIS data, ocean swell with an 11.6-second period would likely have a wave height of 0.5 meters or less at the 10-meter contour. At the project site, the predicted swell wave height would be 0.62 meters. Based on the WIS data, this event could occur approximately 1 percent of the time.

Because the project site is in shallow water and reasonably protected from offshore wave conditions, the design wave condition would be based on the water depth at the site. For an initial design condition, the depth at the site considered should be 4 meters, not including any storm surge. For irregular waves, the largest wave likely to occur in a depth of 4 meters is approximately 2.4 meters. It is strongly recommended that the design wave for the structure account for storm surge, which would increase the water depth and largest sustainable wave. Table 4-3 provides a summary of the wave and swell conditions anticipated at the project site.

Table 4-3. Summary of Wave Conditions

Condition	Wave Height (m)	Wave Period (sec.)	Occurrence During Wave Record
Wave	1.25	6.5	0.7%
Swell	0.62	11.6	1%
Design[1,2]	2.4	-	-

1. Does not include storm surge, and it is recommended that the design wave height account for storm surge.
2. Depth-limited wave, and the period and occurrence were not assessed.

ATM did not provide the design wave specifications used for structural engineering of the facility. However, the Developer has provided that information in Appendix C. Please note that ATM did no engineering design on this project.

4.1.8 AMBIENT AIR QUALITY

Anguilla is located at the eastern edge of the Caribbean, where the predominantly easterly trade winds bring clean humid ocean air from the Atlantic over the islands. Ambient air quality in the

trade winds is generally high. However, there may be localized areas where Anguilla's air quality is affected by sources of air pollution. For example, the more developed areas may be more affected by automobile and marine vessel exhaust, and areas adjacent to municipal waste incinerators may be affected by air pollution from these utilities. Burning of brush following land clearing may be another source of particulate pollution.

The area around the ferry terminal is a working harbour busy with small fishing boats and ferries. These vessels are sources of periodic hydrocarbon and exhaust emissions and, as a result, there may be localized areas on the west side of the harbour affected by air pollution. The proposed project is located on the far western end of Blowing Point Harbour, which is considerably less busy with marine traffic. With evident sources of air pollution, the project site's air quality is moderate and most similar to Sandy Ground.

4.1.9 SURFACE AND GROUNDWATER HYDROLOGY

No surface water features were noted within the project upland boundaries. The island of Anguilla experiences a dry climate, with average annual rainfall totals between 35 and 40 inches. Droughts can last for several months and evaporation rates are high (Island Resources Foundation, 1993). There are no fresh running surface water streams or other sources on the island. Surface water does exist as salt ponds on the main island and adjacent islands and cays (Dog Island, Scrub Island, and Prickly Pear Cay).

There are approximately 20 individual salt ponds on Anguilla, including the Blowing Point Pond east of the project area. The island's rock substructure consists mostly of weathered limestone, which does not efficiently store percolating rainwater. The majority of groundwater is essentially intruded ocean water. There is, however, an overlying layer of freshwater that is extracted to supply potable water to Anguillian residences (Island Resources Foundation, 1993).

4.1.10 COASTAL AND MARINE FEATURES

Anguilla is a low-lying coral limestone island, which has several offshore islands and cays. The coastline has sandy coves in the south and cliffs to the north. The island is sheltered by extensive reefs off the north coast and by fringing reefs along most of the south coast. These reef systems are an important sand source to the region's beaches. Shallow, sheltered habitats found in the area support large areas of seagrass and macroalgae beds.

The coastal features in the project area include Sandy Point, which is a naturally occurring sand spit on the western point of Blowing Point Harbour. The majority of Blowing Point Harbour is protected by a shallow and exposed offshore reef. Passage into the harbour is through channels in the reef system. Sandy Point is reported to have extended out to the nearshore reef as a tombolo type feature in the past.

The area's bathymetry is presented in Figure 4-5. The bay is protected by reefs on its sides and in the center. Commonly, the types of reefs found in the Caribbean are fringing reefs, which border the shoreline; patch reefs, which are isolated patches of many species of coral measuring only a few yards in diameter; and barrier reefs, which separate the shoreline with deep lagoons and limited channels.

Fringing reefs often grow close to the sea surface and near land, protecting the shoreline from high wave action. Incoming waves break and expend their energy on the reef, thereby sheltering the adjacent shoreline. Waves can reform between the reef and shoreline, but the wave energy is much less than if the reef were not present. When a reef dies and becomes rounded or flattened, higher wave energy causes erosion on the shoreline. However, dead reefs left intact still act as a breakwater for adjacent beaches, help protect the shoreline, and provide a source of sand for the beaches. Where dead coral reefs have been removed, erosion often increases dramatically. In Anguilla, coral rubble is common on the shoreline, indicating underwater damage resulting from storm activity such as hurricanes. This is the case for the coral rubble found in Blowing Point Harbour and within the proposed project sphere of influence. Underwater evidence of storm damage on reefs is also common.

4.1.11 QUALITY OF RECEIVING WATER

It is important that the receiving water be relatively clean and the sediment quality be suitable for dolphins and humans. The type of development surrounding the proposed site provides some surface water filtration and does not likely contribute known major inputs of pesticides, herbicides, industrial chemicals or wastes, or other contaminants of concern. Due to concerns surrounding the adjacent boat traffic and potential contributions of pollution from vessels in Blowing Point Harbour, as well as nutrients and bacteria from sewage, surface water samples were analyzed as follows.

4.1.11.1 Sample Locations

Samples locations were selected to get a characterization of the existing water quality in the area potentially affected by the proposed project. On October 4, and October 18, 2007, a total of three (3) water samples were collected from Blowing Point Harbour. All sample locations are described in Table 4-4 and shown in Figure 4-6.

Table 4-4 Sample Locations

Sample Date	Sample ID	Description Location
October 4, 2007	AQU 1	Down current of the proposed dolphin pen
October 4, 2007	AQU 2	Up current of the proposed dolphin pen
October 18, 2007	WQ 3	Immediately off-shore Sandy Beach, near proposed dolphin pen

4.1.11.2 Parameters Measured

To characterize water quality within the area of interest several parameters were measured, including the following.

- Temperature
- Salinity
- pH
- Dissolved oxygen (DO)
- Biological oxygen demand (BOD)
- Turbidity
- Total suspended solids (TSS)
- Total Kjeldahl nitrogen (TKN)
- Nitrite + nitrate (NO_3)
- Ammonia (NH_3)
- Orthophosphate (PO_4)
- Metals of concern (mercury, arsenic, barium, cadmium, zinc, chromium, lead, selenium, and silver)

A discussion of water quality is provided in the following paragraphs.

Temperature, pH and Salinity

Water temperature and pH can reveal a lot about the biological and chemical processes occurring in the water column. For instance, biological processes generally increase with increasing temperature. Also, warmer water can hold less dissolved oxygen than cooler water. Low pH can result during chronic episodes of low oxygen concentrations and can lead to the damage of living organisms. Many aquatic species have trouble surviving if the pH drops below 5.0. The pH of the water also plays an important role in determining the solubility and bioavailability of many chemicals. These chemicals can be nutrients essential for life, or pollutants that are harmful to living organisms. For example, many metals are more toxic at a lower pH because they are more soluble.

At the time of the sampling effort, water temperature was measured to be 29.0 °C, which is typical of the locale and season. The pH of the water varied between 8.08 and 8.25 (Table 4-5). Water with pH levels between 7.5 and 8.5 are generally considered to represent acceptable pH conditions in marine waters (van Dolah et al. 2002).

Salinity influences the distribution and diversity of many invertebrate and fish species and can be stressful to many organisms when large variations occur over short time periods. Generally, the salinity of ocean water remains fairly constant unless the area of interest is near a confluence with a freshwater source such as a river. For Blowing Point Harbour, there is no significant freshwater source. Therefore, the observed salinity of 33.3 is normal and consistent with salinity observations in other harbours of Anguilla.

Table 4-5 Temperature, pH and Salinity

Sample ID	Temperature (°C)	pH	Salinity
AQU 1	-	8.21	-
AQU 2	-	8.25	-
WQ 3	29.0	8.08	33.3

Total Suspended Solids and Turbidity

Total suspended solids (TSS) is a measurement of the amount of particles suspended in the water column, and indicate the occurrence of sediment run-off from land, the level of nutrients in

the water, or wind/wave energy conditions. High levels of TSS can produce very turbid conditions, which affects the availability of light in the photic zone.

The TSS concentration at the proposed project site was between 8.3 and 19.8 mg/l. For comparison, the TSS concentration at another bay in Anguilla, Cove Bay, was observed to be 8.9 mg/l during an unrelated study (ATM, 2007). Typically, unimpacted marine waters have TSS concentrations below 10 mg/l.

Turbidity was measured at 1.8 NTU. This level of turbidity is low and comparable to other harbours on Anguilla. For instance, turbidity at Cove Bay was 1.08 NTU and turbidity at Meads Bay was 1.7 NTU. Table 4-6 provides TSS and turbidity data.

Table 4-6 Total Suspended Solids and Turbidity

Sample ID	TSS (mg/l)	Turbidity (NTU)
AQU 1	19.8	-
AQU 2	13.6	-
WQ 3	8.3	1.8

Total Organic Carbon, Dissolved Oxygen and Biological Oxygen Demand

Fish and other aquatic organisms depend on dissolved oxygen (DO), which is the oxygen present in water, to live. The amount of DO in a body of water is dependent on several things, including water temperature, respiration, decomposition, photosynthesis, and aeration. Respiration and decomposition are processes that consume oxygen, whereas photosynthesis and aeration are processes that produce oxygen. In general, DO concentrations should remain above 5.0 mg/l to maintain the health of aquatic organisms. Dissolved oxygen can drop to dangerously low concentrations in water bodies that are very warm and/or have an excess of organic matter. Organic matter can originate locally via large growths and subsequent deaths of living organisms (oftentimes phytoplankton responding to an enrichment of nutrients), or organic matter can originate elsewhere and enter the water body via waste water treatment plants, failing septic tanks, and agricultural and urban runoff.

Bacteria use oxygen to decompose organic matter. As bacteria populations grow, they can reduce the DO in a water body very quickly. The rate at which bacteria consume oxygen while decomposing organic matter, i.e., the biological oxygen demand (BOD), can be measured in a

laboratory. A high BOD lowers the DO in water. Currently, there are no freshwater or saltwater standards for BOD in natural waters; however, a BOD below 1.8 mg/l is generally considered normal and a BOD exceeding 2.5 mg/l is considered very high (SCDHEC 1998). As expected for the proposed project site, BOD was quite low and not detected above the method detection limit (1.0 mg/l) (Table 4-7).

In the present study, total organic carbon (TOC) was between 0.34 and 5.0 mg/l at the proposed project site. For comparison, TOC at Cove Pond, another bay in Anguilla, was 0.76 mg/l (ATM, 2007).

Measurements of surface DO concentrations revealed that DO was 6.11 mg/l at the proposed project site, which is above the 5.0 mg/l recommendation. The DO concentration measured in Blowing Point Harbour is comparable to that taken at Cove Bay (6.0 mg/l) earlier in the year (ATM, 2007).

Table 4-7. Dissolved Oxygen and Biological Oxygen Demand

Sample ID	Total Organic Carbon (mg/l)	Biological Oxygen Demand (mg/l)	Dissolved Oxygen (mg/l)
AQU 1	0.577	ND	–
AQU 2	0.343	ND	–
WQ 3	0.50	ND	6.11

ND = the analyte concentration was not detected above the detection limit (1.0 mg/l).

Nutrients

Nutrients in surface water serve the same purpose they do for all life – they are essential for growth. In marine waters, particularly those of the Caribbean, nutrients are present in low amounts. When they become available in large quantities in surface waters, they can cause excessive growth of algae and other plants. The main nutrients of concern for surface waters include phosphorus (total phosphorus or orthophosphate) and nitrogen (total nitrogen, total Kjeldahl nitrogen, nitrate, or ammonia). Measuring these nutrients in their various forms can be complex, but is necessary in order to determine the overall effect. Concentrations of nutrients vary seasonally. Manmade pollution from fertilizers and inadequate waste disposal can enter streams at different times of the year, and in high rainfall events, rain washes organic materials downstream, which then decompose into nutrients. Increased nutrients are almost always an indication of pollution from human activities.

Existing nutrient concentrations at the proposed project site are presented in Table 4-8 and are discussed in the following paragraphs. Generally, there is no evidence of nutrient over-enrichment in Blowing Point Harbour.

Total Kjeldahl nitrogen (TKN) is the sum of organic nitrogen and ammonia in a water body. The measurement of TKN can indicate the origin of nitrogen loads. For example, high measurements of TKN typically result from sewage and manure discharges to water bodies. With TKN concentration varying between undetectable (by the analytical methodology) to 0.24 mg/l at the proposed project site, it is unlikely that there is a significant amount of sewage currently entering the area of Blowing Point Harbour.

At all three sample sites, NO_3 was present in larger amounts than NH_3; only one sample site had a NH_3 concentration above the method detection level. Nitrate concentrations varied between 0.16 and 0.34 mg/l. For comparison, the nitrate concentration in Cove Bay, Anguilla was observed to be 0.28 mg/l in March, 2007 (ATM, 2007).

Readily available phosphorus in the form of orthophosphate was not present above the method detection limit. Total phosphorus varied between 0.06 and 0.14 mg/l.

Table 4-8 Nutrients

Sample ID	TKN (mg/l)	NO_2+NO_3 (mg/l)	NH_3 (mg/l)	TP (mg/l)	PO_4 (mg/l)
AQU 1	0.16	0.34	0.14	0.14	ND
AQU 2	0.24	0.29	ND	0.14	ND
WQ 3	ND	0.16	ND	0.06	ND

TKN = total Kjeldahl nitrogen; NO3 = nitrate; NH3 = ammonia; TP = total phosphorus; PO4 = ortho-phosphate.

