ENVIRONMENTAL MANAGEMENT PLAN

BAKER'S BAY GOLF AND OCEAN CLUB

GREAT GUANA CAY ABACOS, BAHAMAS

ENVIRONMENTAL MANAGEMENT TEAM
UNIVERSITY OF MIAMI AND COLLEGE OF BAHAMAS 2005

Environmental Management Program
Baker's Bay Golf and Ocean Club, November 2005

For further information please contact the Environmental Management Team:

EMT Project Manager
Kathleen Sullivan-Sealey, PhD
ksealey@bio.miami.edu

P.O. Box 249118
Coral Gables, Fl 33124, USA
Lab: 305-284-3013

Baker's Bay Club contact information:

Douglas A Shipman VP Development
Bakers Bay Golf and Ocean Club
Discovery Land Company
Great Guana Cay, Abaco, The Bahamas
Office: 242-367-0612
dshipman@discoverylandco.com

Reference:
Environmental Management Plan for Baker's Bay Club. Great Guana Cay, Abaco, Bahamas. University of Miami. 2005.

TABLE OF CONTENTS

ACRONYMS USED IN THIS DOCUMENT

Baker's Bay Club	BBC
Environmental Impact Assessment	EIA
Environmental Management Plan	EMP
Ecological Monitoring Program	EMPr
Environmental Management Team	EMT
Institute for Regional Conservation	IRC

LIST OF FIGURES

LIST OF TABLES

APPENDICES

Environmental Monitoring Program for Baker's Bay Club

1. Overview of the Baker's Bay Club (BBC) Project

A. Description
B. Environmental status of property
C. Vision for development
D. Scope of the Environmental Management Program
E. Environmental Team management and project communications

1A: Description of the Baker's Bay Club Residential Resort Community

Discovery Land Company (Developer) proposes to develop an intimate resort and residential community with a golf and marina club (BBC Project) on Great Guana Cay, a northern cay of the Abacos. Upon approval and completion, BBC will feature:

- Approximately 400 residential units; these units will be a mixture of ocean-front home sites, golf villas and marina village homes,
- A championship-caliber 18-hole golf course,
- A 180-slip marina for vessels under 60ft,
- Up to 75 villa-style rooms available for rental, and
- A high-amenitized equity club with 400 members.

BBC will feature modern infrastructure and utility systems uniquely designed for a fragile island ecological system. The developers will allocate land for both conservation of natural areas and for island-wide logistical support for solid waste processing and transfer, community meeting facilities, and public beach access. A 92-acre nature preserve will encompass the mangrove creek complex at the southern end of the property, as well as 60 acres of protected coastal buffer zone.

BBC will have unprecedented infrastructure and support facilities. A centralized sewage treatment plant, coupled with wastewater gardens will avoid the long-term pollution problems of on-site disposal (cess pits), and recycle water for golf course irrigation. The housing development guidelines will maintain the natural beauty of the island by minimizing lawn size and utilizing native plant corridors to promote wildlife habitat and plant diversity. A state-of-the-art solid waste transfer station, burning with an air curtain destructor and an on-site composting station will reduce the volume of wastes to be transferred to land fills, and seek to recycle as much material as possible.

Short-term and long-term environmental impacts will occur with such a large-scale land conversions. The developers and the Environmental Management Team (EMT) have identified areas of concern:

- Loss of local biological diversity and wildlife habitat
- Degradation of habitats for some wildlife species
- Loss of wetlands
- Probability of chronic eutrophication ("nutrification") stress to near shore marine communities

- Some chance of small scale fuel spillage and seeps

These impacts are measurable and can be managed within the scope of the mitigation and environmental management plans.

1B: Environmental Status of the Property

The Great Guana Cay site is already severely impacted by a previous development at the "Treasure Island Site". The appendices of the EIA (2004) include a section of news articles from 1988 and 1989 on the controversies that surrounded the original construction of the cruise ship resort site and approach channel. The ecological health of the property would have continued to decline without mitigations. There are significant environmental issues associated with:

- Unknown material dumped in two landfills
- Invasive alien plants displacing native vegetation
- Invasive alien insects (Lobate Lac Scale Insect) impacting the health of native trees, especially after hurricane disturbances.
- Erosion of beaches from the removal of dunes and natural vegetation along Bakers Bay
- Erosion of beaches from Australian pine (invasive alien plants)
- Accumulation of trashes and unregulated dumping

There is no stewardship of the natural resources or management of the property at this time. Many people, both local residents and visiting yachtsmen, reportedly use the property, yet no person or organization takes responsibility for management or stewardship of the resources. As land becomes increasingly scarce in Abacos (and all of The Bahamas), there needs to be an overall land use plan that manages and sets aside natural areas for tourism, recreation, and conservation of the natural heritage of the country.

The impacts to the environment will largely be mitigated by attention to detail in the construction process, continuous monitoring and long-term planning. The BBC site includes the abandoned Disney Treasure Island cruise ship resort. Treasure Island is about 90 acres of recently developed, and then abandoned buildings and infrastructure. The Treasure Island complex includes buried dumpsites, land and sea debris, abandoned fuel tanks, transformers and hazardous materials that require removal and mitigation. This previous development introduced invasive alien plant and insect species that now threaten the natural flora and fauna of the island. Immediate landscape management and coastal stewardship actions are needed to prevent further degradation of BBC site.

The 7-point proposed mitigation plan includes several restoration components:

1. Cleanup of contaminants at the Treasure Island complex.
2. Restoration of natural dune systems and native vegetation in coastal buffer zone of Treasure Island complex.

3. Removal and management of invasive alien plants along the coastal zone of the entire project site (especially Australian pine and Hawaiian inkberry).
4. Restore and manage wetlands adjacent to the marina area.
5. Management of wildlife habitat areas, including turtle nesting beaches, white crown pigeon foraging areas, and neo-tropical migratory bird habitats.
6. Dissemination of information on BBC status and documentation of impacts through a project web site.
7. Support the creation of an independent foundation for the management of preserved areas, environmental outreach and education, as well as on-going monitoring of the site.

The proposed mitigation program is both innovative and ambitious. The environmental management plan addresses the future challenges of maintaining the ecological integrity of small island developments.

1C: Vision for the Baker's Bay Club Development

The Developers will utilize the full resources of its partnerships to ensure the BBC will be a source of pride for its members and residents, for the Government of The Bahamas and for the residents of Guana Cay. The Developers will strive to deliver the highest quality development, including:

- Environmental sensitivity in both practice and outreach educational programs,
- Bahamian-influenced architectural and landscaping styles,
- Materials and infra-structure appropriate for the small island setting,
- Services provided to the resort members and community, and
- Socio-economic integration of BBC with both the local and regional communities.

The design philosophy is to use the best available technologies to construct a residential resort community with the highest environmental standards and management practices. The Developers believe that good environmental stewardship will add value to the community, as well as, protect the property from storm damage and erosion. BBC is compatible with the pattern of development of second homes and vacation homes throughout the cays and mainland of Abaco. The development creates a variety of jobs both on-site and in Marsh Harbour.

1D: Environmental Management Team (EMT), Scope and Project Communications

BBC is a unique development project in the transparency of its site management and environmental management and reporting. To achieve the environmental goals of the project, the Developers have established a unique relationship with the Environmental Management Team (EMT) from the University of Miami. The Developers have demonstrated their dedication to an environmentally sound development and conceded some autonomy for the EMT to be responsible for the EMP and related implementation, monitoring, reporting and proposal of mitigation and corrective actions. BBC will be an experiment in sustainability for small island developments. Clearly, local residents or Bahamians in general would not appreciate having "experimental" approaches to development of their natural resources. However, the aim of the experiment is to provide a truthful documentation of the real ecological costs of resort development.

This environmental management plan outlines a 'model' with four components for private land stewardship in the country, particularly for private resort communities with technologies and protocols appropriate for use in national parks and publicly held lands (Crown land). The 'model' components include:

1. Clearly articulated and measurable environmental goals.
2. Educational outreach programs and training material for
    - Contractors, construction crews and all on-site workers
    - Local communities
    - Regional Non-government environmental organizations (e.g. Friends of the Environment)
    - Local businesses and business leaders
3. Clear management and project communications and reporting with:
    - Published "Chain of Command" for site management
    - Documentation and accountability to EIA policies
    - Incident reporting and management plan
    - Clear reporting responsibilities
4. Independent reporting and verification, with monitoring data available in a "status report" format.

The Environmental Impact Assessment (EIA) for the BBC resort community development on Great Guana Cay, Abacos, outlined an environmental management plan (EMP) to monitor, regulate and mitigate construction and development impacts. Research (Dipper, 1998) stresses the need for post-EIA evaluation, to evaluate adherence and success in meeting the stated goals and objectives. Accordingly, the EMT, in partnership with the developers, present a comprehensive program to monitor and evaluate adherence to the EIA, measure impacts to the terrestrial and marine resources, as well as, to mitigate pre-existing perturbations.

The EMP consists of ecological and environmental monitoring protocols and research objectives, mitigation plans and reporting and information dissemination protocols (Figure 1). Impact matrices and 'status reports' (Figure 11) will be used to gauge and measure adherence to goals and objectives. Additionally, a socio-economic component was incorporated to evaluate and review effects of BBC on local communities and economy of the Abaco islands.

Within the Project team, the EMT will play an active role of consultation, reporting and review. Monthly reports will be given to the BEST Commission (Appendix 11) and monthly status reports with impact maps (Section 2C) will be disseminated to pertinent groups. The principle groups involved in the BBC project are shown in Figure 2. Appendix 1 outlines the permitting requests and relevant governmental and local agencies and Appendix 2 provides the contact information for those pertinent to the management plan.

Figure 1. Outline of the Environmental Management Plan (EIA, 2004).

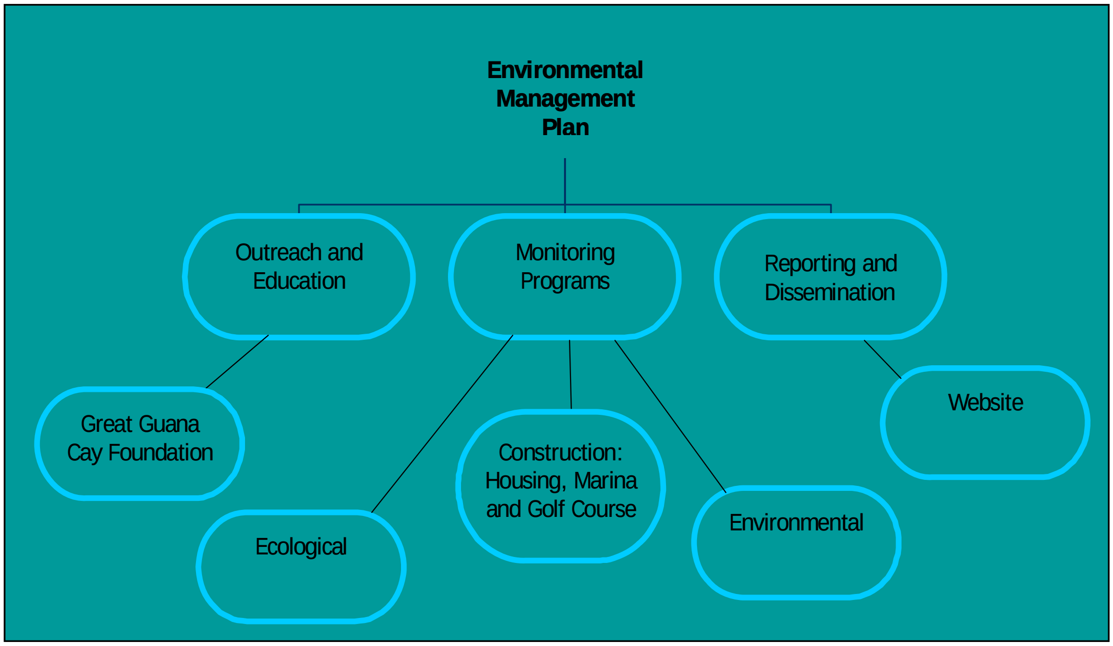
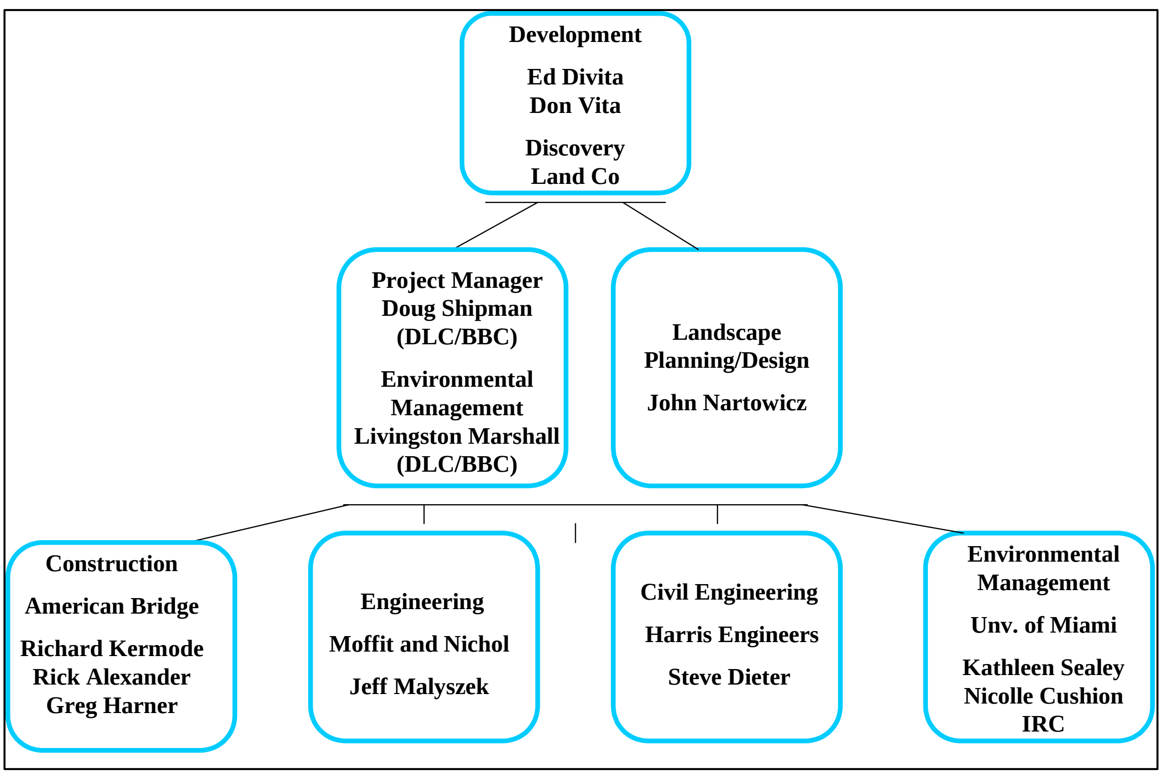