ND = the analyte concentration was not detected above the detection limit.

Metals and Other Industrial Contaminants

Metals and other industrial contaminants can accumulate in aquatic environments and have toxic effects on aquatic life and increase health risks of drinking water. Some of the metals of concern for human and aquatic health include mercury, barium, cadmium, chromium, lead, selenium, silver, and arsenic. Selenium is an example of a metal that is essential to biological processes in trace amounts, but can become toxic when available in high concentrations.

Table 4-9 presents the most recent U.S. Environmental Protection Agency (USEPA) recommended criteria for metals of concern for saltwater environments.

Table 4-9 USEPA Recommended Criteria for Metals of Concern

Metal	USEPA Recommended Criteria for Saltwater (µg/l)	
	CMC	CCC
Mercury (Hg)	1.8	0.94
Arsenic (As)	69	36
Barium (Ba)	n/a	n/a
Cadmium (Cd)	40	8.8
Chromium (Cr)	1,100	50
Lead (Pb)	210	8.1
Selenium (Se)	290	71
Silver (Ag)	1.9	n/a

CMC = criterion maximum concentration, which applies to acute exposure.

CCC = criterion continuous concentration, which applies to chronic exposure.

Source: USEPA, 2004.

The following metals were found to be present in some amount at the proposed project site: mercury, barium, cadmium, chromium, and silver (Table 4-10). However, none of these metals were found to be present in concentrations above USEPA national recommended water quality criteria.

Table 4-10 Metals

Sample ID	Metals (µg/l)							
	Hg	Ba	Cd	Cr	Pb	Se	Ag	As
AQU 1	ND	6.39	ND	2.49	ND	ND	3.95	ND
AQU 2	0.06	6.25	1.02	2.43	ND	ND	ND	ND
WQ 3	-	-	-	-	-	-	-	-
Average	0.06	6.32	1.02	2.46	ND	ND	3.95	ND

Hg = mercury; Ba = barium; Cd = cadmium; Cr = chromium; Pb = lead; Se = selenium; Aq = silver; As = Arsenic.

ND = the analyte concentration was not detected above the detection limit.

Semi-volatile organic compounds (SVOC) were also evaluated for this study. Common SVOCs are PCBs and PAHs; examples include paint thinners, dry cleaning solvents, and some

constituents of petroleum (e.g., gasoline and natural gas). No SVOCs were found at the proposed project site above the method detection limit.

4.1.12 SEDIMENT QUALITY

4.1.12.1 Sample Locations

On October 4, 2007, one sediment sample was collected to characterize the existing sediment quality in the area potentially affected by the proposed project. The sample location is listed in Table 4-11 and shown in Figure 4-6.

Table 4-11 Sample Locations

Sample Date	Sample ID	Description Location
October 4, 2007	SED 1	Within the proposed dolphin pen footprint

To characterize sediment quality within the water bodies relevant to the proposed project, several parameters were measured, including the following.

- Total organic carbon (TOC)
- Cyanide
- Metals of concern
- Semi-volatile organics
- Pesticides
- Polychlorinated Biphenyls (PCBs)

At present, there are no universally accepted sediment quality standards against which sediment quality data may be compared. Rather, there are a number of different sediment quality benchmarks, or sediment quality guidelines (SQGs), that have been developed by researchers. For the present evaluation, three SQGs were used for comparison purposes: USEPA Region 4 Hazardous Waste Site Screening Values, Effects Range-Low (ER-L), and Effects Range-Median (ER-M) (Table 4-12). Effects Range-Low represents a concentration at which adverse benthic impacts are found in approximately 10 percent of studies. Water column species and wildlife are at potential risk via biomagnification (food chain toxicity) if site-related sediment concentrations of PCBs, organochlorine pesticides, or mercury are at or above the ER-L. Other known biomagnifers without NOAA screening numbers (dioxins, furans, other chlorinated organics, and selenium) warrant case-by-case evaluation. The Effects Range-

Median indicates a concentration at which adverse benthic impacts are found in more than 50 percent of cases (Long et al. 1995).

Table 4-12 Sediment Quality Guidelines for Metals of Concern

	Sediment Quality Guidelines (mg/kg)		
Metal of Concern	USEPA Screening Value	ER-L	ER-M
Arsenic	7.24	8.2	70.0
Cadmium	1.0	1.2	9.6
Copper	18.7	34.0	270.0
Lead	30.2	46.7	218.0
Silver	0.733	1.0	3.7
Zinc	124.0	150.0	410.0

A summary of sediment quality data is provided in Table 4-13. In addition to direct loading, the ability of different sediment types to retain various compounds must be considered when evaluating sediment quality. Factors that influence the ability of sediment to retain contaminants include grain size and TOC. Typically, smaller grain sizes (i.e., clays) have a higher relative surface area and can hold more metal and chemical compounds within their matrices. The smaller grain fractions also tend to contain more TOC. Cycling of TOC directly influences contaminant fate (sequestration and/or remobilization) and the potential effects of various contaminants on benthic organisms and, potentially, organisms within the overlying water column. TOC in sediments can serve as a contaminant sink and can reduce bioavailability of contaminants to epifaunal and infaunal benthic organisms. However, TOC concentrations less than 0.5 mg/g (0.05 percent) and greater than 30.0 mg/g (3.0 percent) have been shown to be related to a decrease in benthic abundance as well as decreased biomass (Shine and Wallace, 1999). TOC at the proposed project site was 46,100 mg/kg or 4.6 percent. This concentration is higher than would be expected in Blowing Point Harbour.

Other sediment constituents measured and reported include semi-volatile organic compounds, pesticides, PCBs, cyanide and seven metals of concern (mercury, arsenic, cadmium, copper, lead, silver, and zinc). All measurements of constituents within the first three groups were found to be under the limit of detection and, therefore, not a concern for sediment quality. However, one metal (cadmium) and cyanide were found in measurable concentrations (0.146 mg/kg and 241 µg/kg, respectively).

The cadmium concentration is well below the SQG guidelines found in literature (Table 4-13) and is, therefore, not a concern.

Regarding cyanide, this parameter measured and reported as total cyanides in sediments can include hydrogen cyanide (HCN), cyanide ion (CN-), simple cyanides, and metallo- and organo-cyanide complexes. HCN and CN- are grouped as free cyanides and are the most toxic forms of cyanide. Most complexed cyanides are relatively non-toxic. Therefore, total cyanide determinations are sometimes not very useful for a discussion of sediment quality. Factors that affect the release or dissociation of free cyanides from complexed cyanide forms include pH, photodecomposition, relative strength of the metallo- and organo-cyanide complexes, and the presence of bacteria that can degrade ferrocyanide complexes. The cyanides found in the sampled sediments at the proposed project site are not a cause for concern at this time as they are likely complexed forms. However, they do indicate the "pool" of cyanide potentially available for release in certain conditions.

Table 4-13 Sediment Quality Summary

Sample ID	TOC (mg/kg)	Cyanide (µg/kg)	Metals (mg/kg)							Semi-volatile Organics (µg/kg)	Pesticides (µg/kg)	PCBs (µg/kg)
			Hg	As	Cd	Cu	Pb	Ag	Zn			
SED 1	46,100	241	ND	ND	0.146	ND	ND	ND	ND	ND	ND	ND

Notes:
As = Arsenic; Cd = Cadmium; Cu = Copper; Pb = Lead; Ag = Silver; Zn = Zinc
TOC = Total Organic Carbon
PCBs = Polychlorinated Biphenyls

ND = The analyte concentration was not detected above the reporting limit.
Yellow infill indicates that the concentration is greater than the USEPA Region 4 Screening Value or ER-L, but less than the ER-M.
Red infill indicates that the concentration is greater than the ER-M.

4.2 BIOLOGICAL ENVIRONMENT

The following section discusses flora and fauna, rare species, sensitive habitats, and species of commercial significance that were observed. A site assessment was conducted during six days in September and October 2007. The methodology and full reports with photographs are in Appendices E and F.

4.2.1 MARINE FLORA AND FAUNA

Within Blowing Point Harbour, marine scientists observed 118 species of fauna and 30 species of flora, at the estimated level of abundance described in Tables 4-14 and 4-15.

Table 4-14. Fauna Observed

Family/Scientific Name	Common Name	Abundance
Diogenidae	Hermit Crab	Occasional
Panulirus argus	Caribbean Spiny Lobster	Occasional
Panulirus guttatus	Spotted Spiny Lobster	Occasional
Cyphoma gibbosum	Flamingo Tongue	Occasional
Lithopoma tectum	West Indian Starsnail	Occasional
Strombus gigas	Queen Conch	Occasional
Sepioteuthis sepioidea	Caribean Reef Squid	Occasional
Diadema antillarum	Long-Spined Urchin	Common
Echinometra lucunter	Rock-Boring Urchin	Occasional
Echinometra viridis	Reef Urchin	Occasional
Tripneustes ventricosus	West Indian Sea Egg	Occasional
Eucidaris tribuloides	Slate-Pencil Urchin	Occasional
Acanthurus coeruleus	Blue Tang	Common
Acanthurus bahianus	Ocean Surgeonfish	Common
Acanthurus chirurgus	Doctorfish	Common
Stegastes partitus	Bicolor Damsel	Common
Stegastes planifrons	Threespot Damsel	Common
Stegastes leucostictus	Beaugregory	Common
Stegastes dorsopunicans	Dusky Damsel	Common
Stegastes diencaeus	Longfin Damsel	Occasional
Stegastes variablis	Cocoa Damsel	Occasional
Microspathodon chrysurus	Yellowtail Damsel	Occasional
Abudefduf saxatillis	Sergeant Major	Occasional
Sparisoma viride	Stoplight Parrotfish	Common
Sparisoma aurofrenatum	Redband Parrotfish	Occasional
Sparisoma rubripinne	Yellowtail Parrotfish	Occasional
Sparisoma atomarium	Greenblotch Parrotfish	Occasional
Sparisoma chrysopterum	Redtail Parrotfish	Occasional
Sparisoma radians	Bucktooth Parrotfish	Occasional
Scarus taeniopterus	Princess Parrotfish	Common
Scarus inserti	Striped Parrotfish	Common
Cryptotomus roseus	Bluelip Parrotfish	Occasional
Scarus vetula	Queen Parrotfish	Occasional
Chaetodon capistratus	Foureye Butterflyfish	Occasional
Chaetodon striatus	Banded Butterflyfish	Occasional
Chaetodon sedentarius	Reef Butterflyfish	Occasional
Canthigaster rostrata	Sharpnose Puffer	Uncommon
Diodon hystix	Porcupine	Uncommon

Table 4-14. Fauna Observed

Family/Scientific Name	Common Name	Abundance
Haemulon flavolineatum	French Grunt	Occasional
Haemulon melanurum	Cottonwick	Uncommon
Haemulon aurolineatum	Tomtate	Occasional
Haemulon chrysargyreum	Smallmouth Grunt	Occasional
Haemulon carbonarium	Caesar Grunt	Occasional
Haemulon macrostomum	Spanish Grunt	Uncommon
Haemulon plumieri	White Grunt	Occasional
Haemulon sciurus	Bluestriped Grunt	Occasional
Hypoplectrus puella	Barred Hamlet	Common
Epinephelus striatus	Nassau Grouper	Occasional
Serranus tigrinus	Harlequin Bass	Common
Serranus tabacarius	Tobaccofish	Occasional
Serranus tortugarun	Chalk Bass	Occasional
Lutjanus synagris	Lane Snapper	Occasional
Ocyurus chrysurus	Yellowtail Snapper	Occasional
Aulostomus maculatus	Trumpetfish	Occasional
Halichoeres maculipinna	Clown Wrasse	Common
Halichoeres garnoti	Yellowhead Wrasse	Common
Halichoeres bivittatus	Slippery Dick	Occasional
Halichoeres poeyi	Blackear Wrasse	Common
Hemipteronotus novacula	Pearly Razorfish	Occasional
Thalassoma bifasciatum	Bluehead Wrasse	Common
Gerres cinereus	Yellowfin Mojarra	Occasional
Pseudupeneus maculatus	Spotted Goatfish	Common
Gramma loreto	Fairy Basslet	Common
Holocentrus rufus	Longspine Squirrelfish	Occasional
Holocentrus adscensionis	Squirrelfish	Occasional
Holocentrus coruscum	Reef Squirrelfish	Occasional
Sphyraena barracuda	Great Barracuda	Common
Equetus punctatus	Spotted Drum	Occasional
Caranx ruber	Bar Jack	Common
Caranx bartholomaei	Yellowjack	Occasional
Synodus intermedius	Sand Diver	Common
Trachinotus goodei	Palometa	Occasional
Eucinostomus gula	Silver Jenny	Occasional
Synodus saurus	Bluestriped Lizardfish	Occasional
Equetus acuminatus	Highhat	Uncommon
Pempheris schomburgki	Glassy Sweeper	Occasional
Gymnothorax moringa	Spotted Moray	Occasional

Table 4-14. Fauna Observed

Family/Scientific Name	Common Name	Abundance
Gobiidae	Goby	Occasional
Clinidae	Blenny	Occasional
Octocorals		
Briareum asbestinum	Corky Sea Finger	Occasional
Gorgonia ventalina	Common Sea Fan	Occasional
Eunicea spp.	Knobby Sea Rods	Occasional
Plexaurella sp.	Slit-Pore Sea Rod	Occasional
Pseudoplexaura sp.	Porous Sea Rods	Occasional
Pseudopterogorgia sp.	Sea Plumes	Occasional
Stony Corals		
Agaricia agaricites	Lettuce Coral	Occasional
Colpophyllia natans	Boulder Brain Coral	Occasional
Dichocoenia stokesii	Elliptical Star Coral	Occasional
Diplora clivosa	Knobby Brain Coral	Occasional
Diploria labyrinthformis	Grooved Brain Coral	Occasional
Diplora strigosa	Symmetrical Brain Coral	Occasional
Eusmila fastigata	Smooth Flower Coral	Occasional
Favia fragum	Golfball Coral	Occasional
Isophyllia sinuosa	Sinous Cactus Coral	Occasional
Madracis decatis	Ten-Ray Star Coral	Occasional
Mancina areolata	Rose Coral	Occasional
Meandrina meandrites	Maze Coral	Occasional
Millepora alcicornis	Branching Fire Coral	Common
Montastraea annularis	Lobed Star Coral	Common
Montastraea cavernosa	Great Star Coral	Occasional
Montastraea faveolata	Mountainous Star Coral	Common
Montastraea franksi	Boulder Star Coral	Common
Porites astreoides	Mustard Hill Coral	Occasional
Porites branneri	Blue Crust Coral	Occasional
Porites divaricata	Thin Finger Coral	Occasional
Porites furcata	Branched Finger Coral	Occasional
Porites porites	Finger Coral	Occasional
Siderastrea siderea	Massive Starlet Coral	Occasional
Siderastrea radians	Lesser Starlet Coral	Occasional
Stephanocoenia intersepta	Blushing Star Coral	Occasional
Sponges		
Cliona langae	Coral Encrusting Sponge	Common
Demospongiae	Brown Encrusting Sponge	Common
Cnidarians		
Condylactis gigantean	Pink-Tipped (Giant) Anemone	Occasional

Table 4-14. Fauna Observed

Family/Scientific Name	Common Name	Abundance
Palythoas caribaerum	White Encrusting Zooanthid	Occasional
Zoanthidea	Zoanthid	Occasional
Annelids		
Pomatostegus stellatus	Star Horsehoe Worm	Occasional
Reptiles		
Chelonia mydas	Green Turtle	Occasional

Table 4-15. Marine Flora Observed

Family/Scientific Name	Common Name	Abundance
Halodule wrightii	Shoal-grass	Common
Syringodium filiforme	Manatee-grass	Occasional
Thalassia testudinum	Turtle grass	Abundant
Bryothamnion triquetrum		Common
Chondria littoralis		Common
Rhodogorgon ramosissima		Occasional
Dictyota caribaea		Common
Dictyota divaricata		Common
Dictyota ciliolata	Serrated Strap Alga	Abundant
Dictyota sp.		Common
Padina sp.	Scroll Alga	Abundant
Hydroclathrus clathratus	Swiss Cheese Alga	Common
Lobophora variegata	Encrusting Fan-Leaf Alga	Common
Chlorophyta		
Avrainvillea sp.		Common
Caulerpa paspaloides		Occasional
Caulerpa prolifera	Oval-Blade Alga	Occasional
Caulerpa racemosa	Green Grape Alga	Occasional
Caulerpa sertularioides	Green Feather Alga	Occasional
Caulerpa verticillata		Occasional
Dictyosphaeria cavernosa	Green Bubble Weed	Occasional
Halimeda incrassata	Three-Finger Leaf Alga	Common
Halimeda monile	Green Jointed-Stalk Alga	Common
Halimeda opuntia	Watercress Algae	Common
Neomeris annulata	Fuzzy Tip Alga	Occasional
Penicillus capitatus	Bristle Ball Brush	Occasional
Rhipocephalus phoenix	Pine Cone Alga	Occasional
Dasycladus vermicularis	Fuzzy Finger Alga	Occasional
Udotea flabellum		Common
Udotea spp.	Mermaid's Fans	Common

4.2.2 RARE MARINE SPECIES

Of the species observed, the green sea turtle is the only protected one. The sea turtle was sighted swimming over an area of mixed rock and seagrass with macroalgae in the bay, away from the project site in deep water. It is not known if sea turtles nest on the beach. However, given the level of light and disturbance from the nearby ferry terminal dock, it is unlikely that the site offers prime habitat. The conservation and preservation of this species will not be negatively affected by the project. Nassau grouper were also observed occasionally in the bay; however, they will not be negatively affected by the project.

4.2.3 SENSITIVE MARINE HABITATS

General marine benthic cover types, including seagrass, sand, rock dominated by macroalgae, rock, and living coral, are mapped on Figure 4-7A for the immediate project area, and Figure 4-7B for Blowing Point Harbour. The map on A was edited and revised when the Government of Anguilla sphere of influence was designated as entire Blowing Point Harbour. As shown, seagrass is the dominant bottom type, and the bay has three prominent rock features comprised of relict coral reef.

In general, the bottom cover within the sphere of influence is variable. The total area of each cover type is noted in Table 4-16. Figures 4-8 through 4-13 depict the five general categories of marine habitats observed during surveys. Figure 4-14 shows the methods used for benthic habitat mapping.

The nearshore unvegetated sand bottom transitions to seagrass and mixed seagrass and macroalgae communities. Rock with heavy macroalgae growth and occasional corals are present in the areas where the layer of sand was too thin to support rooted seagrasses. Heavily damaged former coral reef is the abundant bottom condition in the area downstream (i.e., southwest) of the proposed project site, and the corals show very little evidence of recovery. Disease and storms have caused extensive damage and degradation to the reefs. The fringing reefs were once dominated by live elkhorn coral, which is vulnerable to breakage and white band disease. In the project sphere of influence, reefs are comprised mainly of dead elkhorn coral, with small colonies of finger and brain coral growing on the dead reef. Star coral (*Montastrea* spp.) is common in the few areas of live coral cover, with large specimens exceeding 2 meters in diameter.

Table 4-16 provides a listing of the marine benthic habitats and bottom cover types, and total acreage. Descriptions of these benthic habitats and bottom cover types are provided below.

Table 4-16. Marine Benthic Habitats and Bottom Cover Types in the Immediate Vicinity of the Proposed Dolphin Discovery Project

Habitat Type/Cover Type	Hectares	Acres	Percent of Total
Seagrass	2.88	6.29	58.68
Unvegetated Sand	1.24	3.07	25.37
Rock	0.94	1.30	11.81
Algae Dominated Hardbottom	0.20	0.50	4.13
Total	5.26	12.1	100.00

This table addresses habitats shown in Figures 4-7A and B. The following acreage of habitat was generated from this map.

Seagrass is the dominant habitat type of concern. Approximately 1 acre of seagrass habitat would be affected by the proposed project; however, shading impacts from the dock structure are expected to be minimal.

In general, the bottom cover within the sphere of influence is variable. The total area of each cover type is noted in Table 1-2. The nearshore unvegetated bottom transitions to seagrass and mixed seagrass/macroalgae communities. Rock with heavy macroalgae growth and occasional corals are present in the areas where the layer of sand was too thin to support rooted seagrasses. Heavily damaged former coral reef is the abundant bottom condition in the area downstream (i.e., southwest) of the proposed project site, and the corals show very little evidence of recovery. A moderate variety and abundance of marine creatures was observed, but fishes consisted primarily of juvenile reef fishes.

Some areas that appear to be vegetated in aerial photographs are actually areas of drift algae. These areas are interspersed amid and between the rock, seagrasses and macroalgae communities, but there were extensive masses of unattached seaweed and debris mainly in the nearshore area. Broken pieces of brown algae, green algae and seagrasses formed the bulk of this material, but discarded plastics and other human-originated materials washed back and forth in a constantly swaying current-induced motion. Heavier debris (e.g., discarded beer bottles, old rubber tires, and oil filters) had settled more permanently onto the substrate surface.

Fewer fish and other marine life were observed near the swaying drift algae than in the hardbottom, seagrass, and/or macroalgae communities.

4.2.4 MARINE SPECIES OF COMMERCIAL SIGNIFICANCE

Several spiny and spotted lobsters were seen in the project sphere of influence, both in fish traps and hiding in crevices (Figure 4-15). However, none were seen in the project area as the site is dominated by soft substrate with sand or seagrass, and the lobsters require rock crevices for cover during daylight hours when the surveys were conducted. The shallow water of the project site does not offer protection from human predation and as a consequence, lobsters in the survey were found at depths greater than 15 feet. The project will not have a negative effect on lobster.

Although rare in Blowing Point Harbour, queen conchs were also sighted. The project may have a beneficial effect by providing some habitat that is sheltered from fishing. Reef fish such as Nassau grouper and yellowtail snapper may also receive additional habitat shelter.

4.2.5 TERRESTRIAL FLORA AND FAUNA

Birds were the most noticeable of the animals observed during the field assessment. Thirteen species of birds were observed on the site, and the migratory status of many bird species suggests that additional species likely use the property during various times of the year. Species observed included both year-round residents (e.g., green-throated caribs, bananaquits and grassquits) and migrants (e.g., semi-palmated plovers). None of these species were particularly abundant, and there were single sightings of some species (e.g., spotted sandpiper) which suggest that populations of these species are comparatively small. Other species (e.g., bananaquits) were observed repeatedly, which suggests that populations of these species may be somewhat higher. No non-native animal species was observed on the subject property during the field assessments.

Ground lizards appeared to be present in average abundances. No snakes, turtles, tortoises or amphibians were observed, but potential habitat for them exists. Although no evidence of nesting was observed, the stretch of sandy beach that forms the southern boundary of the subject site has the potential to serve as nesting habitat for sea turtles.

The species in Table 4-17 were observed on September 13, 2007 during a landside field assessment conducted within the ±1.75-acre area of the proposed Dolphin Discovery facility near Blowing Point, Anguilla.

Table 4-17. Terrestrial Fauna Observed

Scientific Name	Common Name	Abundance
Mammals		
None		
Crustaceans And Arthropods		
Ocypode quadrata	*Ghost Crab*	*Uncommon*
Birds		
Sula leucogaster	*Brown Booby*	*Occasional*
Fregata magnificens	*Magnificent Frigatebird*	
Pelecanus occidentalis	*Brown Pelican*	*Occasional*
Larus atricilla	*Laughing Gull*	*Common*
Sterna maxima	*Royal Tern*	*Occasional*
Nyctanassa violacea	*Yellow-Crowned Night-heron*	*Tracks only*
Charadrius semipalmatus	*Semi-Palmated Plover*	*Occasional*
Arenaria interpres	*Ruddy Turnstone*	*Common*
Falco sparverius sparverioides	*Kestrel*	*Uncommon*
Zenaida aurita	*Zenaida Dove*	*Occasional*
Eulampus holosericeus	*Green-Throated Carib*	*Occasional*
Coerba flaveola	*Bananaquit*	*Common*
Tiaris bicolor	*Black-faced Grassquit*	*Common*
Reptiles And Amphibians		
Ameiva plei plei	*Anguilla Ground Lizard*	*Common*
Insects		
Pieridae	*Yellow Butterfly*	*Uncommon*
Pieridae	*Sulfur Butterfly*	*Uncommon*
Acrididae	*Grasshopper*	*Occasional*
Apoidea	*Bees*	
Formicidae	*Ants*	*Abundant*
Hymenoptera	*Wasp*	*Occasional*

The flora species in Table 4-18 were observed and identified during an assessment conducted on September 13, 2007. The list should be considered as preliminary, and that additional species would be identified if additional surveys were to be conducted, particularly during different times of the year, when other plants would be in bloom. Nomenclature follows *Flora of the Bahama Archipelago* by D.S. Correll and H.B. Correll and/or Walker et al.

Table 4-18. Terrestrial Flora Observed

Family/Scientific Name	Common Name	Abundance
Cenchrus sp.	Burr Grass	Common
Genus and species unidentified	Grass	Occasional
Sporobolus virginicus	Seashore Rush-Grass	Occasional
Agave sp.	Century Plant	Occasional
Sansevieria hyacinthoides	African Bowstring Hemp	Occasional
Genus and sp. unidentified	Lily	Occasional
Coccoloba krugii	Crabwood, Bow-pigeon, Wild Grape	Common
Coccoloba uvifera	Seagrape	Common
Pisonia subcordata	Loblolly	Occasional
Sesuvium portulacastrum	Pondweed, Sea purslane	Common
Portulaca halimoides	Purslane	Occasional
Canella winterana	Cinnamint, Pepper Cinnamon	Occasional
Capparis flexuosa	Limber caper, Caper-tree, Parrot-Bush	Occasional
Kalanchoe daigremontiana	Devil's Backbone	Occasional
Caesalpinia bonduc	Gray Nicker Tree	Occasional
Canavalia rosea	Bay Bean, Beach Pea	Occasional
Delonix regia	Royal Poinciana	Occasional
Pithecellobium unguis-cati	Bread-and-Cheese, Cat's Claw	Common
Stylosanthes hamata	Sweet Weed, Pencil Flower	Occasional
Zanthoxylum flavum	Yellow-Wood, Satin-Wood	Occasional
Suriana maritima	Bay Cedar	Common
Castela erecta	Cockspur	Common
Azadirachta indica	Neem	Occasional
Croton betulinus	Nanny Bunch	Common
Euphorbia mesembrianthemifolia	Coast spurge, Seaside Spurge	Occasional
Phyllanthus epiphyllanthus	Abraham-bush, Hardhead	Common
Comocladia dodonaea	Hollow wood	Occasional
Crossopetalum rhacoma	Maiden Berry, Mating Berry	Common
Colubrina arborescens	Mauby	Occasional
Corchorus hirsutus	Wooly Corchorus, Jack Switch	Common
Waltheria indica	Sleepy Morning	Common

Table 4-18. Terrestrial Flora Observed

Family/Scientific Name	Common Name	Abundance
Passiflora suberosa	Juniper-Berry, Small Passion-Flower	Occasional
Jacquinia armillaris	Scrub Bush	Occasional
Forestiera eggersiana	Egger's Inkbush	Occasional
Urechites lutea	Wild Unction, Lice Bush	Occasional
Ipomoea pes-caprae	Bay Hops, Bay Winders	Occasional
Argusia (Mallotonia) gnaphalodes	Wild Bay, Sea Lavender	Occasional
Bourreria succulenta	Chink Bush, Pigeon Berry	Common
Lantana involucrata	Sage Cop, Wild Sage	Common
Stachytarpheta jamaicensis	Worry Vine	Occasional
Solanum racemosum	Canker Berry, Corberry	Occasional
Capraria biflora	Goat Weed, Stow-weed	Occasional
Tabebuia heterophylla	Cedar	Common
Erithalis fruticosa	Black Torch, Candlewood	Common
Ernodea littoralis	Cough Bush	Occasional
Exostema caribaeum	Fustic	Occasional
Scaevola plumieri	Inkberry, Black-Soap	Common
Scaevola taccada	Ornamental Candlewood	Occasional
Emilia sonchifolia	Lavender Emilia	Occasional
Launaea intybacea	Wild Lettuce	Occasional

Two non-native pest plant species were observed to be present within the project area during the field assessment. Beach naupaka was present in the pioneer zone on the primary dunes, but was not abundant enough that it appeared to be having an adverse impact on native plant communities. African bowstring hemp was only present in a disturbed area near the eastern property boundary. It was also uncommon enough on the property that it did not appear to be having adverse impacts on natural habitats.