Figure 2. Chain of command for BBC development. The EMT from the University of Miami is responsible for the coordination, monitoring and reporting of the EMP. *Appendix one contains complete contact information.*



2. Components of the Environmental Management Plan

A. Scope of the Environmental Management Plan[1]
B. Ecological Monitoring Program
C. Status report approach to environmental monitoring
D. Environmental Management: Construction Phase
E. Incident reporting and clear reporting responsibilities

2A: Scope of the Environmental Management Plan

The ecological and environmental goals for BBC are (EIA submitted 2004):

- **To maintain viable populations of over 80% of the existing plant species**
- **To maintain representation of all the natural vegetation communities on the island**
- **To maintain water quality parameters in coastal groundwater and near shore marine waters at pre-construction levels.**
- **To enhance wildlife habitat quality in the coastal zone, wetlands and preserve areas, with measurable increases in targeted conservation species.**
- **To maintain coastal stability with the measurable maintenance and/or restoration of beaches, and aid natural recovery of beaches from storm disturbances.**

The ecological monitoring program consists of established parameters to monitor, measure and continually assess whether BBC is successfully meeting the environmental goals and objectives. A grid system (Appendix 2) has been developed for the property and buffer zones (Figure 3, Appendix 3) have been established to help monitor and maintain these goals. In addition to the monitoring plan an on-site native plant nursery will be established to salvage transplants and restore necessary areas.

To meet the ecological and environmental goals it will be necessary to mitigate pre-existing disturbances onsite. Impacts and deteriorations to the natural resources of the property due to a former Disney resort include:

- Abandoned structures
- Abandoned hazardous materials
- Degradation to the adjacent reefs from continual channel dredging and a former dolphin pen
- Marine debris and an abandoned dilapidated dock
- Australian pine invasion, which is leading to beach and dune erosion

Chapters five and six of the EIA address disposal procedures and mitigation options for these perturbations.

[1] The EMP encompasses two distinct management components: an Ecological and an Environmental. The term 'Ecological' refers to the natural and social environment and landscape, the term 'Environmental' refers to waste management, composting, water management, chemical/fungicide management, pest management, etc.

Figure 3. Example of coastal buffer zone.

Example of coastal buffer zone delineation along low energy rocky shore of the BBC property – this buffer zone is incorporated into the planning process, and delineated with protective fencing during construction

2B: Ecological Monitoring Program

The development of an ecological monitoring program is a three-step process (Maddox et al. 1995).

1. Understanding the ecosystem patterns and processes of the system.
2. Incorporating management and conservation goals into the program to evaluate effectiveness.
3. Determining the best indicators to evaluate the goals (Table 1).

Several definitions need to be provided before developing a framework for evaluating the status of ecological communities. The scientific community is continuously learning more about the ecological processes linking land and marine organisms, species and natural communities. Marine and terrestrial communities shift spatially over geologic time in response to rising and falling seas, natural disasters, but persist over hundreds of thousands of years as an assemblage of species. Healthy terrestrial and reef systems will experience periodic changes in abundance, diversity and productivity; diurnal, tidal and seasonal changes in water flow and the physical characteristics of seawater are part of the dynamics of a normal functioning system. Even perturbations such as hurricanes and large storms should not compromise the integrity of a healthy natural system. **Natural systems are characterized by their stability, resistance to change, and resilience in the recovery from disturbances.**

There are four types of human perturbations to natural systems:

- Harvesting of resources
- Pollutant and contaminant discharges
- Physical restructuring, and
- Introduction of exotic species.

The *symptoms* of ecosystem degradation refer to visible or measurable changes. Symptoms can include loss of species abundance or diversity, increase in invasive species, declines in fish abundance, increase in vegetation or coral diseases, or algae blooms on reefs. Symptoms may or may not be linked to human activities, but reflect observations of apparent change in the ecosystem structure and function. These apparent changes could have natural causes, but resource managers are often asked to make long-term comprehensive management decisions without corroborative evidence (Grumbine, 1994). Thus, the controversies in interpreting symptoms of ecosystem degradation stem from lack of information on the relationship between *symptoms, stressors* and *sources*. The *stressors* are the impacts resulting from human activity, which, in turn affect organisms and ecological processes. Chronic stressors are often the most difficult to identify, and usually impact large spatial areas. An example would be the long-term leaching of nutrients from septic systems into a bay or lagoon; changes would be gradual over many years.

Finally, *sources* of ecosystem degradation refer to the human activity at the root of the stressors impacting the environment. Land-use change and urban growth all underlie human-based sources of ecosystem stress. Assuming that sustainable resource use is achievable, the natural world should be managed in such a way that these threats and impacts are minimized.

For example, at critical thresholds of development, the use of advanced wastewater treatment systems to remove nutrients before they enter the coastal environment should be advocated. The scenario throughout the wider Caribbean has been a conscious choice not to take advantage of advanced wastewater treatment technologies (Section D), partly reflecting economics, lack of political will or "out-of-sight, out-of-mind" mentality. The increase in coastal populations without adequate wastewater treatment infrastructure has lead to ground water pollution, coastal nutrification and significant biological impacts on natural communities like coral reefs. Sustainable development rhetoric suggests that we can choose our activities and patterns of development to eliminate the *sources* of ecological degradation.

The EMP for BBC has been developed to minimize the *sources* on-site and the Ecological Monitoring Program (EMPr) (Table 1) has been developed to monitor factors and indicators which can measure how successful BBC is in meeting the prescribed environmental goals. Also, clear, quantitative thresholds levels (desired ecological status) have been determined for indicators **based on the baseline conditions** of the property. The EMPr takes a holistic approach, looking at many terrestrial and marine components to measure effects of the precautions taken and to interpret ecological changes possibly due to the construction of BBC.

The EMPr will monitor four main categories (Table 1):

1. Physical and chemical abiotic factors (terrestrial and marine)
2. Terrestrial Biotic Communities
3. Marine Biotic Communities
4. Socio-economic and Education and Outreach influences

(Detailed standardized protocols, materials and methods of the Ecological Monitoring Program are described in a separate protocol manual.)

Monitoring and management involves systematic long-term data collection and analysis to measure the state of the resource, detect changes over time, and determine and implement corrective actions/mitigations if necessary (Figure 4). Detecting such changes will guide management decisions, and be used to evaluate ecological and environmental the success of BBC. The frequency of monitoring and tentative schedule for 2005 is in Table 1. Appendix 3 lists references for monitoring protocols and procedures. Terrestrial surveys will be aided by aerial flights. Standard reef monitoring procedures will be implemented near shore. Water quality equipment will include a Hydrolab and permanent data loggers (Hydrolab datasond 4A) and sediment (toxicity) samples (land and water) will be processed. Also, two meteorological weather stations will be installed on the property for continuous rainfall and temperature data near the marina and at the northern end of the property.

Figure 4. Schematic of ecosystem levels and responses to management. (Adopted from Cairnes et al, 1995)

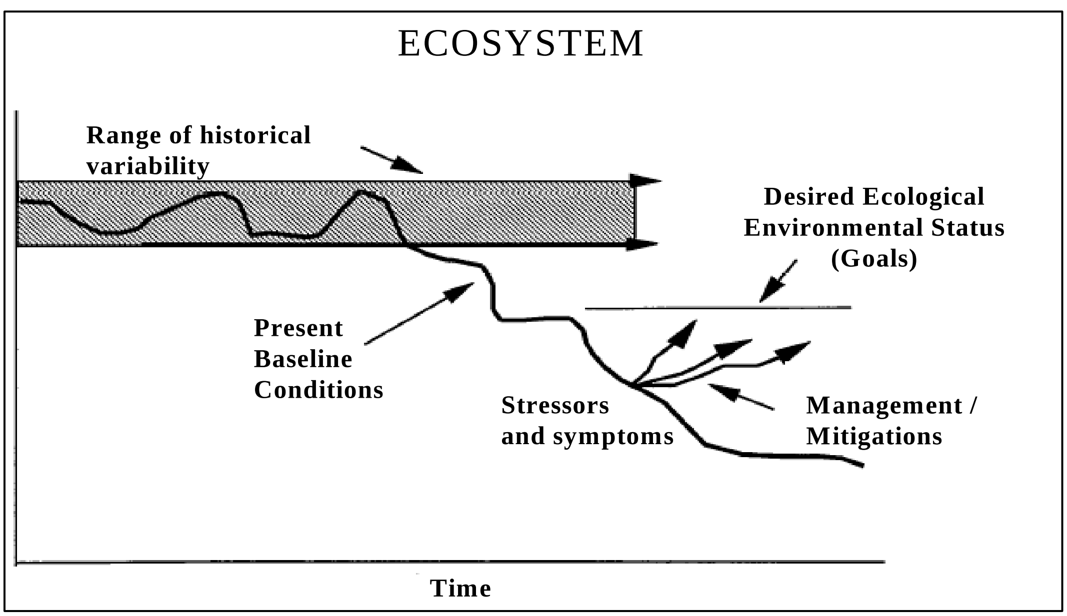


Table 1. Ecological Monitoring Program and schedule for Baker's Bay Club.