4.2.6 SENSITIVE TERRESTRIAL HABITATS

No unusually sensitive habitats were noted in the study area for the project. Four distinctive habitats were found to be present on the subject tract. Table 4-19 identifies these community types, their approximate size, comparative abundance and relative ecological value (Figures 4-16 and 4-17).

Table 4-19. Terrestrial Habitats, Land Cover Acreage, and Environmental Condition

Community Type	Approximate Acreage within Project Area	Condition/Comparative Environmental Value
Sandy Beach (Unvegetated)	1.45	Excellent
Evergreen Bushland (Coastal Coppice)	1.40	Moderate
Beach Dune	1.01	Moderate
Road/Disturbed Roadside	.30	Low
Total	4.16	

Criteria definitions:
Excellent – A natural community with healthy floral and faunal diversity, healthy community structure and little evidence of hydrologic or vegetation disturbance.
Moderate – A natural community that exhibits adverse some impacts from alterations to hydrology and/or vegetation communities.
Low – A natural or significantly man-altered community that exhibits substantial adverse impacts from hydrological alterations and/or changes in plant or animal community structure.

4.2.7 PROTECTED TERRESTRIAL SPECIES

No particularly notable plant species were observed on the subject site. No species of flora or fauna that are protected by various international treaties were observed on the subject property.

4.2.8 TERRESTRIAL SPECIES OF COMMERCIAL SIGNIFICANCE

No species of commercial significance were noted in the terrestrial study area.

4.3 TRANSPORTATION

Traffic conditions and impacts were assessed via field observations, analysis of existing conditions, and analysis of proposed conditions. Wallblake Airport is centrally located on the island, just south of the capital of The Valley, with several daily commercial flights. Flights include one American Airlines (American Eagle) flight from San Juan, Puerto Rico, and several small, local carrier flights (Liat and WinAir, for example) that service islands such as St. Maarten and St. Kitts. The Wallblake Airport also regularly accommodates small, private aircraft. Trends over the past 16 years (1990 to 2005) indicate that the majority of visitors to Anguilla arrive by sea (an average of almost 74 percent). Visitors traveling by sea commonly fly into the international airport on St. Maarten and take the Anguilla Ferry to the Blowing Point ferry dock. This is likely due to the relatively short runway length at Wallblake Airport, which does not allow large commercial airliners to land on Anguilla.

The proposed Dolphin Discovery project site is located less than a quarter-mile west of the Blowing Point ferry dock, in the southwestern portion of Anguilla (Figure 2-1). The primary roadway on Anguilla traverses the majority of the island, and the road name changes several times throughout its length. Roadway names in the western portion of the island include (from west to east) Albert Hughes Drive, Rendezvous Road, and Edwin Wallace Rey Drive. However, this primary road will be referred to as Albert Hughes Drive throughout this section. Most other roads on Anguilla are short roads that branch off Albert Hughes Drive.

The primary mode of transportation on Anguilla is private cars and trucks. In 2004, there were approximately 6,750 registered vehicles on Anguilla (not including Government vehicles), with private cars and trucks accounting for nearly 85 percent. The majority of the remaining registered vehicles are taxis and rental cars (about 12 percent). The workforce on Anguilla was estimated at about 6,000 in 2001 and 6,500 in 2004, with hotels and restaurants employing between 25 and 30 percent of the workforce (as of 2001). A survey conducted in conjunction with the 2001 census indicated that over 55 percent of the West End workforce traveled to/from work by driving private vehicles, and about 35 percent of the workforce traveled to/from work by walking or ride sharing.

Albert Hughes Drive is the primary east/west roadway on Anguilla. It is a two-lane roadway, with one travel lane in each direction (Figure 4-18). The pavement is about 25 feet wide, travel lanes are marked by white stripes and raised pavement markers, and the pavement is in relatively good condition. The speed limit on the majority of Anguilla, and more specifically Albert Hughes Drive, is 30 mph. In addition to Albert Hughes Drive, three other primary roadways may be impacted by the proposed project, all with similar physical characteristics as described above for Albert Hughes Drive.

- Blowing Point Road – the primary north/south roadway connecting the Blowing Point ferry dock to Albert Hughes Drive.
- Jeremiah Gumbs Highway – northeast/southwest roadway connecting the town of Blowing Point to Albert Hughes Drive near the airport.
- Cul De Sac Drive – east/west roadway connecting Blowing Point Road to the Cul De Sac township east of the project site (the site driveway will connect to this roadway).

With about 13,675 residents and 6,750 registered vehicles, traffic on Anguilla is relatively light. The most common times for employee shift changes in hotels and restaurants are 7:00 am and

3:00 pm. Thus, the most traffic congestion was observed surrounding those general times. A privately operated public bus system is currently in the pilot project stage on Anguilla.

In order to gauge the amount of traffic currently using the subject roadways, representative traffic counts were collected at five locations, referred to as primary roadways. The counts were collected for 15-minute intervals on Wednesday, October 3, 2007, and are summarized in Table 4-20.

Table 4-20. Traffic Count Summary

Location	Time Period	Direction	Number of Vehicles		
			Private	Commercial	Total
Albert Hughes Drive, East of Blowing Point Road	15:43 - 15:58	Eastbound	63	16	138
		Westbound	52	7	
Albert Hughes Drive, West of Blowing Point Road	15:59 - 16:14	Eastbound	57	25	126
		Westbound	33	11	
Blowing Point Road, South of Albert Hughes Drive	15:27 - 15:42	Northbound	53	7	104
		Southbound	41	3	
Jeremiah Gumbs Highway, East of Blowing Point Road	16:45 - 17:00	Northbound	24	8	66
		Southbound	29	5	
Cul De Sac Drive, between Blowing Point Road & Project Site	16:24 - 16:39	Eastbound	7	1	15
		Westbound	7	0	

Florida Department of Transportation (FDOT) guidelines provide a qualitative measure of traffic flow called Level of Service (LOS). LOS analyses incorporate many factors, but they are primarily based on traffic volumes and the number of travel lanes on the subject roadway. LOS "grades" range from "A" to "F," with "A" corresponding to an excellent rating (no traffic congestion) and "F" corresponding to the worst rating (almost no traffic flow due to congestion).

The first traffic count shown in Table 4-20 was conducted along Albert Hughes Drive, just east of the intersection with Blowing Point Road. A total of 138 vehicles passed this location during the 15-minute observation period. This representative traffic count roughly equates to 483 vehicles per hour (vph). The hourly traffic volume derived above for Albert Hughes Drive east of Blowing Point Road corresponds to LOS "B."

The second traffic count was conducted along Albert Hughes Drive, just west of the intersection with Blowing Point Road. A total of 126 vehicles passed this location during the 15-minute observation period. This representative traffic count roughly equates to 441 vph. This hourly traffic volume for Albert Hughes Drive west of Blowing Point Road also corresponds to LOS “B.”

The third traffic count was conducted along Blowing Point Road, just south of Albert Hughes Drive. A total of 104 vehicles passed this location during the 15-minute observation period. This representative traffic count roughly equates to 364 vph. This hourly traffic volume for Blowing Point Road south of Albert Hughes Drive corresponds to LOS “B.”

Note, a grade school (Blowing Point Elementary) is located just south of the intersection of Albert Hughes Drive and Blowing Point Road (near the location of the third traffic count in Table 4-20). Traffic associated with the school (students being picked up) was observed to moderately contribute to the existing traffic volumes near this location.

The fourth traffic count was conducted along Jeremiah Gumbs Highway, east of the town of Blowing Point. A total of 66 vehicles passed this location during the 15-minute observation period. This representative traffic count roughly equates to 231 vph. This hourly traffic volume for Jeremiah Gumbs Highway corresponds to LOS “A.” The final traffic count was conducted along Cul De Sac Drive, just west of Blowing Point Road. A total of 15 vehicles passed this location during the 15-minute observation period. This representative traffic count roughly equates to 53 vph. This hourly traffic volume for this roadway corresponds to LOS “A.”

5.0 ASSESSMENT OF ENVIRONMENTAL IMPACTS AND RISKS OF THE PROPOSED DEVELOPMENT

5.1 METHODOLOGY FOR IMPACT ASSESSMENT

The questions and categories of concern listed in the Terms of Reference guided this impact assessment process. Each question in the document found in Appendix A has been answered except for those pertaining to socioeconomic or cultural concerns. The assessment team included marine biologists, coastal engineers, architects, physical scientists, modelers, marine mammal experts, veterinarians, structural engineers, and others. The proposed facility was also compared with other sites in the world, including the Bahamas, Jamaica, and Dubai.

5.2 PHYSICAL IMPACTS

The project includes driving piles, constructing docks and floating walkways, installing fences in the ocean, and clearing land for buildings and destination amenities. The physical impacts include excavation of the swimming pool, additional impervious surfaces, and change in land cover. Construction impacts include excavation and grading, and pile driving in the marine environment. Careful control of turbidity and erosion will be the primary methods to reduce impacts to the water quality of the coastal environment.

Changes in land cover may temporarily increase the runoff from the site during construction. Following the Best Management Practices outlined in Section 7 will reduce the risk of stormwater runoff. No major changes in the topography are expected that would drastically alter drainage patterns. There are no project components, such as excavation for the pool and Jacuzzis, that will significantly affect groundwater flow based on the information provided by Dolphin Discovery.

5.2.1 COASTAL WATER QUALITY FOCUS

The upland component of the proposed project is not expected to have a significant adverse impact on water quality in Blowing Point Harbour. At this time, there is no stormwater management plan proposed for the upland portion of the proposed project. However, if appropriate stormwater management practices are implemented, impacts to coastal water quality from stormwater runoff are expected to be minimal.

An open water dolphin pen in Blowing Point Harbour has the potential to impact water quality in a harbour already affected by heavy boat traffic. Impacts to water quality from the proposed project may include the loading of nutrients and fecal coliform bacteria. Nutrients and fecal coliform may be introduced to the water column by dolphin feed and/or waste. Potential adverse impacts from nutrient enrichment include the over-growth of algae, which may in turn reduce water circulation, water clarity, dissolved oxygen, and the areal coverage of seagrass beds. Fecal coliform are bacteria that are common to the intestinal tract of mammals. These bacteria, while not dangerous on their own, can indicate biowaste from livestock or humans and may be a sign of disease-causing pathogens.

The US Department of Agriculture (USDA) has standards for animal health and husbandry. According to their water quality standards for marine mammals, bacterial counts of fecal coliform should not exceed 1,000 MPN (most probably number) per 100 ml of water. Because this criterion does not account for humans swimming along with the dolphins in the enclosure, International Blue Flag beach standards were also consulted. The Blue Flag Beach Criteria and Explanatory Notes, 2007-2008 states that beaches with good bathing water quality should have total coliform counts below 500 MPN/100 ml, fecal coliform counts below 100 MPN/100 ml, and fecal streptococci counts below 100 MPN/100 ml. This Blue Flag document also includes an example data sheet for recording bacterial counts and summarizing the information for public consumption. The example data sheet is included as Appendix G.

Because of the potential impacts described in the above paragraph, the development of an open water dolphin pen must be done in such a way as to maintain satisfactory water quality. This means ensuring that the circulation of the pen is sufficient to flush pollutants (i.e., nutrients and bacteria) out of the enclosed area to be diluted in the open water outside of Blowing Point Harbour. To assess the water circulation within Blowing Point Harbour and the dilution rate of waste generated by the dolphins, a hydrodynamic and mass transport analysis was performed. The evaluation was conducted using a numerical computer model to simulate the transport over time of conservative pollutants in and around the proposed dolphinarium system. The results of the simulations were used to estimate the dilution of nutrient pollution loads from the dolphinarium system. The specific pollution loading estimates and dilution around the project site for specific pollutants is discussed in the nutrient section below. A complete report regarding the results of the hydrodynamic model analysis is provided as Appendix H.

A summary of potential impacts to various water quality parameters is provided in the following paragraphs. Generally, it is expected that the management of the proposed facility will include water quality monitoring of the parameters discussed below as this is the best way to ensure that water quality is being maintained and to make any necessary adjustments to the management of the facility.

5.2.1.1 Turbidity

Baseline turbidity at the proposed project site was comparable to other bays in Anguilla. Due to proposed project, there potentially will be some moderate increase in turbidity. This increase in turbidity would likely originate from the operation of the open water dolphinarium via the potential increase in organic matter. The upland portion of the proposed project should not significantly result in turbidity impacts since as long as construction includes best management practices that avoids or minimizes soil erosion and runoff. Best management practices to be used during construction include, but are not limited to, selective clearing, silt fencing, and vegetative buffering.

5.2.1.2 Biological Oxygen Demand and Dissolved Oxygen

Biological oxygen demand (BOD) was undetectable for baseline conditions at the proposed project site. Due to the operation of the proposed project, BOD is expected to increase marginally with the introduction of dolphin waste. A standard of 1.4 mg/l was established by the National and Environmental Planning Agency (NEPA) of Jamaica for dolphin facilities.

As long as BOD remains below 1.4 mg/l, dissolved oxygen (DO) should remain in concentrations suitable to maintain a healthy environment for fish and other aquatic organisms (i.e., above 5.0 mg/l). Dissolved oxygen concentrations will likely decrease marginally in correlation with increases in BOD. However, circulation within the pen should maintain DO concentrations above 5.0 mg/l.

5.2.1.3 Fecal Coliform

The development does not propose to discharge any sewage or wastewater treatment effluent into the marine environment. Therefore, this should not be a contributing factor for concern. Bacterial testing by the operator at the existing upland Dolphin Discovery facility near Meads Bay can provide some idea as to the amount of fecal coliform produced by the dolphins. In general, during a typical sampling collection, fecal coliform concentrations at various locations

around the pool were between 10 and 35 CFU/100 ml. As mentioned previously, a Blue Flag criterion for contact water recreation was set at 200 CFU/100ml. Therefore, the proposed project should have a minimal impact on the health to animals and recreational bathers. However, fecal coliform will have to continue to be regularly monitored at the proposed facility in order to assure water quality, particularly if additional animals are added.

5.2.1.4 Nutrients

Baseline concentrations of readily available phosphate were undetectable at the proposed project site. The proposed project is not expected to have a significant adverse impact on phosphate concentrations in Blowing Point Harbour. All wastewater will be collected in underground storage tanks and will be routinely removed by a local, licensed contractor for proper treatment.

While the consistency of dolphin fecal wastes (liquid) lends to its ability to quickly dilute and disperse, nitrogen (N) from the urine and excreta of dolphins will have some impact on the water quality within the immediate area and downstream of the proposed project. As a conservative estimate, one dolphin is likely to produce 45 g N per day (Environmental Management Consultants, Ltd 2007). The proposed dolphin pen will begin with 8 dolphins and increase to a maximum population of 15 dolphins within a few years. This means that daily loads of N via dolphin waste will start at 360 g N and increase to as much as 675 g N. The flushing model (Appendix H and Figure 5-1) assumed a loading rate of 100 units/s (or 100 g N/s) at a single point of discharge and calculated a maximum concentration within the pen of 40 units/m^3 (or 40 g N/m^3, which equals 40 mg N/l) – this is not including the modeled concentration at the point of discharge at the center of the pen, which is unrealistic in this case (in reality, the loads will be discharged all around the basin, not at a single point). Applying the literature-cited loading estimate of 360 g N/day (or 4.17×10^{-3} g N/s) for 8 dolphins, a maximum N concentration of 0.0017 mg/l is determined for the pen. For 15 dolphins, this N concentration increases to 0.0031 mg/l.

The destination of the N is just as important as its flushing from the immediate area of the dolphin pen. The results from the model indicate that once the N is flushed from the dolphin pen it will be carried away at lower concentrations (Figures 5-2 and 5-3). This figure shows that the waste concentration will be less than 20 units/m^3 at 300 m west of the pen, and 10 units/m^3 at 200 m east and 100 m south of the pen. Using N as the waste constituent of interest, this is

calculated to be 0.0008 mg/l at 300 m west of the pen, and 0.0004 mg/l at 200 m east and 100 m south of the pen. These are low concentrations that will have a minimal impact on water quality.

The additional nitrogen from dolphin wastes may increase algae production within the proposed project's area of influence, particularly downstream of the site. A potential concern is that circulation in the pens may be reduced by eventual fouling by algae and colonizer organisms. As long as the Dolphin Discovery management monitors the fouling of the pens and takes the appropriate precautions to ensure continued circulation, this will not likely become a significant issue

To reduce the potential for nutrient enrichment, dolphins will be fed on a schedule and a diet that minimizes food waste and mimics their natural patterns and diet. Maintaining circulation through the pens will also reduce secondary impacts of excess nutrients such as increased TOC and BOD levels and subsequent decreased DO levels.

Overall, it is expected that the proposed project will have some minor impacts to water quality within a localized area around the dolphin pen. However, the tidal circulation of water through the pen will dilute the waste material such that any adverse impacts are expected to be minimal. Again, a water quality monitoring program will ensure the maintenance of water quality and proper management of the proposed project.

5.2.1.5 Metals and Other Industrial Contaminants

The proposed project will not make a significant contribution to metals or other industrial contaminants in Blowing Point Harbour.

5.2.2 LONG SHORE SAND MOVEMENT

The Dolphin Discovery facility will include both fenced dolphin pens and a pier structure for accessing these pens. The pier will extend from the existing beach. Pens will be enclosed with open-meshed fencing that will extend to the bottom. The pier and pen structure will be constructed on pilings. These pilings and the open mesh fencing enclosing the dolphin pens are not anticipated to significantly inhibit long shore sand transport. Accordingly, no significant accumulation of sand on one side of the pier or sand loss on the other is anticipated.

It is recommended that this conclusion be confirmed through preconstruction and post-construction beach profile surveys, with the post-construction survey conducted 1 year after the completion of construction. It is anticipated these surveys will confirm that any change in the long shore transport will have been negligible. In addition, if the surveys do show an unacceptable accumulation of sand on one side of the pier, simple mechanical transfer of the sand from one side of the pier to the other will return the sand to the long shore system.

This involves the transfer of beach quality sand from one location to another, using a pipeline and pump system or a truck haul system. With a truck haul operation, vehicular access can be an issue, while with a pump and pipeline, turbidity can be an issue as the sand is moved in a slurry form.

Sediment curtains are recommended in case of sand transfer. Turbidity reduction is the primary goal for minimizing the effects of this activity. With little organic material in the sand, lowered dissolved oxygen levels are not a concern as they are for some dredging activities. The area that would be augmented with sand, should erosion become a problem, is already sandy. Therefore, there would be no habitat impacts such as those which occur with beach creation.

5.2.3 TOPOGRAPHIC AND BATHYMETRIC CHANGES

The landside portion of the project site is relatively small (approximately 1.82 acres) and has only minor topographic relief, with the ground elevation ranging from a low of sea level along the beachfront to a high of approximately 25 feet along the northern site boundary. The primary beach dune is 5 to 10 feet in height. Site construction will include typical site grading and contouring that would be expected for any beachfront building site.

There will be no changes to existing bathymetry necessary for the pier or the dolphin pens. All over-water structures will be supported by pilings.

5.2.4 COASTAL AND OTHER SOIL EROSION

Construction of the landside portion of the Dolphin Discovery facility will require site clearing. Site clearing can cause soil erosion during major rain events. Erosion caused by upland runoff has the potential to produce turbidity plumes and degrade water quality if the runoff reaches the open waters of Blowing Point Harbour. Accordingly, Best Management Practices (BMPs) for site erosion control should be utilized at all times during construction. For example, the

construction site should be bounded by construction silt fencing that will contain the site during rain events. The silt fencing should be inspected daily to ensure its integrity, and repaired or replaced as necessary to maintain its effectiveness.

5.2.5 OCEANOGRAPHY

The pens and pilings are not anticipated to cause any substantive changes in the existing current patterns or wave diffraction patterns within Blowing Point Harbour. It is not anticipated that the structure, dolphin population, or operations, will cause significant changes in water temperature or pH.

5.2.6 GEOLOGY INCLUDING CAVES AND SINKHOLES

The site assessment conducted during September 2007 did not find any caves or sinkholes on the terrestrial portion of the project site. However, a detailed study was not conducted and contractors clearing the site should be aware of any features which were overlooked during the field effort.

5.2.7 NOISE

Concerns surrounding noise include those during construction and operation from the project, and the effect of ambient noise on the dolphins.

5.2.7.1 Project Noise

Noise generated during the construction phase of the project will be short lived and will consist most noticeably of machinery engines, pile drivers, and other construction-related equipment. Operational noise will be long term, but will be generally less conspicuous. Types of noise produced during the operation of the proposed facility will be similar to those noises produced at any tourist attraction or recreational facility, including vehicle engines and talking crowds of people.

Pile driving and other construction noises will be limited to the daytime hours and will be short in duration. The following steps will ensure that there are no significant noise emissions during construction and that there will be no significant increase in the noise level.

1. Hours should be within 7 AM and 6 PM for construction, and 7 AM to 10 PM for operation.
2. Pile driving shall not be conducted between 6 PM and 7 AM.

3. All jackhammers and chainsaws shall be enclosed with shields, acoustic barrier enclosures, or noise barriers.
4. Use of all impact devices, including hoe rams, jackhammers, chiseling devices, and pavement breakers, shall be prohibited during the nighttime hours (i.e., 10 PM to 7 AM).
5. Vendors shall use approved transportation routes to minimize noise at nearby residences.
6. Trucks shall not idle for more than 5 minutes.

To enforce these policies, it will be important to maintain contact with local residents and visitors to hear concerns and satisfy disputes, share architectural designs, and monitor noise levels.

5.2.7.2 Underwater Noise

The following describes the hydroacoustic study that was conducted to evaluate the effects of ambient noise on dolphins.

Within the last few decades, concern has arisen that sounds introduced into the ocean by humans may have deleterious effects on marine mammals. This could potentially happen in any of three ways: interfering with the animals' ability to detect calls from conspecifics, echolocation pulses, or other important natural sounds; interrupting normal behavior or activities (e.g., resting, feeding, or socializing); or causing temporary or permanent reductions in hearing sensitivity (Richardson et al. 1995). Generally, to avoid harmful effects in marine mammals, underwater sound should remain below 150 dB at 1 meter from the source (US Department of the Navy 2001).

An animal's sensitivity to sounds varies with frequency, and its response to a sound is expected to depend largely on the presence and levels of sound in the frequency band (range of frequencies) to which it is sensitive. Bottlenose dolphins are most sensitive to sounds in the frequency range of 40 to 100 kHz; although, they can hear frequencies between 75 Hz to 150 kHz (Ridgeway 1990).

Blowing Point Harbour is a working harbour frequented by fishermen and ferries traveling to and from the Anguilla Ferry Terminal. Anthropogenic underwater noise audible in the harbour would almost exclusively be from boats. To evaluate what impact this noise would have on the

dolphins living in the proposed open water dolphin pen, a hydroacoustic study was performed on October 17, 2007.

Acoustic data collection was conducted from a boat within the footprint of the proposed project (Figure 5-4). Measurements involved recording sound files (in a digital WAV format) from 30 seconds to 5 minutes in length. Data for both ambient and potential noise sources (e.g., boat traffic) were collected. The acoustic monitoring occurred at varying distances from different operating boats. Because Blowing Point Harbour is such an active area, measurements usually included more than just one noise. These noises were later separated through spectral decomposition, as well as careful listening to the audible signal while viewing the signal amplitude time series plot.

The analysis of the acoustic data entailed the evaluation of peak amplitude and root mean square (RMS), as well as performing a spectral energy analysis. Amplitude is an acoustic measure of sound pressure and is directly related to the acoustic energy and intensity of a sound. The RMS is a common method used to measure the average amplitude of a sound wave over time. Both amplitude and RMS are expressed using decibels (dB). For this study, RMS levels were computed for the entire calculated spectrum (18 Hz to 22,050 Hz).

The spectral energy analysis was calculated with a Fast Fourier Transform (FFT) size of 8,192 samples, which provides a spectral resolution bandwidth of 5.383 Hz. However, the power spectral density (PSD) option was utilized for this spectral analysis, thereby normalizing the spectrum to a 1 Hz band, which results in amplitudes independent of FFT size and sampling rate. The frequency limit for the spectral analysis is 22,050 Hz, which is considerably higher than any noise of interest.

Table 5-1 presents amplitude and RMS data for ambient conditions and various boats operating in Blowing Point Harbour within different distances of the proposed project site.

Table 5-1. Amplitude and RMS Data for Ambient Conditions and Various Boats Operating in Blowing Point Harbour

Noise Source	Peak Amplitude (dB)	RMS (dB)
Ambient Conditions	107.2	133.0
Unnamed 60 ft, inboard distance: 435 ft	109.4	134.9
MV Amalia *50 ft, inboard* *distance: 300 ft*	113.1	135.3
Unnamed 35 ft, twin outboard distance: 600 ft	112.0	135.5
Unnamed 20 ft, twin outboard distance: 450 ft	115.2	139.9
Blue mono-hull 55 ft, inboard distance: 270 ft	127.4	142.6
Blue mono-hull 55 ft, inboard distance: 90 ft	130.7	145.1

For ambient conditions, amplitude and RMS levels were 107.2 dB and 133.0 dB, respectively. Ambient acoustic conditions are illustrated in the following time series and spectral analysis (Figures 5-5a and 5-5b, respectively). In addition to amplitude and RMS, the spectral analysis results also include peak frequency. As seen in Figure 5-5b, there was not a single peak (or spike) in frequency. Instead, ambient noise spanned several hundred Hz. It should also be noted that ambient noise levels at a given frequency often can vary by 10 to 20 dB from day to day.

Generally, two primary ambient noise sources exist in this shallow water area: wind and wave noise and biological noise. Biological noise sources may include marine mammals and certain fish and shrimp. In the present study, snapping shrimp were main contributors to ambient noise in the frequency range 2 to 200 kHz. These shrimp can contribute some 20 to 30 dB above all other natural sources combined in this frequency band (Potter et al. 1997).

As mentioned previously, beyond ambient sounds of wind, waves and aquatic animals, underwater noise audible in the harbour would almost exclusively be from boats. Sound levels and frequency characteristics are roughly related to ship size and speed, but there is significant individual variation among vessels of similar classes.

The closest distance a vessel came within the proposed project site was approximately 90 feet. The vessel was a 55-foot inboard motor boat that provided ferry services between Anguilla and St. Martin. At this distance, the vessel produced the greatest RMS level recorded (145.1 dB). An example portion of time series data from an acoustic recording of this vessel is pictured in Figure 5-6a. Figure 5-6b illustrates the spectral analysis for this data; an overlay of ambient conditions (green line) is included for comparison.