	Environmental Monitoring- Great Guana Cay					
Category	**Factors**	**Indicators**	**Source of Impact**	**Impact**	**Scale of impact and monitoring**	**Monitoring Frequency**
1. Physical and chemical	1.1. Water - Ground and Nearshore	Ph, DO,Phosphates, Nitrates coliform, stable isotopes	Fertilizer (landscaping), improper underground septic and disposal pits, house chemicals, oil and gas	These levels will increase with disturbance, altering ecology if too high	Island, regional, country	Quarterly
	1.2.Sediments	Sedimentation rates nearshore and offshore	Dredging, plant removal and landscape alteration	These levels will increase with disturbance, altering ecology if too high	Island to regional	Intensively for month to get natural rate, then ongoing during dredging and major construct
	1.3. Pollutants	Metals in soils: Methal Mercury, Organo phosphates, PAH's	Oil, gas	These levels will increase with disturbance, altering ecology if too high	Island to regional	Quarterly
	1.4 Meteorology	Rainfall patterns, temperature, wind, humidity	Weather conditions can exacerbate environmental condition	Fluxes in these indicators will influence ecological communities	Island to regional	Continous- on-site weather station
2. Biotic - Land	2.1. Plant Diversity	Species abundance, diversity, rarity, quality, invasives, new exotic species, increase in exotic abundance	Construction and habitat alteration, importation of exotics with machinery, soil, contruction materials, nursery and nursery stock	Loss of plants (extirpation), species habitats, coastal erosion,	Island	Ongoing during construction, then biannually
	2.2. Habitats	Species turnover, structural changes, lack of regeneration, mortality, soil erosion	Groundwater changes, airflow changes, extirpation of pollinators, chnges in island's microclimate (soil, water, nutrients, humidity, wind)	Loss of natural vegetation cover, erosion, species loss, wildlife loss,	Island	Ongoing during construction, then biannually
	2.3. Land Conversion	Vegetation coverage, disturbance, loss of vegetation buffers, species loss	Construction alteration, post-construction habitat alteration on home lots	Loss of plants, species habitats, coastal erosion	Island	Ongoing during construction, then biannually
	2.4. Preserve Areas	Encroachment, plant mortality	Construction alteration, tree and other plant cutting, hebicide use, sprinkler system intrusion	Loss of species diversity, loss ecosystem sustainability, increased storm vulnerability	Island	Ongoing during construction, then biannually
	2.5. Landscaping	Species use, maintenance needs, invasiveness, undercutting natural vegetation buffers	Improper use of palette, excessive watering, excessive fertilizing, use and escape of prohibited species	Increase in exotic plant abundance, hybridization with native plants, loss of habitats, coastal erosion, decreased hurricane resistance	Island	Ongoing during construction, then biannually

	2.6. Restoration	Species use, maintenance needs, invasiveness	Improper species selection, lack of diversity in planting materials, lack of succession, invasion of exotic species, invasion of weedy species	Creation on non-sustainable habitats, increase of abundance of exotic plant species	Island	Ongoing during construction, then biannually
3. Biotic- Sea	3.1. Fish	Diversity, Trophic structure, Size frequency of selected fish and abundance of juveniles	sedimentation (construction) and runoff from pollution (fertilizers, oil, gas)	Increased levels of pollution, sedimentation and runoff may decrease diversity and juveniles, alter trophic structure (case study species- Hamlets)	island, regional	Biannually- seasonally
	3.2. Corals (Nearshore)	growth rates, recruitment, changes in diversity and abundance, physical signs of stress/disease, symbiotic algae	sedimentation (construction) and runoff from pollution (fertilizers, oil, gas)	Increase levels of pollutants may decrease growth, reduce abundance and diversity of species, contribute to poor health (increased disease, change in 'good' algae, swollen polyps and increased mucus)	island, regional	Biannually- seasonally
	3.3.Benthos (nearshore)	Macroinvertebrate diversity and abundance	sedimentation (construction) and runoff from pollution (fertilizers, oil, gas)	Increase levels of pollutants may change community to more pollutant tollerant "weedy" species	island, regional	Biannually- seasonally
	3.4. Corals and Benthos (Offshore)	Coral diversity, benthic composition, disease, recruitment	sedimentation (construction) and runoff from pollution (fertilizers, oil, gas)	Increase levels of pollutants may decrease diversity and alter benthic composition (more algae, less corals), reduced recruitment	island, regional	Biannually- seasonally
	3.5. Algae	abundance, diversity	sedimentation (construction) and runoff from pollution (fertilizers, oil, gas)	Increased levels of pollution, sedimentation and runoff may lead to decrease in diversity	island, regional	Biannually- seasonally
4. Socio-economic	4.1. Surveys	Income from tourism and fishing	During construction and after	Change in income from tourism and/or fishing catch	island, regional	Annually
	4.2. Business review	Income	During construction and after	Change in income and/or tourism	island, regional	Annually
	4.3. New house construction, Housing now, Housing per year	Housing density, construction impacts	During construction and after	Change in income and/or tourism	island, regional	Annually
5. Outreach success	5.1. Comminity Perception Surveys	attitudes and thoughts of development	Construction and Mediation of Impacts	Change to positive feelings	island, regional	Annually

Category	*Factors*	*May-05*	*Jun-05*	*Jul-05*	*Aug-05*	*Sep-05*	*Oct-05*	*Nov-05*	*Dec-05*	*Jan-06*	*Feb-06*	*Mar-06*	*Apr-06*	*May-06*	*Jun-06*	*Jul-06*	*Aug-06*	*Sep-06*	*Oct-06*	*Nov-06*
1. Physical and chemical	1.1. Water - Ground and Nearshore		√	√	√				√	√				√	√				√	√
	1.2.Sediments		√		√				√				√				√			
	1.3. Pollutants		√	√	√										√	√				
	1.4 Meteorology		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
2. Biotic - Land	2.1. Plant Diversity	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	2.2. Habitats	√		√		√		√		√		√	√		√		√		√	
	2.3. Land Conversion	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	2.4.Preserve Areas	√		√		√		√		√		√	√		√		√		√	
	2.5. Landscaping	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	2.6. Restoration	√		√		√		√		√		√	√		√		√		√	
3. Biotic- Sea	3.1. Fish			√						√				√					√	
	3.2. Corals (Nearshore)	√		√						√				√					√	
	3.3.Benthos (nearshore)			√						√				√					√	
	3.4. Corals and Benthos (Offshore)			√						√				√					√	
	3.5. Algae			√						√				√					√	
4. Socio-economic	4.1. Surveys	√	√						√	√					√	√				
	4.2. Business review	√	√						√	√					√	√			√	√
	4.3. New house construction, Housing now, Housing per year	√			√			√				√				√				√
5. Outreach success	5.1. Community Perception Surveys	√	√						√	√					√	√			√	√

1. Physical and chemical abiotic factors

Abiotic factors including nutrient levels, water quality parameters and pollutants will be monitored (Table 1). Terrestrial pollutants have already been found on the property from the former Disney resort and will be mitigated and cleaned. Water quality concerns need to be assessed by addressing two questions: what are the baseline physical characteristics of coastal waters and what are the baseline conditions of adjacent near shore environment and coral reefs? Water quality, in effect, controls which plants and animals can grow in near shore marine environments. Algae and seagrasses are really the products of water quality history. The abundance and species of algae and seagrass growing on the seabed define the marine habitat, and we want to know, "**Has this community changed as a result of human alterations of the adjacent land?**"

There are three concepts to understanding the land-sea links on coastal islands:

- First: Water is the vital ingredient for all living organisms. Water moves over the planet in a hydrological cycle from air to land to sea. Water falls to the earth's surface as precipitation, enters surface waters (e.g. streams and rivers) and groundwater, and then runs into the ocean. Evaporation returns water to the atmosphere. ***Water is a powerful solvent and carrier.*** As water moves through the hydrological cycle, it transports salts, nutrients, and organic material from land to sea. Water is the medium for life in the ocean, thus all marine organisms are sensitive to key physical attributes of seawater: temperature, salinity, dissolved oxygen, turbidity, and inorganic nutrients. Human activities on land, in terms of urban development and disposal of sewage, impact the water quality of the coastal waters.
- Second, the islands are low-lying and composed of very porous limestone rock. There is a conspicuous absence of surface fresh waters (no large rivers or lakes). The bulk of the fresh water is found underground in freshwater lenses, trapped by less porous layers of rock. All islands have underlying porous rocks with salt water. Anything dumped into or on to the ground can and will end up in the sea. Concerns about coastal water quality are typically approached from a public health perspective. Coastal waters can become contaminated with sewage and human effluents through inadequate or failed sewage disposal systems. The Bahamas Department of Environmental Health monitors wells and beaches for the presence of fecal colliform, bacteria. These are indicators of leakage of human sewage into the coastal waters, which presents a serious health threat to humans. Even before sewage and nutrient seepage reaches a level sufficient to register a human health concern, these pollutants are already changing the ecology and health of coastal marine plants and animals.
- Third, the symptoms of ecosystem degradation refer to visible or measurable changes. The symptoms of water quality degradation include algae blooms, die-off of seagrasses, fish kills, coral bleaching or changes in the abundance of sea life such as fish or lobsters. Symptoms may or may not be linked to human activities, but reflect observations of apparent change in the ecosystem structure and function. Thus, the controversies in interpreting symptoms of ecosystem degradation stem from lack of information on the relationship between symptoms, stressors and source (Sullivan *et al.* 1996).

Concerns about coastal water quality are typically approached from a public health perspective. Coastal waters can become contaminated with sewage and human effluents through inadequate or failed sewage disposal systems. Even before sewage and nutrient seepage can cause a human health concern, these pollutants are likely changing the ecology and health of coastal marine plants and animals (Section D addresses waste management).

There is a conspicuous absence of surface fresh waters (no large rivers or lakes). Most of the surface water on land occurs in brackish or ephemeral ponds. The bulk of the fresh water is found underground in freshwater lenses, trapped by less porous layers of rock. Very little fresh water appears to be trapped in a lens o the BBC property. There are numerous brackish water and seasonal wetlands, but the geology and size of the island precludes any large lens development. Where freshwater is available, groundwater wells will be installed. The EMT will monitor the groundwater wells on the property, using stable isotope analysis and water quality parameters.

Data analysis

a. Water quality

The **water quality** will be addressed by the monitoring of abiotic factors:

- **Temperature**
- **Salinity**
- **Inorganic nutrients**
- **Dissolved oxygen and**
- **Turbidity**

In general, an increase in inorganic nutrients and turbidity and a decrease in dissolved oxygen can be viewed as a negative impact on water quality, leading to eutrophication. Water quality equipment will include a Hydrolab and permanent data loggers (Hydrolab datasond 4A) and sediment (toxicity) samples (land and water) will be processed. Also, a **meteorological weather stations** will be installed on the property for continuous rainfall and temperature data.

Monitoring water quality over daily, tidal and seasonal cycles will be critical for characterizing natural variability in both ground water (fresh to brackish) and the near shore marine waters. Specific monitoring will also be focused during and post marina construction. Sediment, turbidity and signs of eutrophication will be closely monitored via permanent data loggers, sediment traps and construction status reports (Section 2C). Long term data loggers produce comprehensive dataset to plot box plots (Figure 5). The larger the box, the more variability occurs at a particular site. This variability in temperature in coastal waters over a tidal cycle can be used to evaluate flushing or circulation patterns. Changes in these variability patterns come from human alterations of the island hydrological cycles and processes. Water quality monitoring and analysis will be monitored and compared to standards for the Florida Keys National Marine Sanctuary and the Southeast Environmental Research Center (http://serc.fiu.edu/wqmnetwork/FKNMS-CD/index.htm).

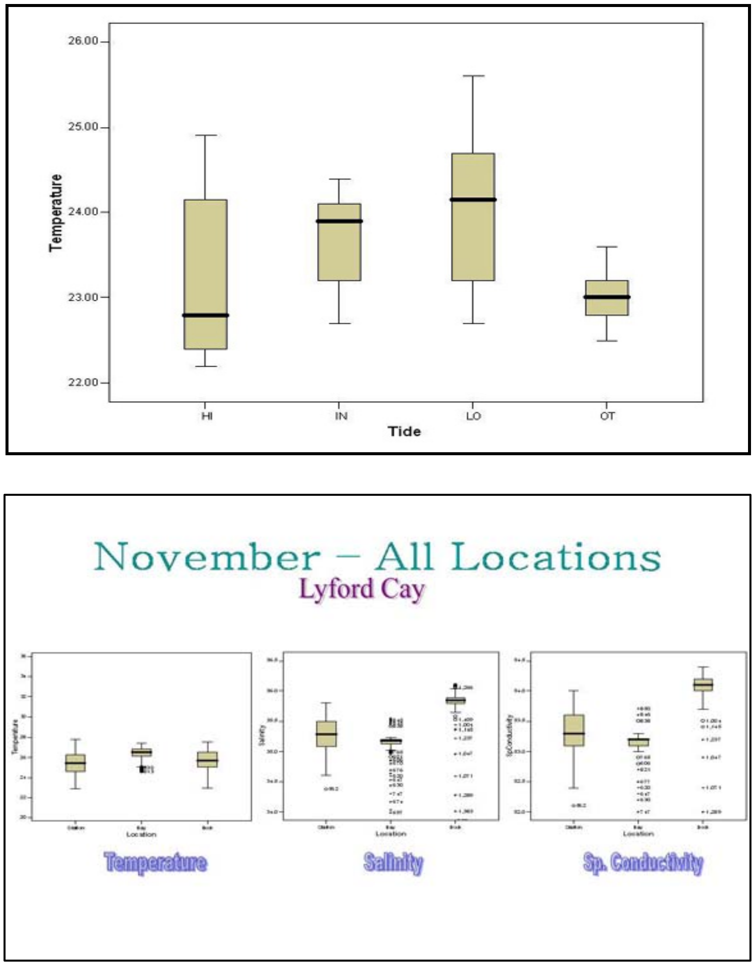


Figure 5b. Example box plots that characterize the near shore water quality from Lyford Cay, Bahamas. These samples are taken from a relatively enclosed bay with large private homes along the shoreline. The water quality has become a concern to residents because of the overgrowth of algae, plankton blooms leading to "greenish" water, and bad smell in hot summer months. The variability of parameters such as Salinity and Conductivity can be directly tied to discharge events from private residences in this area. Examples include discharge from swimming pools and holding tanks.

b. Ground water

Groundwater monitoring is accomplished with a YSI -85 environmental probe. On a tidal cycle sampling plan, all wells are sampled intensively for a two-week period every quarter. Additional sampling occurs after rainfall events and storms. Temperature, salinity, conductivity, dissolved oxygen and pH are recorded. Water samples are retrieved for **Particulate organic carbon (POC), Dissolved inorganic nitrogen (DIN) and Total nitrogen (TN)**. After rainfall events, **biomarkers** will be used to study flux rates of material away from the well. Groundwater sampling programs can help establish the effectiveness of landscape management practices, and detect early threats of eutrophication to nearshore marine environments.