To avoid harmful effects in marine mammals, underwater sound should remain below 150 dB (DON 2001). For the proposed project, results from the study show that this should be an attainable objective. To assist in maintaining boat distances away from the proposed dolphin pen, it is recommended that a series of buoys is positioned at a 100-foot radius. By encouraging boats to remain a minimum distance of 100 ft away from the dolphin pen, noise generated by operating boats should not interfere with the dolphins' health or behavior.

5.2.7.3 Other Noise Associated with Facility Construction and Operation

Facility construction will result in typical noise associated with a construction site. These noises include various trucks and construction equipment. No blasting will be needed for any part of the construction of the facility. Facility completion is anticipated to be 4 to 6 months from the start of construction, so any construction noise will be temporary and restricted to daylight hours. Once operational, the facility is not expected to generate any significant noise. The majority of the sounds anticipated to be generated from the operational facility include commonplace traffic noise (generated by visitors, staff, and delivery vehicles), and the people participating in the Dolphin Discovery experience.

5.2.8 WASTE DISPOSAL

Construction-generated debris and all solid waste from facility operation will be collected in onsite containers and removed by a waste-hauling contractor to the existing municipal landfill.

Onsite liquid waste generation will be limited to wastewater from the restrooms, locker rooms, and kitchen operations. Wastewater will be collected in an onsite cistern. A contractor will periodically pump out the cistern and transport the collected wastewater for disposal.

5.2.9 AIR POLLUTANTS

During the construction phase, the facility will generate air pollutants typical for a construction site, consisting primarily of vehicle exhaust (trucks, diesel equipment) and dust. However, these pollution sources will be temporary. Once in operation, the facility will not be using any specialized equipment that will generate air pollutants. Any other operation phase air pollutants would be limited to commonplace sources such as vehicle exhaust, landscaping equipment, and boat engines. Dust associated with the construction phase will be controlled once the site is landscaped and under landscaping maintenance.

The potential health risks related to particulate air emissions include asthma, emphysema, chronic bronchitis, cancer, and heart disease. People most at risk are young children, the elderly, and those with preexisting respiratory problems. Dust can also cause eye irritation and be a nuisance.

Generally, potential particulate air emissions will be limited to the construction phase of the proposed project. During the limited earth-moving and hauling operations, dust may become airborne and affect local air quality. Adverse impacts to air quality via fugitive dust can be avoided and/or minimized with the use of proper construction BMPs, including the following.

- Minimizing the area of land to be disturbed,
- Covering dusty truck loads with tarpaulin sheets,
- Restricting the movement of vehicles to defined access/egress routes,
- Minimizing the excavation and transfer operations of surface soils on windy days,
- Fencing in work areas with cloth or fabric (such as green garden type mesh) to minimize dust migration off the site,
- Prohibiting or limiting the burning of waste material, and
- Suppressing fugitive dust with water to minimize fugitive dust on unsealed roads and work areas.

Regarding the proposed project, the Developer does not intend to clear the entire property before construction. Rather, portions of the property will be cleared in phases using machinery and/or manual labor. The proposed structures will be constructed in these cleared areas, and native vegetation between buildings will be preserved. In this way, fugitive dust will be minimized.

5.2.10 QUALITY OF BATHING AND DRINKING WATER COLLECTED (POTABLE WATER QUALITY)

Water will be used from municipal sources. No testing of this source is anticipated.

5.2.11 CONFLICT WITH OTHER LAND USES

The Dolphin Discovery facility is not anticipated to conflict with other land uses other than the adjacent beachfront villas. The over-water portion of the facility is not anticipated to interfere with the ferry dock and boat traffic. The landward portion of the facility is being located on an undeveloped site. The adjacent waterfront properties are residential. The Dolphin Discovery site will have a dedicated access road from a main road, so that visitors will not have to pass through residential areas. The Dolphin Discovery operation has taken steps to mitigate the interference with the public's use of the beach. Section 4.3.1 provides a description of the beachfront plan that maintains full access by the public.

5.2.12 LANDSCAPE /SEASCAPE

With the exception of the grading and contouring associated with site preparation, no substantial impacts to landforms will result from project construction. The site does not include any prominent topographic features (such as ridge lines, cliffs, or rock outcrops) that will be altered by the project. As described in sections above, shoreline monitoring should be conducted following construction to ensure that significant changes to the beach due to the proposed facility are not occurring.

The small scale and nature of the project precludes any climate or significant micro-climate effects. The site plan does not include any high-rise structures that will alter wind patterns. The site plan does not include extensive areas of asphalt that will raise local temperatures.

5.2.13 VISUAL IMPACT

The upland facility architecture will be consistent with the Anguillian beachfront. The dolphin facility will be visually and aesthetically pleasing and resemble a dock structure. Figure 2-5 shows a similar facility in Mexico, while Figure 2-6 shows an artist's rendering of the new facility at Blowing Point.

5.2.14 TRANSPORTATION

An unpaved road leads to and within the project site. From discussions between the Developer and the Anguillian Government, it is apparent that the Government plans to remove the road from the Developer's property and maintain it as a public beach access road. Consequently, the proposed project will not interfere with public beach access. Figure 5-7 shows the current access location.

Due to the limited roadway system capacity, this report includes a detailed analysis of traffic. The following describes the assumptions for the traffic analysis and Section 4 included the baseline conditions.

As currently proposed, the Dolphin Discovery facility will consist of a two-story building with a reception area and retail, pool, restaurant, and exhibit areas. The project is proposed to consist of two phases of construction spanning about 1 year on a site that is approximately 16 acres (4 upland acres and 12 marine acres).

Dolphin Discovery is planning to employ 40 to 45 employees upon construction completion. Existing Anguilla residents are anticipated to provide the bulk of the additional required workforce for these projects. Due to the fact that the majority of the post-construction workforce already utilizes the Anguilla roadways, traffic volumes on the primary roadways analyzed above are expected to conservatively increase by 2 percent during peak hours (around 7:00 am and 3:00 pm) due to employees.

Another traffic source associated with the proposed Dolphin Discovery project is construction traffic. The construction work force is proposed to consist of 24 people, about half of which will be housed at the project site. Thus, the construction workforce will generate few additional trips on the primary roadways analyzed above. Upland construction will typically require one large container delivered to the project site per week. Marine construction will require a total of about

10 containers delivered to the project site during the expected 6-month construction duration. Delivery/service vehicles may also contribute minimal daily trips (both during and after construction); however, large construction-related containers can be delivered/removed during nighttime or off-peak hours to minimize traffic impacts. Container deliveries will use all of the primary roadways, except Jeremiah Gumbs Highway. Traffic related to construction, although mostly temporary, is conservatively anticipated to increase existing traffic volumes on the primary roadways by about 1 percent.

Facility guests will mostly access Anguilla by vessel, followed by airplane arrivals. Due to the limited number of commercial flights to Anguilla, many visitors commonly fly to St. Maarten and take a ferry to Anguilla. Compared to Wallblake Airport, the airport on St. Maarten has more daily commercial flights and is able to accommodate larger aircraft. Currently, the ferries from St. Maarten arrive in Anguilla at the Blowing Point ferry dock, which is less than a quarter-mile east of the project site.

The Dolphin Discovery facility is expecting to draw between 25,000 and 30,000 guests annually, and the hours of operation will be 8:00 am to 5:00 pm daily. Most guests (around 85 percent) are expected to arrive at the Blowing Point ferry dock, and they will be transported by bus (49 passenger capacity) the short distance to Dolphin Discovery. Two (2) bus trips per day are planned, two or three times per week during the low season (May through October) and three or four times per week during the high season (November through April).

Guests arriving at Wallblake Airport (about 15 percent) will access Dolphin Discovery via taxi (about five taxi trips per week are expected) or by renting a vehicle. Also, the facility will provide bus service (a small 25-passenger bus) from the airport every other week. In summary, additional trips will be generated by taxis and buses transporting guests, as well as rental vehicles, but mostly during non-peak traffic periods. Thus, traffic volumes on primary roadways are assumed to conservatively increase by 1 percent during peak hours due to rental vehicles, buses, and taxis.

All project-related traffic sources discussed above that are anticipated to increase existing peak-period traffic volumes on Albert Hughes Drive are summarized as follows.

- Employees – 2 percent
- Construction – 1 percent

- Rental vehicles, taxis, and buses – 1 percent
- Delivery/service (post-construction) – 1 percent

Table 5-2 summarizes the existing hourly traffic volume approximations, adjusted existing hourly volumes (adjustment for counts collected during a non-peak period), and existing LOS. It also summarizes project-related trip estimates, total anticipated hourly traffic volumes, and expected LOS, both during construction and post-construction.

Table 5-2 – Projected Traffic Volumes

	Existing			Projected					
				During Construction			Post-Construction		
Location	Volume (vph) *	Adjusted Volume (vph) *	LOS	Additional Trips	Total Volume (vph)	LOS	Additional Trips	Total Volume (vph)	LOS
Albert Hughes Drive, East of Blowing Point Road	483	483	B	5	488	B	19	502	B
Albert Hughes Drive, West of Blowing Point Road	441	485	B	5	490	B	19	505	B
Blowing Point Road, South of Albert Hughes Drive	364	364	B	13	377	B	53	417	B
Jeremiah Gumbs Highway, East of Blowing Point Road	231	254	A	3	257	A	10	264	A
Cul De Sac Drive, between Blowing Point Road & Project Site	53	58	A	16	75	A	66	124	A

* Existing hourly volume based on observed 15-minute periods on 03 Oct 2007.
Adjusted volume compensates for counts not collected during the peak traffic.

The existing hourly volume estimates on Jeremiah Gumbs Highway, Cul De Sac Drive, and Albert Hughes Drive west of Blowing Point Road were adjusted to more closely reflect peak traffic conditions, since the counts at those locations were collected after the peak period. A peak hour factor of 1.1 was used to adjust the volumes. The number of additional trips, both during and after construction, was calculated based on the percentages above. As shown in Table 5-2, the LOS corresponding to the projected traffic volumes is expected to be the same LOS as existing conditions, indicating the facility will not significantly deteriorate the existing traffic flow in the area.

Based on the information presented above, the Dolphin Discovery facility will contribute additional traffic to the existing roadways on Anguilla, particularly Blowing Point Road and Cul De Sac Drive. In general, the magnitude of additional traffic is relatively small and not expected to have a significant impact.

Traffic flow throughout Anguilla is currently considered to be very good. Traffic flow is expected to continue to be very good post-construction, especially with the utilization of buses to transport visitors from the Blowing Point ferry dock to the facility. Additionally, adjusting employee work schedules to make shift changes non-coincident with that of West End resorts and the beginning/end of the school day (Blowing Point Elementary) would further minimize the impact expected on Anguilla roadways.

NOTE: Statistical information presented in the Background section was provided by (and/or calculated from data provided by) the Anguilla Statistics Department. Facility program and operations information presented in the Proposed Conditions section is as current as that made available by Dolphin Discovery Group.

5.3 ECOLOGICAL IMPACTS

5.3.1 DIRECT IMPACTS TO MARINE ECOLOGICAL RESOURCES

Figure 4-7 provides the footprint of the dolphinarium structure overlain on the benthic marine cover map. The overall footprint is approximately 1.49 acres in size. Table 5-3 lists the benthic cover types and their areas contained within the dolphinarium footprint. The majority (91.52 percent) of the benthic cover within the dolphinarium footprint consists of either the sparse macroalgae and sparse seagrass (69 percent) or unvegetated sand (23 percent) cover types. All benthic cover types are described in detail in Section 1.

Table 5-3. Dolphinarium Footprint Impacts on Marine Benthic Habitats

Benthic Cover Type	m^2	Hectares	Acres	Percent of Total
Sparse Macroalgae and Seagrass	4148.44	0.41	1.03	68.60
Unvegetated Sand	1386.29	0.14	0.34	22.92
Rock	300.99	0.03	0.07	4.98
Algae Dominated Hardbottom	127.46	0.01	0.03	2.11
Mixed Seagrass	80.4	0.01	0.02	1.33
Sandy Beach	3.99	0.00	0.00	0.07
Total	6047.57	0.60	1.49	100.00

Because the dolphinarium is primarily a fenced enclosure with perimeter docks and piers, direct, short-term impacts related to the construction and placement of the structure will be relatively minor. Dolphinarium construction will require installation of pilings into the bottom. These pilings will be used to support the perimeter docks and piers, as well as support the fencing for the dolphin pens. At piling locations where the bottom substrate consists of deep sands, the pilings will be installed using water jets. The water jet will be fastened to the end of the piling and the jet directed downward, allowing the piling to be set using its own weight. Preliminary site investigation indicates that most of the piling locations (approximately 95 percent) have a deep sand substrate, and jetting will be an appropriate method for installing the pilings. Jetting into the sand will cause localized sediment suspension, but the sand material is coarse and will settle rapidly and not result in a turbidity plume. At those few locations where rock will be encountered, an underwater jackhammer will be used to create a 2-foot-deep, 4-foot-square footing into which concrete will be poured to secure the piling.

Permanent but limited shading impacts will occur to the seagrass and macroalgae habitats. Approximately 92 percent of the benthic cover within the dolphinarium footprint is either sparse macroalgae and seagrass (69 percent) or unvegetated sand (23 percent). While seagrass and macroalgae are sensitive to light penetration that may be affected by the facility, the shading effect is only partial. Neither habitat type is expected to be eliminated by the project. The majority of the bottom area within the structure will remain untouched both during and after construction. However, large rocks encrusted with algae and coral species are located within the project site and will be removed.

The pier and piling structure will provide attachment substrate for invertebrates and algae. Species typical of a fouling community, including tunicates, sponges, algae, crustaceans, and other fauna will utilize the pilings and pier as marine habitat.

The proposed pen facility will contain 8 to 15 dolphins over the lifespan of the project. Concerns regarding the environmental impacts from this facility include elevated nutrient input from dolphin feed and wastes and subsequent effects on water quality and habitat.

Receiving waters in Blowing Point area have existing impacts from the harbour and heavy boat traffic in the area. Based on diver surveys in September and October 2007, the existing habitats are shown in Figure 4-7. They include seagrass and macroalgae dominated hardbottom. Area coral reefs are dead but some live finger and brain corals encrust the relict reef and scattered rocks. Coral habitats are the most sensitive in terms of nutrient enrichment.

Concentrations of fecal and food material are controlled mechanically in a pool or lagoon habitat, however, in the open ocean, no control may be necessary. Monitoring is recommended to ensure that this prediction is accurate. In this high current area, flushing rates are rapid and water quality conditions generated by the additional fecal and food waste material will be less troublesome.

Quantitative conclusions regarding the nutrient loading will be contained in the modeling results in Appendix H.

5.3.1.1 Rare or Protected Species

The project plan complies with international agreements including the Convention on International Trade in Endangered Species. The Anguillian Government does not have a national endangered species list; however, the project team has investigated the species listed as of concern by the IUCN. The IUCN, also known as the World Conservation Union, maintains a comprehensive list of species of special concern that includes 35 species found in Anguilla (IUCN 2004 Red List of Threatened Species, downloaded from www.redlist.org). The IUCN red list was consulted prior to field surveys to determine if any species were present in the proposed project area. Of the 35 species considered, the green turtle and Nassau grouper were the ones present within the project's Sphere of Influence. It is possible that green, hawksbill, or

leatherback turtles nest on Sandy Point Beach. However, more extensive nesting season surveys would be required to determine if this is an active nesting beach.

5.3.2 DIRECT IMPACTS TO TERRESTRIAL ECOLOGICAL RESOURCES AND VEGETATION

Figure 4-8 provides the master site plan for the landside portion of the facility overlain on the terrestrial vegetation and land cover map. The landside portion of the facility includes the entrance road and parking area, all buildings and interconnecting walkways, and a swimming pool. The existing terrestrial vegetation and land cover present on the site are detailed in Section 4. The master site plan for the landside portion of the facility does not impact the existing beach or beach dune landside portion of the project site. This includes approximately 4.16 acres, of which 1.45 acres is unvegetated sandy beach.

5.3.2.1 Exotic Species Considerations

Upland exotic species introduced by the project, including birds and plants cultivated for their visual impact, should be tightly controlled. A list of exotic species housed on the property and steps to protect against their release will be provided to Government by the project developer.

5.3.2.2 Type and Features of Habitats and Ecosystems (Species Diversity, Rare and Endangered Species)

No rare or endangered species or habitats were observed during surveys. Existing habitats and conditions are discussed in section 4, including complete species lists. Bats are a native species of concern, and the only mammal native to Anguilla. No caverns or sinkholes were identified during surveys that would be likely to support bats.

5.3.2.3 Infestation of Sharks, Animals and Other Pests

Dolphin facilities operated by Dolphin Discovery have not been shown to attract sharks or other pest animals. Feeding dolphins on a schedule and with a diet that minimizes waste should reduce the risk of attracting other predators. Dolphin veterinarians and biologists were contacted to verify that no problems with predators had occurred at other facilities: “The U.S. Navy Marine Mammal Program has been housing dozens of dolphins and sea lions in ocean pens for almost 50 years, on a permanent basis in San Diego, Hawaii, Key West (Florida), and Kings Bay (Georgia), and during temporary deployments to locations all over the world. We have never had any indication that the presence of our animals attracted sharks.” (personal communication, Dr. Mark J. Xitco Jr.).

5.3.2.4 Impacts of Existing Activities on the Proposed Dolphins

Nearby human activities will negatively affect the penned dolphins. Nearby car, boat and ferry infrastructure make this destination suitable from a traffic viewpoint, however, the non-point source pollutants generated by ferry and fishing vessels may be harmful to dolphins. A veterinarian for Dolphin Discovery in Mexico provided testimony regarding boat and marine traffic in the vicinity of other captive dolphin facilities. That letter is provided in Appendix I.

5.4 RISKS OF ACCIDENTS AND HAZARDOUS DEVELOPMENT

5.4.1 DOLPHIN SAFETY

This section describes risks from the project that may increase the cumulative impacts over long time scales. These include accidental release, fisheries effects, and disease. There is an increased risk of introduction of dolphins to area reefs resulting from release or escape, and the close proximity of one another among the captive dolphins increases the transmission of contagious diseases.

Because dolphins can jump, it is possible, although unlikely, that the captive dolphins may escape. If this were to occur, they may 1) remain in the area; 2) be killed by local fishermen or sharks; or 3) leave the area. None of these potential scenarios has significant environmental effects.

Enclosed dolphinariums may have a higher likelihood of disease than open systems, as contagious diseases are more likely to be passed among individuals. The dolphin to be brought to the facility will be screened for disease by a qualified veterinarian before release into the pens. This will reduce and likely eliminate the risk of introducing disease to wild populations from the captive dolphins. Regular veterinary observation and care of the captive dolphins is part of the facilities operation and will further reduce the risk of diseases and their spread. Environmental risks to dolphins include

1. Wave action,
2. Ferry wakes,
3. Metals and petroleum pollutants leaking or released from boats, and
4. Sewage from failed septic tanks and fields.

5.4.2 HUMAN SAFETY

To minimize risks from the proposed project, the Developer will conduct specialized training and safety classes for all personnel. Operational safety for animals, employees and guests is of paramount concern. A number of initiatives have been undertaken to ensure the safety and quality care of the animals. Equally as important, additional measures will be included that enhance safety for program participants.

During all interactive sessions, animal behaviorists will directly observe and supervise each program participant. Managers will be on duty each day to supervise the staff. Staff members will be trained in safety measures and observation skills. For their safety, guests who do not follow program rules will be immediately removed from the program. Animals that demonstrate poor response or unusual behavior will be immediately removed from the program.

All animal training staff members will be required to undergo water rescue training. All water rescue procedures will be printed for reference in both the operations manual and safety manual.

A complete operations manual will be drafted, detailing all aspects of daily operations. Sections will include staff procedures, water rescue, opening and closing procedures, cleaning schedules, animal forms and records, and animal profiles.

A complete safety manual will be drafted, detailing all aspects of animal, staff, and guest safety. Sections in the manual will include emergency systems, water rescue procedures, SCUBA guidelines, spotter responsibilities, netting procedures, public interaction guidelines, behavior lists and guidelines, and health/hygiene policies. All staff members will be required to read this manual and demonstrate a knowledge and understanding of all items through testing and review.

Animal training procedures, manuals, and management will emphasize both animal and guest safety through advanced training principles. Staff members will be highly trained and tested on observation techniques and behavior patterns that might involve safety issues. Positive reinforcement training has had documented success in reducing inappropriate behavior patterns and aggression. This type of training system, when maintained effectively, ensures the highest possible safety environment for animals and guests. In addition, behavior and medical

observations by both staff and management will bring multiple perspectives and a redundant observation system to the animal care system. Animals that show anomalies in behavior patterns will be removed from the program and evaluated for medical treatment or further behavior modification.

Swimming in the ocean environment presents risks, despite precautions. The dock and fence system will prevent most large marine life from entering the enclosure. To prevent an accident or injury, all animal training staff members will be required to undergo water rescue training. All water rescue procedures will be printed for reference in both the operations manual and safety manual.

5.5 SEDIMENT QUALITY

The proposed project is not expected to have any significant adverse impacts on sediment quality. The consistency of dolphin waste is liquid; therefore, there will not be significant settlement of organic material via waste material from the dolphins.

5.6 INCREASED PASSENGER AND BOATING TRAFFIC

It is not anticipated that the passenger and boating traffic will increase because the pre-existing site on Anguilla can accommodate the same volume of visitors as the proposed site.

5.7 FACILITY COMPARISON

The impacts from the proposed facility were compared to three other dolphin operations: The Atlantis facility in Nassau, Bahamas, and Atlantis, Palm Island, Dubai, and Dolphin Cove, Hanover, Jamaica. The proposed facility at Sandy Point meets or exceeds the efforts to avoid, minimize, and mitigate impacts to the surrounding environment documented for the other facilities. An independent project in Jamaica was chosen as a comparison for the proposed facility at Sandy Point. Using the same criteria to determine significance, the proposed Jamaican project and the Anguilla projects are compared below.

Table 5-4. Potential for Impact at Dolphin Discovery, Anguilla Compared to Dolphin Cove, Jamaica

Impact	Paradise Dolphin Cove, Jamaica	Dolphin Discovery, Anguilla
Coastal water quality impairment	High to Moderate	Low
Change to oceanography	High to Moderate	Low
Coastal wetland filling	High to Moderate	None
Dredging seabed	High to Moderate	Low/None
Increased traffic	High to Moderate	Low
Potential for pests and vectors	Low to Moderate	Low
Modification of drainage patterns	Low to Moderate	Low
Beach fill and creation	Low to Moderate	Low/None
Increased coastal erosion	Low to Moderate	Low/None
Increased vulnerability to storms	Low to Moderate	Low/None
Loss of fishing area	Low to Moderate	Low
Nuisance noise	Low to Moderate	Low
Consumption of building materials	Low to Moderate	Low
Change to air quality	Low to Moderate	Low/None

As shown, the Dolphin Discovery project proposed for Sandy Point is a small scale and low impact operation as compared to other models that require modification of the shoreline, dredging, and coastal wetland and aquatic habitat fill.

6.0 MITIGATION MEASURES

6.1 MANAGEMENT PLAN

Through acceptance and implementation by the Government and the Developer, the mitigation measures will help minimize detrimental project effects on the environment. Social and economic impact monitoring are not included under this draft plan.

The goal is to protect the long-term health of the environmental resources within the project boundary and adjacent areas.

6.2 PUBLIC EDUCATION PROGRAMS

To offset impacts to the adjacent community resulting from visual and land use changes, the project will offer public education programs. These programs will emphasize ocean conservation, wildlife protection and responsible environmental stewardship. This will be done via direct narration, film footage, graphics, brochures and website development. Programs will begin with an enhanced educational and safety briefing, in a theater environment, prior to each in-water program. The content of these programs, which will follow a standard outline and last approximately 20 minutes, will include:

- Viewing an educational film that focuses on wild dolphins,
- Emphasis on natural history, facts about breeding, development, growth, behavior, predators, prey and current threats to wild populations,
- Briefing guests on local dolphin populations and their unique role in the ecosystem.
- Viewing a film on controlled interactions with dolphins.
- Emphasis on safety aspects, appropriate and inappropriate interactions with dolphins, what to expect, and the importance of listening carefully to instructions while in the water.
- Explaining the animal training process, benefits to the animals, and contributions to research and marine science, including descriptions of the learning process with dolphins and its applications to other animals using a positive, gentle approach to animal training.

Marine mammal science education programs will be provided through the Dolphin Experience facility. Learning is enhanced when education and entertainment are combined. In a 1997

Roper poll of U.S. zoological institutions, 97 percent of respondents said that their experience with captive animals greatly enhanced their awareness of conservation issues. The response was even greater for those who experienced dolphin interactive programs. Through unique programming, trained behaviors, and formal presentations, guest perceptions and learning are enhanced when information is presented in an exciting venue. Shows are a critical element for enhancing public awareness. Dolphin Discovery will enhance the education of all visitors. During specialized programs, areas of emphasis will include:

- Ocean ecology
- Natural history of dolphins
- Dolphins in the Caribbean
- Learning and behavior in marine mammals
- Conservation of our oceans

Learning tools, such as videos, graphics, posters, models and direct narration will provide guests with in-depth information about marine mammals. Information will be available regarding critical ocean resource management issues. Information, pamphlets, brochures will be available to program participants. Student research programs, university collaboration and teacher's workshops will also be developed for higher levels of marine mammal education. Visitors will learn about the new marine mammal program when they participate in the facility tour. Through these and other programs yet to be developed, Dolphin Discovery will contribute to the public awareness of marine science and conservation.

6.3 CONSTRUCTION BEST MANAGEMENT PRACTICES

To ensure that these practices are used, a Construction Manager should be dedicated. The Construction Manager is responsible for land-based operations including land-clearing, earth-moving, site preparation, and construction of all phases of the project. This person will ensure that sediment and erosion is controlled on land, and that storm water carrying pollutants, including silt, do not reach the marine environment. Recommended Best Management Practices include:

1. Provide workers with protective gear
2. Manage stockpiles
3. Landscape immediately after clearing to minimize exposed soil
4. Minimizing periods of work stoppage

5. Limit construction activities to daylight hours
6. Use and maintain silt screens.
7. Make portable lavatories available
8. Dispose of solid waste at approved sites daily
9. Maintain equipment and vehicles
10. Limit haulage operations to off-peak traffic times
11. Observe road safety & speed limits

The Construction Manager shall be responsible for keeping construction activities under surveillance, management, and control to avoid pollution of surface and ground waters. The Construction Manager shall not discharge or permit discharge into the waterways, of fuels, oils, bitumens, garbage, sewage, or other materials which may be harmful to fish, wildlife, or vegetation, or that may be detrimental to outdoor recreation. The Construction Manager will be responsible for investigating and complying with all applicable Government laws and regulations governing pollution of waters.

During construction, the Construction Manager will be required to log daily Quality Control Reports, including any problems in complying with laws, regulations, ordinances, and permits, and any corrective actions taken. These logs shall be available during construction for review by Government officials at any time. The responsible engineer during construction will notify the Construction Manager of any observed noncompliance with the EMP. The Contractor shall be required to take immediate corrective action. If the Contractor fails or refuses to comply promptly, the responsible engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken.

The Construction Manager position requires a familiarity, aptitude, and enthusiasm for environmentally sensitive construction methods. The position requires an understanding of the effects of sediments and construction site pollutants on the environment; ways that soils, precipitation, hydrology, topography, and vegetation affect erosion; sediment trapping methods; erosion and pollution control plans and practices suitable for each site; and experience putting plans into practice.