Figure 6. Groundwater well insertion at Victoria Pond, Great Exuma. Ground water wells are installed and then sampled to examine the flux of nutrients from the coastal zone into the near shore marine communities. Above a well is being installed in a large coastal wetland.

c. Stable isotope analysis

In nature, elements consist of atoms of different mass called **isotopes**. During the evaporation and condensation of water, the concentration of oxygen and hydrogen isotopes that make water molecules undergo small changes. Modern instruments and testing can measure these with great exactness. The history and pathway of water in different parts of the hydrological cycle can be followed by the abundance of the stable heavy isotopes of hydrogen (^{2}H) called deuterium, and oxygen (^{18}O). In this way, water from different environments develops isotopic "fingerprints" with which it can be identified and its origins traced.

These isotopes are carried into groundwater by infiltrating rain and can be measured with specialized, sensitive equipment. Knowing the "half-life" (time it takes for the element to decay by 50%) of isotopes allows a measurement of their concentrations to be interpreted as an "age", or residence time, of groundwater. Residence time indicates the replenishment rate as well as the rate of movement of groundwater. So, isotope techniques can assess the vulnerability of groundwater to pollution from the surface by determining how rapidly it moves and where it is being recharged. Surface sources of pollution can then be determined, e.g. natural, industrial, agricultural, or domestic. Isotope techniques can also identify developing pollution, providing an early warning.

Isotope techniques:

- can determine the origins and ages of different water bodies;
- can provide an estimate of the degree of mixing;
- can determine the location and proportion of water recharge;
- can indicate the velocity of ground water flow;
- can identify and track pollutants.

Isotope analysis will be done in terrestrial locations (especially those in proximity to the golf course), groundwater wells and the near shore waters to track water residence time and to detect pollutants.

d. Multivariate analysis

The goals of this monitoring are to look for and prevent long-term chronic changes to coastal systems. Long-term changes in environments stem from climate change (which can be natural, though humans can alter global climate patterns) and gradual changes in coastal water due to increases in coastal nutrient loading, loss of coastal vegetation and increased sedimentation with development. Changes in water quality can be represented by ecological community changes. Water quality analysis will be coupled with baseline conditions which include: a) prior land usage, b) baseline data on epifauna, c) macroalgae and, d) fish diversity (section 3) and abundance.

2. Terrestrial Ecological Monitoring

The terrestrial factors being monitored will look at changes in vegetation diversity, abundance of species and rare species (Section 2D, Part 3), land cover alterations and exotic and introduced species. The analysis species distribution and abundance will be put into context of the coastal/terrestrial environment in which they occur (Figure 7). The BBC property and its coastal environments are dynamic and distinct. These communities and species have been ranked in terms of the occurrence of rare species within them, ability to resist change and persist and uniqueness as habitat for animal species. Also, maintenance of the **Buffer zones** will be monitored in monthly status reports (section 2C). The buffer zones are critical to the stability of the island systems and health of the near shore environment. Additionally, Appendix 7 lists **Critical Conservation** plants for BBC and a ranking system of removal and transplantation.

Figure 7. Classes of coastal environments.

CLASSES OF COASTAL ENVIRONMENTS

A1) *Beaches and Beach Strands*: This class consists of high relief beaches and beach strand communities that are shrub or herb-dominated, with varying widths and heights of dune systems. The high relief beach strands slope to *Uniola paniculata* herb-shrublands, then to lowland subtropical evergreen forests/woodlands/shrublands (Sealey et al.1999).

High Energy Soft Sediment Coastal Zones: an element common to beaches is the sand dune. The coastal dunes that build up behind a beach are inhabited by salt-tolerant plants including railroad vine, sea purslane, stunted sea grape, and the exotic causuarina (Sealey 1990). The dune vegetation plays an important role in fixing the soft sand sediments and preventing the spread of sandy sediments inland (Sealey 1990). The dunes themselves store fresh water and provide a natural sea wall against storms (Sealey 1990).

Beaches can be described as HIGH or LOW relief, based on the shore profile. Beaches can also be described with the following modifiers:

a) with or without beachrock underlying sand, b) with or without exotic plant invasion, c) with or without offshore reefs, barrier islands or tombolos

On some soft sediment coastal zones, such as those of North Bimini, the occurrence of *beachrock* can be observed. Beachrock is the result of sand slightly below the surface being cemented into rock; it becomes exposed on coastlines when the sandy surface of the beach is stripped away (B.E.S.T. 2002). Pores are common and large in beachrock, which weathers to form a smooth surface. Most beachrock has a sandy color, although the presence of blue-green encrusting algae can cause the surface to be stained black (Sealey 1985). There are three main components to beach rock: 1) boulders of rock from the cliff bordering the beach, 2) conch shells, coral, and glass debris, and 3) fine sand, but it may also include mollusks, *Halimeda*, coral, and encrusting algal debris as well (Multer 1971).

Cementation most likely occurs when there are alternating wet and dry saltwater spray conditions, with skeletal grains providing nuclei for precipitation from a supersaturated calcium carbonate solution (Multer 1971). Sealey (1985) noted that beachrock can form rather rapidly, as modern rubbish such as bottles and cans can be found in some deposits.

B) Low Energy Soft Sediment Coastal Zones: are low relief beach strands, coastal wetlands, and mangrove communities. Examples of this type of coastal zone can be found in western Andros Island and the southwestern parts of New Providence.

Beaches and Beach Strands- Low relief beaches can be present in two forms: a) beach to lowland subtropical evergreen forest/woodland/shrubland transition, and b) beach to palm dominated lowland subtropical evergreen shrubland transition (Sealey et al. 1999).

As with high energy beaches and beach strands, dunes and beachrock can be observed (refer to A1 for details). Typically on low-energy beaches, there are soft muds and fine sediment communities offshore. The beach is very flat and often large areas are exposed at low tides.

Mangrove Communities: Although their specific structural and functional characteristics may vary greatly, mangroves are generally found in areas sheltered from high-energy waves. Coastal mangrove areas can be divided into three subclasses based upon their hydrology and geomorphology:

Overwash and creek systems: Water flow and nutrient input is high and interstitial salinities are variable with evaporation and rainfall, which mean that these areas have the highest degree of structural development (Cintron-Molero and Schaeffer-Novelli 1992).

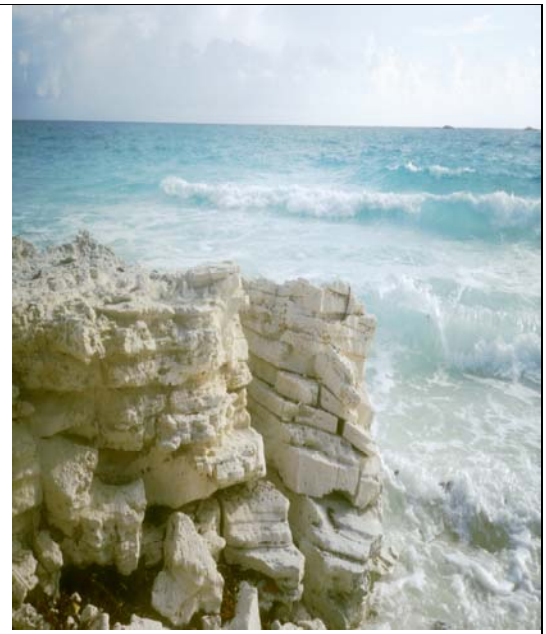
Fringe: Fringe mangroves occur along the seaward edges of protected shorelines or around overwash islands (Cintron-Molero and Schaeffer-Novelli 1992). Fringe areas are characterized by salinity levels similar to seawater and lower nutrient input. Fringe forests can develop in dry environments, backed by hypersaline lagoons, salt flats, or xeromorphic vegetations.

Isolated and inland Basin: Basin forests develop over inland basins influenced by seawater and occupy the highest levels subject to tidal intrusion. Tidal flushing is less frequent than in fringes or overwash creek systems, and is sometimes limited to the highest tides of the year.

Mangrove communities can serve many purposes, including: removal of excess nutrients and heavy metals from runoff, storm buffers, sites of fish recruitment, nurseries and feeding, bird sanctuaries, honey bee havens, and homes for orchids and bromeliads (B.E.S.T. 2002).

C) High Energy Consolidated Sediment Coastal Zones: are high relief rocky shores and cliffs, such as the cliffs along the ocean side of Eleuthera and Clifton, New Providence. Such cliffs are close to the ocean or deep-water channels and get little or no protection from shallow water or coral reefs, which means that the waves strike the coast with full force (Sealey 1990).

The energy rocky cliffs of The Bahamas can be up to 8 meters in height, but most are between 4 and 6 meters high. The vegetation along theses high energy rocky shores is often dwarfed or stunted due to continuous salt spray and wind



D2) Low Energy Consolidated Sediment Coastal Zones: are also called low relief rocky shores. These rocky shores demonstrate a wide, long transition from an evergreen shrubland to a lowland subtropical evergreen forest/ woodland/ shrubland (Sealey et al. 1999). Examples of this kind of coastal zone can be found along much of the developed shores of New Providence off Eastern Road.

These rocky shores have a clearly visible tidal zonation of white, gray, black and yellow zones. These zones provide the habitat for many intertidal snails, mussels and crabs.

Data analysis

a. Floristic Inventory

A **Floristic Inventory**, developed by the Institute for Regional Conservation (IRC) will be used to gauge terrestrial impacts and determine mitigation options. IRC is a leader in plant conservation planning and has established floristic databases and inventories for the U.S. National Parks of South Florida and Puerto Rico (see www.regionalconservation.org/). The Floristic Inventory of Great Guana Cay will be a critical component in monitoring the short and long-term impacts of development on the terrestrial ecosystems of Great Guana Cay.

The Inventory is being prepared by preparing plant inventories (vegetation list Appendix 4) (by habitat) for each 200m x 200m monitoring grid (Appendix 2) that cover the island. Each plant species in each cell, in each habit, is recorded. A percent cover of each species is then estimated.

Upon completion of the baseline inventory a Floristic Quality Index will be prepared. A coefficient of conservatism will be given to each plant species. This coefficient is a range from 0-10. The value of 10 is given to species that tolerate essential no unnatural disturbance. Values of 0 are given to species that are found exclusively to species that are only found in areas of high disturbance. All exotic plant species are ranked as 0. Species are given ranks between 0 and 10 based upon their tolerance for disturbance. For each cell a baseline Floristic Quality score can be calculated by averaging the coefficients for each species. During and after development resurveys will be done in each cell and a new score calculated based on the species that have colonized or disappeared from each cell. Changes in the score will indicate the direction and degree of changes in the quality of the plant assemblages in each cell.

Table 2 highlights critical plant species to be protected by transplantation (if necessary) and then replanted within the BBC development itself and the preserve. One species of critical importance is the orchid *Oncidium sasseri*. This orchid is endemic to the northern Bahamas and is very rare. Orchids overall are poorly protected throughout the islands, with poaching and habitat destruction being major causes of species loss. CITES[2] species include all cacti and orchids, while *Swietenia mahagoni* (mahogany) and *Guapira discolor* (blolly) are protected species in the Bahamas. The other endemics on the list occur throughout the Bahamas.

Table 2. Rare or endangered plants of the Bahamas on the BBC property.