The Construction Manager will receive training as necessary in erosion and sediment control practices and sensitive natural and cultural resources, as well as tools to relay this information

to staff. The Construction Manager will educate the contractors working on the project about such practices during a pre-construction meeting and be responsible for enforcing compliance with the practices outlined in the EIS.

Specific mitigation projects that Construction Manager shall take responsibility for leading include:

1. Removing debris;
2. Using sediment and erosion control measures;
3. Applying storm water management systems and improvements;
4. Implementing construction Best Management Practices.

The Construction Manager is responsible for knowing the location and significance of these sites and avoiding any accidental or purposeful looting, damage, or destruction from construction crew and activities.

Lastly, the Construction Manager shall be responsible for security and safety within the construction areas. Public safety shall be maintained through appropriate signage and fencing to limit public access into dangerous areas. Secure areas will be established for storage of all materials and equipments with appropriate storage containers for fuel, oils and other chemicals or hazardous materials.

Along with reviewing the plans, permits, schedules and other contract documents, the pre-construction or project kickoff meeting will also include discussion of the following:

1. Use of BMPs during project construction;
2. Construction sequencing; and,
3. Construction safety and spill prevention /pollution control.

The focus of the construction sequencing will be to create a construction schedule that will minimize the total disturbed area(s) at any time during the project. During the construction phases involving clearing and earthwork during development, stockpiled soils, heavy equipment and organic debris will be staged within the active construction area.

Construction will begin following the necessary field services to mark project boundaries and layout finish grades. Land clearing operations will begin with the clearing and grubbing of the

limited vegetation within the construction area(s). Construction sequencing will attempt to stage construction so one area is stabilized before another area is disturbed.

BMPs will be employed during all phases of construction to limit offsite impacts including pollution, sedimentation, siltation, and turbidity. Temporary soil stabilization methods and sediment control BMPs will be applied to all applicable phases of construction. Erosion and turbidity may be controlled during construction by using temporary methods such as diversions to carry water away from the construction site to where it can be safely dispersed or silt fences or hay bales to trap sediments before they can enter the water. A combination of methods may be the best solution.

The following controls, at a minimum, will be incorporated into an overall storm water and sediment control BMP plan.

1. Prior to removal of any existing vegetative cover or alteration of the existing topography, silt fencing or other means slowing overland storm water flow and trapping sediment will be placed a strategic points in the overland flow pattern. Land areas that become stripped of vegetation during construction activities will be revegetated as quickly as possible to reduce erosion during storm events.
2. Sediment and erosion controls will be inspected at least weekly and immediately following significant rainfall events
3. Storm water discharge velocities will be reduced to provide for a non-erosive velocity for overland flow away from structures and control structures.
4. Storm water quality controls will be incorporated into the management plan to maintain quality of local waters.

Other BMPs that may be used to reduce erosion or turbidity during construction include properly securing or covering materials on truck beds and barges when hauling, limiting delivery paths and haul roads, and minimizing unnecessary vehicular and machinery activities.

7.0 PROGRAMME FOR MONITORING IMPACTS

7.1 BEACH PROFILE MONITORING

Beach profile surveys will be conducted to monitor the effect of the dolphinarium and access pier on long shore sand transport, and determine if there is any associated beach erosion or accretion caused by the structure. A pre-construction survey will be conducted to document baseline conditions and a post-construction survey will be conducted 1 year after the dolphinarium construction.

7.2 WATER QUALITY MONITORING

Monitoring will be conducted to ensure that dilution and flushing are vigorous enough to maintain current standards for water quality. It is recommended that the project monitor fecal loading to the bay and downstream areas on site, as the holding time for this test is 6 hours. The lack of another facility to count fecal coliforms means that the Developer should monitor water quality using its own facilities. No further specific monitoring should be necessary.

7.3 SEAGRASS MONITORING

It is possible that the seagrass and coral communities in the project footprint will be negatively affected by shading. To measure any change in the community, which may indicate shading or water quality impacts, monitoring is recommended.

Seagrass communities in the vicinity of the proposed project and in control sites will be monitored by the Developer. The Braun-Blanquet method will be used to monitor seagrass beds in the project area and in control areas. This method uses ten random 0.25 m quadrats along a 50 m transect. Divers or snorkelers record community composition, percentage cover and density of the benthic community on waterproof slates during monitoring efforts. Three species are found in the waters surrounding Sandy Point: *Thalassia testudinum, Syringodium filiforme, and Halodole wrightii.* Each species is identified and assigned a cover-abundance scale value. The cover codes are:

0 = not present
0.1 = solitary specimen
0.5 = few, with small cover
1 = numerous, but less than 5 percent cover

2 = 5-25 percent cover

3 = 25-50 percent cover

4 = 50-75 percent cover

5 = 75-100 percent cover

Water depth, current conditions, and bottom type will be recorded as well as indicators of eutrophication or disease. Eutrophication is linked with blooms of macroalgae, microalgae, and planktonic algae. Nutrients are limiting for some tropical marine plants, and changes in nutrient concentrations can be reflected in species shifts among seagrass and algae communities. Seagrasses dominate in oligotrophic conditions, but as nutrients increase, so do macroalgae. As the macroalgae increase, they compete with seagrass for light. If nutrient availability increases, epiphytic microalgae dominate epiphytic macroalgae, and then planktonic microalgae begin to bloom. Algal cover will be estimated on a scale of 1-5 and blooms will be photographed.

7.4 CORAL MONITORING

Because they are so sensitive to shading and nutrients, we recommend coral reef baseline studies, monitor coral reef impacts, and react to monitoring results. The main focus is on several hard corals (*Montastraea* spp.*, Agaricia* spp.*, Diploria* spp.*,* and *Porites astreoides*). The monitoring will use control stations and impact stations: 6 impact stations and 2 control stations. Locations are indicated in Figure 7-1. Permanent $1m^2$ quadrats will be established by marked corner pins, 3 at each station, and digital photographs will be taken at each monitoring event. Underwater notes will be made of hard and soft coral species present in each quadrat. Quantitative analysis of each quadrat will include:

- total living coral area, by species, in m^2
- total initial bleaching, by species and percent
- total initial mortality, by species and percent

Monitoring triggers will occur if significant (greater than 10 percent) coral mortality or bleaching occurs at the impact stations but not the control stations. At this point, the impact sites will be monitored once per week to determine if the impacts are stable or increasing. If they increase to 20 percent, actions will be taken to identify and reduce project related effects and to identify other effects.

Analysis will consist of measuring change in the community. Major changes in background community composition will be reported. Data will be provided to government on an ongoing basis.

7.5 MONITORING REPORT SCHEDULE

Coastal construction monitoring will take place every other month during construction and quarterly for two years after construction is completed. The first monitoring event will take place prior to construction and will also serve as a temporal control. A report will follow within 30 days of each monitoring event, submitted to Anguilla National Trust, Department of Marine Fisheries and Planning. The last report of each year will serve as the annual report and will summarize data from the previous year's studies. Hypothetical monitoring events using one year of construction are shown below as an example.

Year 1 Construction

1. Pre-project baseline monitoring and report
2. 1st Monthly monitoring and report
3. 2nd Monthly monitoring and report
4. 3rd Monthly monitoring and report
5. 4th Monthly monitoring and report

Year 1 Post-construction Monitoring

1. 1st Post Construction Monitoring and Report
2. 2nd Post Construction Monitoring and Report
3. 3rd Post Construction Monitoring and Report
4. 4th Post Construction Monitoring and Report

Year 2 Post-construction Monitoring

1. 5th Post Construction Monitoring and Report
2. 6th Post Construction Monitoring and Report
3. 7th Post Construction Monitoring and Report
4. 8th Post Construction Monitoring and Report

8.0 CONCLUSIONS

This EIS has addressed all issues and questions outlined in the TOR, except for those regarding socio-economics. Information on socio-economics is contained separately in Appendix B. Based on the information provided by Dolphin Discovery and available through assessment methods described in Sections 4 and 5, this project will not have significant impacts.

Briefly, impacts from the proposed project are summarized as follows:

- There will be some loss of upland vegetation. Permanent visual impacts and changes to land cover from clearing will be mitigated by allowing review of all architecture by a local stakeholder committee, and replanting of all cleared areas with native vegetation or landscaping.
- There will be an increase in visitors to the area, if not the island. The local traffic will increase, but the proposed project's proximity to the ferry terminal may reduce traffic on island roads.
- Regarding use, there will be a moderate increase in pressure on Sandy Point Beach. However, public access will be maintained.
- Additional nutrients in coastal receiving waters from fish and dolphin waste will have low to moderate impacts on water quality. Monitoring of water quality, benthic habitats, and sediment transport will ensure that the assumptions made in this evaluation are valid.
- Direct impacts to benthic habitats will be minor (shading).

Table 8-1 lists all impacts considered, and the level of significance during construction and operation, respectively.

Table 8-1 Impact Summary (* to be monitored)

Impact	Project Phase(s)	Significance Construction/Operation
Changes to oceanography	Operations	Low
Decreased coastal water quality	Operation and Construction	Low/Moderate*
Loss of upland vegetation	Operation and Construction	High/Moderate
Changes to sediment transport	Operation	Low/None*
Shading of benthic habitat	Operation	Low
Increased vehicle traffic	Operation and Construction	Low

Table 8-1 Impact Summary (* to be monitored)

Impact	Project Phase(s)	Significance Construction/Operation
Increased use pressure on beach	Operation and Construction	Moderate/Low
Public access conflicts on beach	Operation and Construction	Low/Moderate
Nuisance noise	Operation and Construction	Low/Moderate
Potential pests/disease vectors	Operation and Construction	Low/None
Land use change	Operation and Construction	Moderate/Moderate
Air quality change	Operation and Construction	None/Low
Consumption of raw materials	Operation and Construction	Low/Low
Waste outputs	Operation and Construction	Moderate/Low
Visual impact	Operation and Construction	Moderate/Moderate
Loss of rare, sensitive species or habitats	Operation and Construction	None/None

To conclude, the Dolphin Discovery facility has been sited and designed to minimize any direct impacts to either the terrestrial or the marine environment.

The facility is designed and will operate as an adequate educational and entertainment facility. The environmental impacts will be related to moderate water quality effects, habitat shading, and visual intrusion of adjacent land owners. These impacts will be mitigated and the net impacts should not be significant.

This EIS addresses environmental aspects. However, as mentioned previously, aspects regarding socio-economics are provided separately. The Government of Anguilla will provide ultimate consideration of this EIS after reviewing the final socio-economics report, applications for environmental permits and beach licenses, and determining whether there is any environmental or social issue for why the project should not proceed as proposed.

9.0 REFERENCES

Applied Technology and Management (2007). Cove Pond Rehabilitation Recommendations, May 4, 2007. Prepared for Shoal Bay West Properties. Charleston, SC.

Convention on International Trade in Endangered Species. Recent data uploaded from http://www.animallaw.info/treaties/itcites.htm.

Department of the Navy. (2001). Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar. Final Overseas Environmental Impact Statement and Environmental Impact Statement, January, 2001. Department of the Navy, Chief of Naval Operations, Arlington, VA.

Environmental Management Consultants, Ltd. (2007) Environmental Impact Assessment for the Proposed Dolphin Park, Paradise, Hanover. Prepared for Dolphin Cove Ltd. Ocho Rios, St. Ann, Jamaica.

Godley B.J, Broderick A.C, Campbell L.M, Ranger S., Richardson P.B. 2004. An Assessment of the Status and Exploitation of Marine Turtles in the UK Overseas Territories in the Wider Caribbean. Final Project Report for the Department of Environment, Food and Rural Affairs and the Foreign and Commonwealth Office. 253 pp.

Humann, P., N. Deloach. 1993a. Reef Coral Identification: Florida, Caribbean, Bahamas. New World Publications, Inc., Jacksonville, Florida.

Humann, P., N. Deloach. 1993b. Reef Creatures Identification: Florida, Caribbean, Bahamas. New World Publications, Inc., Jacksonville, Florida.

Humann, P., N. Deloach. 1993c. Reef Fish Identification: Florida, Caribbean, Bahamas. New World Publications, Inc., Jacksonville, Florida.

International Union for Conservation of Nature and Natural Resources (IUNC). Red List.

Island Resources Foundation and The Anguilla Archeological and Historical Society. 1993. Anguilla – Environmental Profile.

Littler, D.S., M. Littler, K.E. Bucher, J.N. Norris. 1989. Marine Plants of the Caribbean: A Field Guide from Florida to Brazil. Smithsonian Institution Press, Washington, D.C.

Long, E.R., MacDonald, D.D., Smith, S.L., and Calder, F.D. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management Vol. 19, No.1. pp. 81-97.

National Climate Data Center. 2004.

National Oceanic and Atmospheric Administration. 2005.

Natural Resources Institute. 1995. Benthic Habitat Atlas of Anguilla.

Potter, J.R., F.N. Wu, and L. Hong. A planned tomographic inversion experiment for snapping shrimp; temporal and spatial statistics of these primary noise producers, In Shallow Water Acoustics Conference. 1997. Beijing: China Ocean Press.

Raffaele, H., J. Wiley, O. Garrido, A. Keith, and J. Raffaele. 2003. Birds of the West Indies. 216 pp.

Richardson, W. J., Greene Jr., C. R., Malme, C. I. and Thomson, D. H. 1995. Marine Mammals and Noise. San Diego: Academic Press.

Ridgway, Sam H. "The Central Nervous System of the Bottlenose Dolphin." In *The Bottlenose Dolphin,* edited by Stephen Leatherwood and Randall R. Reeves, pp. 69-97. San Diego: Academic Press, Inc., 1990.

Walker, M., O. Hodge, F. Homer, and W. Johnson. 2005. A Guide to Common Plants of Anguilla. Anguilla National Trust and Biodiversity Conservation, Inc., The Valley, Anguilla, British West Indies.

Whitney, E., D.B. Means, A. Rudloe. 2004. Priceless Florida: Natural Ecosystems and Native Species. Pineapple Press, Inc. Sarasota, FL.