Full Name	CITES	Bahamas Endemic	Northern Bahamas	Description
Ardisia escallonioides			Yes	This shrub is known from the Bahamas only on the northern islands. It also occurs in Florida, the Greater Antilles, and Central America. At BBC is grows in coppices.
Borrichia frutescens			Yes	This small shrub is known from the Bahamas only from Grand Bahama and the Abacos. It occurs in sunny to partially shaded habitats with periodically flooded brackish or saline soils.
Calyptranthes zuzygium			Yes	This small tree is known from the Bahamas only on the northern Islands. It occurs in coppices.
Cattleyopsis lindenii	II			This is an epiphytic orchid that is listed by CITES. The species is widespread in the Bahamas and also occurs in Cuba. It grows on a variety of trees in shade and partial shade.
Cephalocereus bahamensis	II	Yes		This large cactus listed by CITES. It is known in the Bahamas only from Cat Island, Andros Island, and northwards. It grows in coppices on sand or rock. At BBC it is found in the coastal coppice just east of Jones' Bay. This species may be transplanted

[2] CITES (Convention on the International Trade of Endangered Species) is an international treaty which prohibits the trade of rare/endangered species.

Encyclia boothiana	II		Yes	This is an epiphytic orchid that is listed by CITES and is known from the Bahamas only in the northern islands.
Encyclia rufa	II	Yes		This is an epiphytic or terrestrial orchid that is listed by CITES. The species is widespread in the Bahamas and may also occur in Cuba. It grows on a variety of trees in shade and partial shade.
Eragrostis excelsa			Yes	This grass is known in the Bahamas only from the northern islands. It is also found in Cuba. At BBC it is found in a variety of open sunny habitats including dunes and disturbed areas.
Eupatorium havanense			Yes	This small shrub is known from the Bahamas only on the northern islands. It also occurs in Cuba, Texas and Mexico. At BBC it is found in coppices and slightly disturbed uplands.
Eupatorium lucayanum		Yes		This small shrub is endemic to the Bahamas and occurs throughout the archipelago. At BBC it is found in coppices and slightly disturbed uplands.
Euphorbia cayensis		Yes		This herb is endemic to the Bahamas where it occurs from San Salvador, the northern islands, and Cay Sal or the Angular Cays. At BBC it is found in open sand in full sun on dunes or slightly disturbed areas.
Euphorbia trichotoma			Yes	This herb is known from the Bahamas only on the northern islands. At BBC it grows on dunes.
Guapira discolor				This tree is listed by the Bahamas. It occurs throughout the Bahamas, Florida, the Greater Antilles, and Grand Cayman. At BBC it is a common to abundant tree.
Iresine canescens			Yes	This herb is known from the Bahamas only from the Abacos and Grand Bahama Island. It also occurs in the southeastern United States, the Caribbean, and continental tropical America. At BBC it occurs on the windward side of the island in coppices.
Malvaviscus arboreus var. cubensis			Yes	This shrub is known from the Bahamas only from the Abacos and Grand Bahama Island. It also occurs in Cuba. At BBC it is frequent in coppices and in the abandoned Disney area.
Maytenus phyllanthoides			Yes	This shrub is known from the Bahamas only from the Abacos and Grand Bahama Island. It is also known from Florida, Cuba, Texas, and Mexico. At BBC it occurs at the ecotone between mangrove wetlands and coppice in the northern part of the island.
Morinda royoc			Yes	This scandent shrub is known from the Bahamas only from the northern islands. It is also known from Florida, the Caribbean, Central and northern South America. At BBC it grows in coppices.
Oncidium sasseri	II	Yes		This epiphytic orchid is endemic to the northern Bahamas and is listed by CITES. This is the most endangered plant species at BBC. Only a few collections of this species have been made in the Bahamas, including two from Andros, five from Great Abaco.
Opuntia stricta	II			This cactus is listed by CITES. It occurs throughout the Bahamas, and also occurs in Florida, Mexico, and the Caribbean. At BBC it grows on dunes in cells I8 and I9, and at the edge of coppice in cell 12 in slightly disturbed soil.

Panicum amarulum			Yes	This grass is known from the Bahamas only from the northern islands. It also occurs in the southeastern United States, Mexico, and the Caribbean. At BBC it is frequent on beach dunes.
Swietenia mahagoni	II			This tree is listed as protected in the Bahamas and is listed by CITES. It occurs throughout the Bahamas and also in Florida, Central and South America, and the Caribbean. It is protected because of extensive logging for the valuable wood. At BBC.
Ziziphus taylori		Yes		This small tree is endemic to the Bahamas. It occurs throughout the archipelago. At BBC it is frequent in coppices.

b. Impact Mapping and coastal characterization

Percent change and impact mapping will be used to monitor land conversion. During the mitigation and construction processes land vegetation will be altered either by restoration or clearing. Using Geographic Information System (GIS) the grids will be analyzed monthly to track these alterations and determine % changes. The 'quality' of land cover will be considered during this analysis. For example an area may go from heavily vegetated with Australian pine (poor quality) to more sparsely covered with native coastal species (good quality), which are stabilizing a beach. Section 2C expands upon the Impact Mapping System which will be used to illustrate the Ecological and Environmental status of the property.

For four years, the Earthwatch coastal ecology expedition has been tracking coastal changes in the Bahamas, developing **coastal characterizations** for sites within the country (http://henge.bio.miami.edu/coastalecology/GECoastalMapping.htm). Coastal maps and analysis are done by integrating shore profiles, shore plant communities, shore type, satellite images and score cards which rank coasts in terms of potential sources for coastal water quality degradation. The coasts of the property will be characterized, tracked throughout developed and evaluated regionally and nationally.

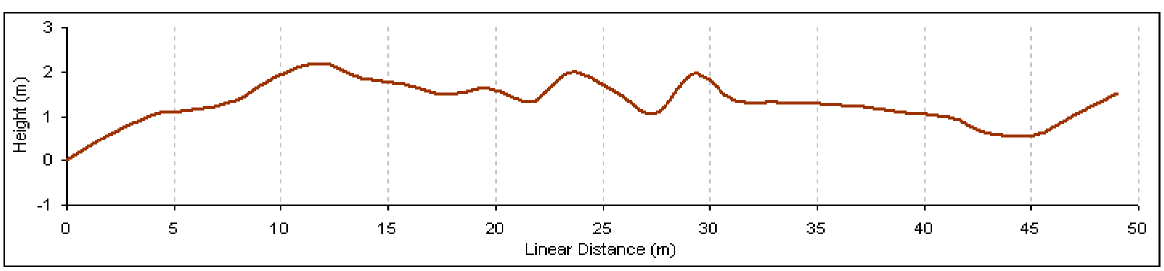
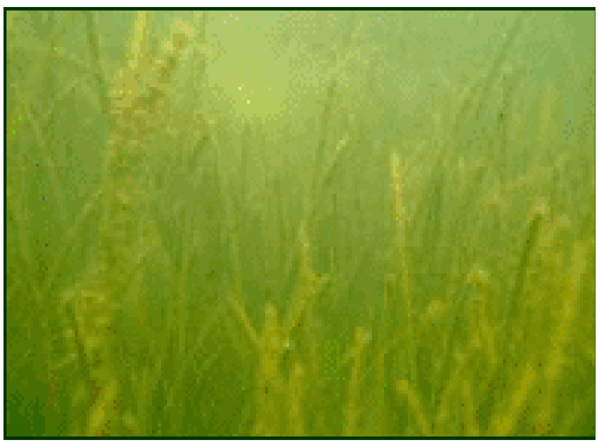


Figure 8. An example of shoreline data collected for characterization. It shows the basic topography of Fowl Cay, which is an example of a non-altered cay. The line graph in this figure shows the varying heights of the terrain including the different zones. From the zero to the 15 meter mark is the pioneer zone, 15 to the 40 meter mark is the bluff, 40 meter to 45 meters is the ridge, 45 to 80 meters is the windward rocky bluff, and to the 90 meter mark is the rocky shore. The table is a record of the height of the points taken by the Zip level at each interval according to the height that was taken at the first point (in the figure, this is marked as 0.000; each meter mark coincides with the elevation of each point).

3. Marine Biotic Communities

The maintenance of the health of the adjacent waters and biota is critical to the success of BBC. Baseline data has been gathered on the water quality, benthic and fish communities around the property. Understanding these baseline conditions and standards pertaining to them will be the focus of the monitoring program. Looking for changes in communities, degradation in water quality or the proliferation of 'weedy' organisms (those which thrive in pollutant tolerant systems) and scoring them will guide the EMT in delegating mitigation priorities if necessary. Results will be compared and related to baseline conditions and other areas within the Bahamas. The aggressive monitoring program and timely data analysis will aid to ensure protocols are being followed, *sources* of degradation are minimized and feasible mitigation options can be implemented when necessary (e.g. pausing construction, placing sediment curtains, applying mulch in dry areas, etc).

Figure 9. A stressed and polluted seagrass bed.



This picture shows a polluted and stressed seagrass community- typified by heavy epiphytic growth and murky water (due to sedimentation and run-off). Monitoring based on baseline conditions and tracking stressors such as sedimentation will help detect and correct run-off events.

As listed in Table 1 many factors will be investigated to assess impacts to the near shore communities and nearby reefs. *Stressors* affect fish, benthic and algal populations and many studies have been done investigating these effects (Figure 8, Appendix 5). Additionally, research by Earthwatch (http://henge.bio.miami.edu/coastalecology/) has been tracking the influences of coastal development throughout the Bahamas for four years. This information will guide data analysis and interpretation.

Data analysis

a. Univariate indices

Univariate indices such as species diversity, abundance, area coverage and hard coral growth will be evaluated and compared to the baseline conditions of the sites. The near shore flora and fauna have been evaluated (Appendices 8-10) and threshold levels (desired ecological status) have been determined for these areas. Similar to terrestrial communities, loss of certain species abundance, diversity and coverage can be indicative of anthropogenic stressors. Tropical islands are particularly sensitive to changes in nutrient input. Degradation of near shore marine habitats is manifested in a loss of macroalgae diversity and production that are particularly important to fishes and marine life dependent on near shore marine habitats as part of their life cycle.

b. Habitat complexity

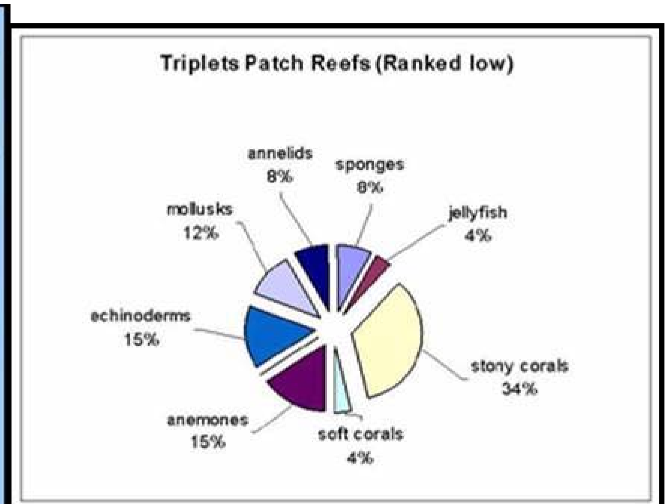
The near shore ecological community can be evaluated in terms of its **Habitat Complexity**. The flora and fish species of these near shore communities are intrinsically connected and can be analyzed in terms of the diversity of benthic species, the physical complexity of the bottom and fish diversity (Gratwicke and Spreight, 2005). This information for BBC's near shore environments will be analyzed in a status report format (section 2C).

c. Stressors

The fauna in the marine ecosystems react to stressors (pollution and sedimentation) similar to humans by producing visible signs of 'sickness'. In unhealthy or unstable systems, signs of stress include:

- excess mucus production in corals and sponges;
- disease outbreaks in sponges, hard and soft corals;
- epiphytic growth on seagrass; and
- the proliferation of certain 'weedy' species and alga

In situ monitoring will be performed to detect stressors. Also, under water photo documentation and photo analysis will be used.



I

Figure 10. Benthic flora and fauna community classification. Changes in the distribution and abundance of certain alga or bottom species can be indicative of pollutants or stressors on the near shore community. Baseline conditions, such as % coverage will be compared to future samples to assess any changes and look for stressors. In stressed marine systems 'weedy' species will begin to dominate, changing the community characteristics, decreasing community integrity.

4 & 5. Socio-economic influences and Education and outreach analysis

An assessment will be done to examine the affects of the BBC development on the human environment. A socio-economic analysis and education and outreach success analysis will evaluate the effects of the BBC development on the local communities and economics of the Abacos. The objectives of the socio-economic analysis and education and outreach success analysis are to:

1. Estimate and track changes in the housing densities and infrastructure in the Abacos.
2. Estimate the market and non-market economic values derived from BBC.
3. Demonstrate how sustainable development practices can benefit the region economically and socially (e.g. jobs generated, scientific information acquired, partnerships fostered, etc.).
4. Consensus build and foster a cooperative management and stewardship process.
5. Disseminate educational materials and facilitate education seminars, programs, etc. and document community perceptions.

Data Analysis

Socio-economic analysis will build upon existing data from the Earthwatch Coastal Ecology of the Bahamas project and incorporate government available data (e.g. housing density in Abacos, tourism revenues in Abacos, boating/yachting density, etc.) to track changes from the development of BBC. These studies will follow those done by Leeworthy and Wiley (Appendix 4) in the Florida Keys. To foster environmental stewardship with local community members and future residents, the Developers have also established an independent Great Guana Cay foundation. This foundation will disseminate project ecological and environmental information via a website, brochures, meetings, and nature tours.

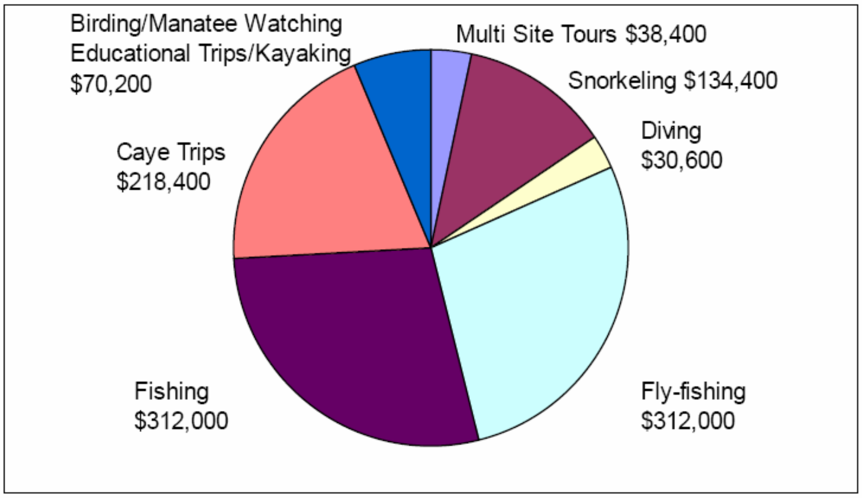


Figure 11. Example resource value assessment pie chart. BBC will expectedly impact the Abacos economically and socially. Tracking changes BBC has on the local economy in terms of revenue generated, jobs gained, partnerships fostered will be a critical component of the monitoring program.

Figure 12. A socio-economic survey distributed by Earthwatch.

Coastal Community Surveys and Impact

Surveyors:	
Island:	
Date/Time:	
Settlement	
GPS LOCATION	
X:	Y:

PHOTO Number	
Interveiwee	
Resident	
Tourist	
year of birth	
years on island	
male	
female	
employed	
unemployed	

Attitudes towards QUALITY OF LIFE

Better	Worse	No diff.	Not Sure	How would compare now to 5 years ago?
				quality of life in general on out island
				opportunities for work
				quality of the environment
				quality of fishing
				quality and availability of housing

Attitudes towards GROWTH AND ENVIRONMENTAL ISSUES

VS = very serious; S = Serious, NP = Not a problem, Not Sure

VS	S	NP	Not sure		HOW DO YOU RATE THE FOLLOWING ISSUES
				1	limitations or availability of fresh water?
				2	contamination of ground water (with sewage)
				3	salt water intrusion to ground water sources
				4	limitation on land for settlements - housing , schools
				5	sprawl and unplanned development on island
				6	loss of agriculture and agricultural areas
				7	cost of housing
				8	hurricane and flood insurance
				9	transportation services - airport and mailboat
				10	roads and transportation infrastructure on island
				11	enforcement of environmental regulations
				12	solid waste management, dumping and trash
				13	old and abandoned vehicles
				14	protection of wildlife, particularly birds, land crabs
				15	invasion of exotic plants like Australian pine
				16	sand mining and rock excavation
				17	coastal erosion and loss of beach areas
				18	pollution and dumping in blue holes and caves
				19	pollution of marine environment, coastal waters

BEST SOURCES FOR INFORMATION
- Radio Station
- ZNS - TV
- Newspaper
- Church
- Community Meetings
- Local Government
- Other

Name and address if wants summary report

Add to mailing list
Yes No

Attitudes on COST AND RESPONSIBILITY for ENVIRONMENT

RANK

1st	2nd	3rd	not sure		WHO IS MOST RESPONSIBLE FOR ENVIRN. MANAGEMENT?
					local government
					island-wide planning council
					central government
					individual citizens
					WHO SHOULD BEAR COSTS OF ENFORCEMENT
					local government
					island-wide planning council
					central government
					individual citizens
					WHO SHOULD BEAR COSTS OF CLEAN UPS?
					local government
					island-wide planning council
					central government
					individual citizens

OPINIONS ON ENVIRONMENTAL REGULATORY MECHANISMS

S = Strengthed or Need this, R = Relax or don't need, NC = no change needed

elax or don't need, NC = no change needed

S	R	NC	Not sure		HOW WOULD YOU CHANGE THE FOLLOWING
				1	Environmental Impact accessments of new projects
				2	enforcement of current regulations
				3	regulatory legislation in environmental protection
				4	local government involvement
				5	central government involvement
				6	citizen involvement and education
				7	non-government organization involvement

2C: Status report approach to monitoring and Impact mapping

Status reports will be evaluated for the factors and indicators measured in the ecological and environmental monitoring program. Scores and rankings will be based upon the percent or level of change from the baseline conditions within the island grid system. A cumulative score for the factors and indicators will be determined. Suggestions by the EMT will be made based upon these scores. Figure 13 is an example status report.

Figure 13. Example status report for factors and indicators measured in the environmental monitoring program.

Grid: D6 **Factor**: Plant diversity
Indicators: species abundance, rare species, invasive species

Parameters	Baseline level	Current level	% or level of change	Score (1-5)
Species abundance				
Relative abundance of rare species				
Relative abundance of invasives				

Cumulative Quadrat Score (1-5) _______

Cumulative Score Criteria for Plant Diversity:

1. Data suggests that the complexity and distribution of the plant communities is in **notable decline** (substantial negative alterations from baseline condition).
2. Data suggests that the complexity and distribution of the plant communities is in **decline** (noticeable alterations from baseline condition).
3. Data suggests that the complexity and distribution of the plant communities is **unchanged** (negligible alterations for majority of parameters, similar to baseline conditions).
4. Data suggests that the complexity and distribution of the plant communities is **improving** (favorable or recovering for majority of parameters).
5. Data suggests that the complexity and distribution of the plant communities is **notably improving** (community is much improved from baseline conditions).

The EMT will make mitigation recommendations for those grids scoring a 1 or 2. Follow-up procedures will proceed to gauge recovery.

A monthly development impact status report will be used to track development impacts and for the EMT to promptly offer advice and mitigation options if necessary. It is noteworthy to stress that 'impacts' should not always be viewed with a negative connotation. For example mitigations and dune and beach restoration are positive impacts. The status report will track ecological and environmental impacts in addition to a GIS impact map. The status reports and maps seek to track Best Management Practices (BMP's), Buffer Zone maintenance, land changes, mitigations, air burner emissions, nursery operations, and EIA compliance. The maps will offer visual progressions of the project, highlight BMP's and indicate areas where corrective/mitigation actions may need to be advised (Figure 15).

A. Marine Status Reports

Quarterly, marine status reports (Figure 14) will be completed. The status reports will seek to elucidate the status or changes in benthic and fish communities, water quality and hard coral growth. The reports will be specifically related to development practices to infer if there are any related environmental effects.

B. Construction and Development Status Reports

To gauge and measure the construction and development of Baker's Bay Club (BBC), environmental managers will use the Development Status Report for Environmental Management (Figure 15). The Environmental Impact Assessment (EIA) and the Environmental Management Plan (EMP) outline Best Management Practices (BMP's) for construction and development procedures, mitigations, and documentation advocated and recommended by the Environmental Management Team (EMT). The Status Reports will rate site construction, mitigations, nursery, and pest control procedures in terms of their adherence to BMP's, protocols, procedures and recommendations as advised in the EIA, EMP and personal communications with the EMT. Status Reports will be completed monthly and will be submitted to BBC staff and the B.E.S.T. Commission.

Figure 14. Marine Status Report

Hard Coral Growth-Population and Individual	Hard Coral Health	Marine Plant Diversity	Epifauna Diversity	Fish Diversity	Water Quality Index	Sedimentation Index
5: no deviations from original size-frequency distributions / positive growth of 75% transplants	**5**: presence of mucus, polyp swelling, discoloration, and/or partial colony mortality evident in <25% transplants and residents	**5:** no significant difference in species presence or abundance in any survey areas, presence of healthy indicator species	**5**: no significant difference in species presence or abundance in any survey areas, healthy indicator organisms present	**5**: no significant difference in species presence or abundance in any survey areas	**5**: no parameters significantly deviate from mean baseline data	**5**: all baseline sedimentation rates maintained
4: no deviations from original size-frequency distributions / arrested growth of 50% transplants	**4**: presence of mucus, polyp swelling, discoloration, and/or partial colony mortality in <50% transplants and residents	**4**: <25% communities contain disturbance indicator species	**4**: significant differences in presence or abundance in <25% of sites	**4**: significant differences in presence or abundance in <25% of sites	**4**: 1/4 parameters fall out of mean baseline range	**4**: 75% baseline sedimentation rates maintained
3: no deviations from original size-frequency distributions / arrested growth of 75% transplants	**3**: presence of mucus, polyp swelling, discoloration, and/or partial colony mortality in <75% transplants and residents	**3**: <50% communities contain disturbance indicator species	**3**: significant differences in presence or abundance in <50% of sites, disturbance indicators present	**3**: significant differences in presence or abundance in <50% of sites	**3**: 2/4 parameters fall out of mean baseline range	**3**: 50% baseline sedimentation rates maintained
2: deviations from original size-frequency distributions of at least one population, arrested growth of 50% transplants	**2**: evident stress responses as listed previously, and/or presence of new disease lesions	**2**: <75% communities contain disturbance indicator species, or proliferation of one species in any community	**2**: significant differences in presence or abundance in <75% of sites, disturbance indicators dominate	**2**: significant differences in PRESENCE or abundance in <75% of sites	**2**: 3/4 parameters fall out of mean baseline range	**2**: 25% baseline sedimentation rates maintained
1: deviations from original size-frequency distributions of two or more populations / arrested growth of >50% and mortality of transplants	**1**: significant mortality of transplants and/or residents	**1**: proliferation of one species in >1 community, or drastic loss of algae or seagrass communities	**1**: drastic phase shift of any macro-invertebrate community	**1**: drastic loss of fish communities	**1**: all parameters drastically altered	**1**: significant sedimentation event inflicting severe community damage
Status:	**Status:**	**Status:**	**Status:**	**Status:**	**Status:**	**Status:**

Figure 15. Construction and Development Status Report

BAKER'S BAY CLUB CONSTRUCTION STATUS REPORT					
DATE: STAFF:					
Questions: The following check list provides an **outline** to aid on-site environmental managers surveying BBC construction and developm for the purposes of weekly status report completion					
CONSTRUCTION	**Y**	**N**	**Cell(s)**	**GPS**	**Photo (P) / Figure (F)#**
Inland					
1. Buffer zones observed and clearly marked?					
2. Road widths proper?					
3. Sediment curtains in place and secure?					
4. Avoidance/transplantation of flagged vegetation?					
5. Cleared roads are covered in mulch/watered?					
6. Vegetation along roads in healthy status?					
7. Construction following outlined plan?					
8. Hazards clearly marked?					
9. Encroachment into the preserve?					
10. Are dredge materials being properly handled (e.g. high organic soils not drying out, materials stored in proper location)					
Coastal/Buffer zone/Near shore					
1. Machinery/construction on beaches during sea turtle nesting season?					
2. Dredging operations are being properly managed?					
3. Noticeable sedimentation around dredging operations?					
4. Barges stirring up sediment or grounding?					
5. Improper activities in the coastal buffer zone?					
6. Chemical usage?					
EXOTIC REMOVAL AND WASTE CLEAN UP	**Y**	**N**	**Cell(s)**	**GPS**	**Photo (P) /Figure (F)#**
1. Recommended protocols/procedures being followed?					
2. Proper equipment/techniques being used?					
3. Regrowth of exotics? Species?					
4. Healthy conditions observed in restored areas?					
5. Proper waste disposal procedures being followed (e.g. composting, recycling, toxin removal, proper location)?					
6. Artificial wetland functioning properly?					
7. Air burner procedures being followed? Log being kept?					
8. Proper disposal/action with landscaping waste (composting/recycling)?					
9. Only required materials being burned (e.g. no compostable or recyclable materials)?					
NURSERY	**Y**	**N**	**Cell(s)**	**GPS**	**Photo (P) /Figure (F)#**
1. Rare, conservation and landscaping vegetation properly flagged?					
2. Proper vegetation removal procedures being followed (e.g. large trees transplanted, rare species transplanted, Casuarina removal following outlined procedures)?					
3. Log book being kept (species transplanted, transplantation/ propagation specs, watering regime, chemical usage)? Collect weekly.					
4. Proper chemical usage and storage?					
5. Sediment controls where necessary?					

PEST CONTROL					
1. Adherence to the Integrated Pest Management plan?					
2. Application schedule and quantities being followed?					
3. Proper chemical usage?					
4. Proper waste disposal- not exacerbating pests/rodents?					
5. Imported materials/vegetation checked for exotics?					
6. Lob lac scale found?					

Status Report

A. CONSTRUCTION	
4. Complete adherence to EIA, EMP or EMT recommendations and specifications 3. Slight discrepancies in adherence to EIA, EMP or EMT recommendations, no mitigations required. No environmental impacts, proper communication with EMT. (E.g. sediment curtains needed maintenance, minor sedimentation problems while dredging- but operations curtailed or halted, slight deviation from construction plan, unauthorized machinery on beach) 2. Minor impacts and mitigations required. Incomplete adherence to EIA, EMP or EMT recommendations. Proper communications with EMT. (E.g. roadside vegetation damage, sediment curtains remaining un-tucked, minor buffer zone encroachment, sea turtle endangerment) 1. Major impacts to construction grids, no adherence to EIA, EMP or EMT recommendations. No communications with EMT or on-site environmental manager. Major mitigations required. (E.g. Rare/conservation plants, large trees not salvaged, improper road clearing, no mulch, encroachment into preserve or buffer zone, heavy sedimentation, ship/barge grounding, major sedimentation problems while dredging, weekly construction plan not followed.	
CURRENT STATUS:	PREVIOUS STATUS:
Comments:	
B. EXOTIC REMOVAL	
4. Complete adherence to outlined restoration procedures. Proper communications with the EMT and on-site environmental manager. Proper chemical usage. 3. Exotic seedlings colonizing restored areas. Minor deviations from outlined restoration procedures. Proper communications with the EMT and on-site environmental manager.. No mitigations required. 2. Many juvenile exotics observed in restored areas. Proper communications with the EMT and on-site environmental manager. Minor improper chemical and/or equipment usage (no environmental damage). 1. Many adult exotics colonizing restored areas. Improper chemical usage, outlined restoration procedures not followed. Improper equipment usage. No communications with EMT or on-site environmental manager. Mitigations required.	
CURRENT STATUS:	PREVIOUS STATUS:
Comments:	
C. CLEAN UP AND WASTE DISPOSAL	
4. All materials disposed of and/or stored properly. Proper communication with the EMT and on-site environmental manager. 3. Minor improper disposal/location of waste and chemicals. No environmental degradation or mitigations required. Proper communication with the EMT and on-site environmental manager. 2. Improper disposal/location, minor mitigations required, but remedied in a timely manner. (E.g. excess air burning of compostable/recyclable materials, major lay-down area infractions) Proper communication with the EMT and on-site environmental manager. 1. Improper disposal/location of waste and chemicals (e.g. dredge materials in unauthorized location, dumping of oil/fuel and/or chemicals.). Environmental degradation, mitigations required. Hazardous materials improperly handled. No communications with EMT or on-site environmental manager.	
CURRENT STATUS:	PREVIOUS STATUS:
Comments:	

D. PRESERVE AREAS	
4. No construction encroachments. No mitigations required. Ecological status preserved. Preserve area adequately delineated. Proper communication with the EMT and on-site environmental manager. 3. Minor construction encroachments. No mitigations required. Ecological status not compromised. Preserve area adequately delineated. Proper communication with the EMT and on-site environmental manager. 2. Minor construction encroachments. Minor mitigations required. Ecological status compromised. Preserve area not adequately delineated. Proper communication with the EMT and on-site environmental manager. 1. Major construction encroachments. Mitigations required. Ecological status compromised. Preserve area not adequately delineated. No communications with EMT or on-site environmental manager.	
CURRENT STATUS:	PREVIOUS STATUS:
Comments:	
E. NURSERY	
4. Between 75-100% of rare/conservation or large trees flagged or transplanted within construction grid/s. (< 25% of rare/conservation vegetation or large trees lost during construction.). Proper communication with the EMT and on-site environmental manager. Log submitted. 3. Between 50-75% of rare/conservation or large trees flagged or transplanted within construction grid/s. (50-25% of rare/conservation vegetation or large trees lost during construction.). Proper communication with the EMT and on-site environmental manager. Log submitted 2. Between 25-50% of rare/conservation or large trees flagged or transplanted within construction grid/s. (75%-50% of rare/conservation vegetation or large trees lost during construction.). Proper chemical usage/storage. Proper communication with the EMT and on-site environmental manager. Log submitted. 1. Less than 25% of rare/conservation vegetation or large trees flagged or transplanted within construction grid/s. (100-75% of rare/conservation vegetation or large trees lost during construction.) No communications with EMT or on-site environmental manager. Improper chemical usage/storage. Log not submitted.	
CURRENT STATUS:	PREVIOUS STATUS:
Comments:	
F. PEST CONTROL	
4. Full adherence to IPMP and monthly application schedule with localities. Proper communication with the EMT and on-site environmental manager. 3. Minor deviations from IPMP and/or and monthly application schedule. Proper communication with the EMT and on-site environmental manager. 2. Unauthorized deviations from the Integrated Pest Management Plan (IPMP) and/or the monthly application schedule with localities. No adverse environmental impacts. Monthly application schedule and localities submitted to on-site manager or EMT. Proper communication with the EMT and on-site environmental manager. 1. Insufficient adherence to Integrated Pest Management Plan (IPMP). (E.g. unauthorized chemical applications, applications within the buffer zone, deviating from application schedule.) Adverse environmental impacts. Improper waste disposal/construction practices exacerbating rodents and pests. Monthly application schedule with localities not submitted to on-site manager or EMT. No communications with EMT or on-site environmental manager. Chemical log not submitted.	
CURRENT STATUS:	PREVIOUS STATUS:
STATUS TOTAL:	PREVIOUS STATUS:
ISUES TO FOLLOW UP ON:	**ISSUES RESOLVED:**

2D: Environmental Management

The BBC project seeks to promote Best Management Practices in environmental management by being innovative and environmentally sensitive concerning waste management, nursery operations and pest management. The project will be utilizing a variety of resources and technologies and environmental management will be evaluated and documented. The implementation of Environmental Management plans will be the responsibility of the on-site project manager. The EMT has set up the procedures, regulations, policies and will monitor to confirm adherence, offer insights and corrective actions if required.

1. Solid, hazardous and sewage waste management

a. Solid Waste

Table 3 lists the manner in which each type or waste will be managed.

Table 3. Waste and hazardous material management during construction.

TYPE OF WASTE	DESCRIPTION	FATE OR DEPOSITION
Plant material, garden waste and cuttings	All plant material, including exotic plant removal from coastal areas, shrubs and trees trimmed from homes and the resort, as well as golf course clippings	Chip and compost small material. Casuarina trees logs recycled for fencing of coastal buffer zone, as needed. Air curtain destructors (e.g. airburners.com) will be used for leftover materials.
Household/ Food Organic Material	High nitrogen organic wastes generated from food preparation	Compost at communal composting or permiculture in employee settlement
Construction Debris and Wastes	Large pieces of waste from Removal of Disney Treasure Island complex, concrete, wire and lumber, not toxic	Lumber recycled in landscaping, Unusable material compacted for removal from island
Re-cycled Material	Glass, tin, paper, plastic and glass	Any material, particularly from packaging that can be recycled will be separated and stored. PPS will work with local environmental groups on recycling processing for the region
Last discard-appliances, cars, etc.	Large, disposable items	Compaction and store for removal from island
House-hold wastes	Compactable household and resort waste that can not be recycled	Compaction and store for removal from island
Toxic and hazardous wastes	Contaminated soil removed from the Disney Treasure Island complex, paints, used oil, and other materials requiring special consideration in disposal	Special storage facilities and processing for removal from island
Sewage and Waste water treatment	High organic content, potential public health hazards	Composting toilets, artificial wetland processing

An on-site composting facility will be constructed to compost green landscaping waste and house hold waste.

b. Air curtain burner

Air curtain burners (ACB's) (Figure 16) have been used by the US Department of Agriculture, the UK Department of Environment, Food and Rural Affairs, the Canadian Forest Service, and in the Bahamas for purposes expediently burning trees infested with disease, disposing of infected animal carcasses, and disposing of hurricane debris. ACB's are specialized in design to reduce particulate matter and emissions when burning, producing little to no visible smoke when optimally operating. ACB's are steel container with an internal refractory lining with a pipe running along the top of one long edge that produces a high velocity air stream over the top of the open container. The top is open for loading fuel and to create a swirling action within the container to assist efficient combustion. Optimally, temperatures within the ACB range from 600º to 1000º Celsius in order to lessen emission of CO_2 and CO and oxides of nitrogen (report for UK Department of Environment, Food and Rural Affairs, 2002).

A logbook will be kept on-site recording estimated amount of materials going into the ACB, estimates of the types of materials (green vegetation, wood, etc), hours of burning and temperatures. **The on-site environmental manager will be responsible for submitting this monthly to the EMT in order to estimate emissions and to enter into it the monthly environmental BEST report and status report.**

Figure 16. Air curtain burner.

2. Waste Water Treatment and Management

The following activities are KNOWN to increase coastal eutrophication will be AVOIDED in the BBC development:

- **On-Site Disposal Systems or Soak-Aways** - Most island houses have a "**soak-away**" or septic system. The system is designed to include a series of underground filters to digest the organic material in sewage and wastewater. In tropical environments, often soils are very thin, therefore effluents from septic systems and soak-aways migrate rapidly through to ground water. Poorly constructed "soak-aways" are essentially **cesspits** that afford very little wastewater treatment, and pollutants move rapidly through groundwater to coastal waters. Cesspits can result in the degradation of water quality in adjacent canals and lagoons, not to mention contamination of ground water.
- **Package Plants and Injection Wells** - Injection wells are used in more densely populated hotels and resorts. Most **package plants** are not designed to remove nutrients. Injection wells make use of cavities and caves in the carbonate platform, and inject both raw sewage and **secondary treatment** effluent into wells of varying depths. This is the "out of site-out of mind" philosophy, and over time contaminated groundwater can migrate to surface waters.
- **Live-aboard boats and yachts** - The Bahamas has long been a Mecca for sailors and yachtsman with its beautiful waters and many islands. Yachting traffic dumps sewage directly into coastal waters in the Bahamas where holding tanks are not required. Raw sewage or disinfected sewage can be pumped overboard and rapidly diluted by tidal currents when holding tanks and pump-out stations are not used. The "solution to pollution is dilution" concept has applied to many anchorages of the Bahamas with low population densities and strong tidal flushing on harbours and bays. However, the increasing popularity of boating in the Bahamas and increased yachting tourism now presents a problem for some areas. Holding tanks will be required for resident boat owners
- **Stormwater runoff** - Stormwater runoff is totally untreated, and heavy rains can carry **nutrients** and **hydrocarbons** (petroleum and oils) from roads, bridges, rooftops and yards into coastal waters. Most rainwater soaks into the porous carbonate rock, but heavy rains can carry significant amounts of pollution into coastal waters from densely populated and urban areas. Storm water management can be accomplished through planned drainage systems away from the sea and by maintaining a healthy coastal vegetation buffer zone

There are two options for SEWAGE AND WASTE WATER TREATMENT for the Bakers Bay Club:

- Composting toilets and /or
- Constructed wastewater processing wetlands

These sewage and gray water treatments can be used throughout the full operations of the Bakers Bay Club by relocating the composting toilets to the marina and the Discovery Environmental Outreach Centre after the construction.

a. Composting Toilets

The CLIVUS MULTRUM Company has demonstrated to the world that sewage treatment can both conserve water and prevent eutrophication of sensitive wetlands and coastal areas. Now there are a variety of companies that can provide basic composting systems for the construction-site. Composting toilets are a healthier alternative than the flush waste treatment system.

Alternatively, the composting toilet allows the nutrients in human excreta to be captured and readied for use again as fertilizers—instead of mixing them with water or toxic industrial chemicals. The composting toilet makes it unnecessary to pollute water and soil, or to use clean water to flush toilets.

The breakdown of waste in the composting toilet is carried out by mesophilic organisms, i.e., organisms that thrive within a temperature range of 20-45 °C. These temperatures are perfect for fast decomposition in The Bahamas. Chief among these are a wide range of bacteria and fungi. Also highly active within the compost system are many invertebrates, such as red worms, which transport oxygen and moisture throughout the compost mass while they assist the physical and chemical breakdown. Red worms would NOT be used in island systems to avoid unintentional introduction of species.

Bulk material (typically, shredded bark mulch or Australian pines) is added to help maintain a porous texture that promotes aeration and good moisture content. Human pathogens are killed not by the heat within the composter but by predatory organisms and the long retention time in the system. Especially important in the compost process are the nitrifying bacteria (e.g., nitrobacter and nitrosomonas), which turn the nitrogen in human waste into nitrites and nitrates, i.e., forms of nitrogen plants need for growth.

Since greywater, i.e., water from sinks, showers, and washing machines contains only about 10% as much nitrogen as does human waste; it’s far less of a pollution problem. When greywater is put into the aerobic environment of topsoil soon after it has been collected, plants and soil organisms use the nutrients it contains. However, low nutrient soils found on tropical islands are very intolerant to excess nutrients. The grey water needs to be processed through a constructed wetland.

b. Constructed wetlands

In the past couple of decades, there has been growing interest among governments and industries in utilizing the abilities of constructed wetlands for processing and eliminating wastewater and sewage. The use of natural systems for treating waste is called **bioremediation, or phytoremedation** when plants are involved. Wetland biological communities are comprised of diverse communities of bacteria and hardy, fast-growing plants that are adapted to taking advantage of high nutrient loads. They have proved to be especially capable of biodegrading nutrient-laden domestic sewage and even some toxic industrial effluents, and rendering them less harmful to neighboring ecosystems and human communities (Figure 17).

Constructed wetlands can provide a highly effective, partial solution towards sustainable water use on tropical islands. There are already constructed wetlands for wastewater processing on Eleuthera and Exuma islands. Wastewater travels through a constructed wetland and emerges both filtered and lower in nutrients. The wastewater can be used for watering the native landscape or golf courses. As tropical islands' soils tend towards low nutrient concentrations, many native plants are not adapted to dealing with rich soils, and have adverse reactions to over-fertilization.

It is relatively cheap and easy to build a constructed wetland. Even while becoming established, a properly designed greywater wetland will produce absolutely no bad odors or increase mosquito populations. The only difference between constructing a pond is that a natural wetland is mostly or completely filled in with some sort of growing medium for the plants (e.g gravel). The diagram below shows a basic rectangular design, with some optional "features". There is flexibility with regard to design, as wetlands themselves are generally very robust and forgiving. Wastewater wetlands can be added in a series of linked modules.

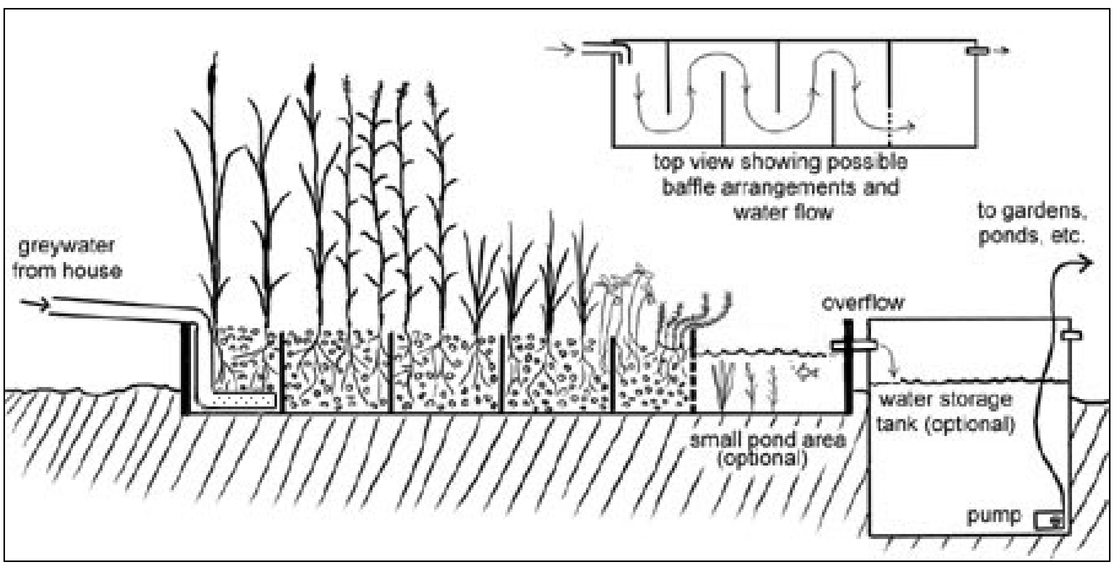


Figure 17. Schematic diagram of a phytoremediation wetland. Copyright Lawrence Fields. Photograph by Lawrence Fields.

It's possible (especially in warm climates) to build a wetland large enough that it has no output or overflow, where all the greywater that went in would be lost to evapotranspiration. Generous water consumption rates have been estimated at would be about 150 litres of waste per day per person for toilets, showers, kitchen and laundry. The waste water should take 4 to 5 days to travel from one end of the wetland to the other, taking into account the gravel fill in the wetland construction, the typical capacity for constructed wetlands is about 3 cubic meters per person.

Modules for 10 people would be 1 meter deep, three meters wide by 10 meters long (300 cubic meters of wetland). Modules can be added for increased capacity, and “stored” by drying down to decrease capacity.

Factors influencing the purification process of constructed wetland treatment systems:
The main factors that typify the treatment characteristics are:

a) hydraulic loading (m^3/[ha x d]) and hydraulic detention time (d)
b) temperature
c) influent pollutant concentration
d) oxygen supply
e) development stage of the plant ecosystem (this sequence is in random order, not according to quantitative importance) High volume systems like aerated lagoons or planted soil filters offer comparatively large growth surfaces and detention times, which can be controlled by height variable outlet weirs.

The wastewater gardens will be visually evaluated monthly in terms of functioning, presence of algal/bacteria mats and odour. This will be included in the monthly status report.

3. Nursery operations

The on-site nursery and management of it is a critical component of the BBC project. A goal of the EIA is to use only local vegetation, mainly from the property, for dune restoration and landscaping. Also, salvaging and replanting of conservation/rare species is vital for meeting project goals and complying with local and international regulations. Thorough documentation of species transplanted, horticulture specifics, species success rates and transplantations is important regionally and environmentally. In light of the ‘experimental nature’ of this development, the resources, efforts, and horticultural specifics used will be valuable information for understanding the specific local propagation needs for native species. This information will be documented and disseminated to local operations and homeowners to encourage native plant propagation and utilization within the Abacos. Environmentally, it is important to track water and fertilizer/herbicide/chemical use and regularly test the surrounding soils and waters to monitor for pollutants. The nursery manager and staff are responsible for the tagging of pertinent vegetation, salvaging operations, horticulture specifics (fertilizer, watering, size, growth, etc) and transplantation. **The nursery manager will keep a logbook specifying the aforementioned and submit to the EMT monthly.** Additionally, the EMT will do periodic soil testing around the nursery.

Figure 18. Nursery site. The on site nursery will be established to transplant and salvage conservation and landscaping species. The developers have salvaged and restored structures left by a previous development for the nursery.

4. Integrated Pest Management

The minimization of insects and pests in heavily populated areas is important for disease control and personal well-being. However, it is vital to minimize personal toxic exposure and soil, groundwater and near shore pollution that can arise from chemical use. The EIA specifies judicious use of chemicals on the property, especially concerning golf course maintenance. The porosity of the property will not allow for filtering of the chemicals, making vegetation, animals (e.g. land crabs) and near shore flora and fauna susceptible to these chemicals. The BBC staff and the EMT will implement an Integrated Pest Management Plan (IPM) (*in draft*). IPM means regular monitoring to determine if and when treatments are needed, and employing biological, cultural, mechanical, physical, and educational tactics to prevent pests or keep their numbers down. The BBC IPM will emphasize non-chemical control methods, focusing on screening in areas, natural insecticides/larvicides, raking of the beaches and avoidance of standing water sources/ drainage. The on-site environmental manager will oversee the IPM and any chemical use will be documented. Appendix 12 outlines the BBC IPM plan.

Patients and staff at San Francisco General Hospital spend time in an organic flower garden where they can relax or visit in an environment free of toxic pesticides. The gardeners enhance the healing atmosphere by using hardy, pest-resistant plants, weed barriers,and other alternative methods to keep pest numbers low.

Monitoring for disease with soil probes and other tools, use of organic fertilizers and beneficial soil organisms, judicious water management and other cultural practices have substantially reduced pesticide use on the City's pilot IPM golf course. The success of the pilot program has led to implementation of IPM at the City's bowling green and its four other golf courses.

Figure 19. Examples from San Francisco's Integrated Pest Management Plan (IPM). The IPM for BBC will advocate a proactive approach to pest management, minimizing chemical use by reducing breeding sources, screening in areas, natural insecticides/ larvicides and raking beaches.

The most effective way to control mosquitoes is to find and eliminate their breeding sites.

Elimination of breeding places will focus on:

1. Removing standing water caused by construction puddles, seepage pools, lawn, or landscaping depressions by drainage or filling with earth.
2. Checking irrigation and drainage ditches for leaks or seepage and maintain free flow of water.
3. Grading newly developed land to prevent standing water.
4. Providing drainage away from premises for excess irrigation water, or collect in storage sump and reuse on land.
5. Managing weeds in areas where adult mosquitoes congregate (such as small man-made bodies of water, ornamental pools), water retention ponds, lagoons or water reservoirs.
6. Regularly removing floating debris from standing water to reduce egg-laying sites.
7. Constructing drainage holes on structures and containers that may trap water such as barrels.

2E: INCIDENT REPORT AND CLEAR REPORTING RESPONSIBILITIES

The EMP is the system of 'checks and balances' for determining success in meeting the goals and objectives of the EIA. Delegating clear procedures for reporting is critical to this process. The EMT will prepare monthly reports which will be submitted to the Bahamas Environment Science and Technology Commission.

Incident Report

WHAT IS AN INCIDENT?
An incident is a real or perceived change in the development and operations plan. The implication of reporting an "incident" is that there is some unplanned negative impact on the environment of the project site, and thus, the potential for violating the protocols and standards set in the Environmental Impact Assessment. ANY deviation from the plans circulated and approved needs to be reported.

Although there is great concern for safety on any construction-site, this particular incident report does not deal with work-place injuries OTHER than poison wood rashes or injurious encounters with marine life. We want to particularly monitor the spread of poison wood seedlings or "outbreaks" of sea lice or thimble jellies that may prove harmful to people as well as indicate specific ecological events.

The INCIDENT REPORTING SYSTEM can

- be used to address real problems in the construction phase like lack of protection of the coastal buffer zone or heavy ground compaction, and thus improve management practices,
- be used as an internal response mechanism for dealing with accidents and mishaps that need immediate attention for clean-up or restoration,
- be a tool for positively addressing rumors and "outside" observations of the construction process (e.g. yachtsmen reporting damage to seagrass beds or high turbidity in the sea during dock construction).

The REPORTING SYSTEM is meant to be a transparent mechanism for tracking problems on the ground. Anyone can complete the report. Internally generated reports will be processed through the development team. Externally generated reports will be dealt with and posted on the www.saveguanacay.org or related project website.

Submission Procedure:

1.) Incident submission forms should be available both on-line on the project FTP site and hard copies on-site.
2.) Forms should be completed and sent to DOUG SHIPMAN, DLC. Doug should be the first point of contact for all incidents
3.) D. Shipman will pass the form on to the Environmental Management Team (Nicolle Cushion, University of Miami) within 24 hours with three questions addressed:
    a) Is there a need for immediate action and follow up to mitigate, restore and clean-up the area impacted?

b) Does this incident warrant a separate, formal report to the Ministry of Financial Services and BEST Commission?
c) What are the corrective actions that need to be put into place (e.g. better supervision, better signage, better marking of sensitive areas)?

4.) The Environmental Management Team will respond within 1-day on the protocols for clean up or restoration. Some clean up protocols need to be in place for immediate deployment. These include:
a) oil and gas spills on land or in the water of more than 2 liters,
b) any spill of pesticides, paints, petrol-chemicals or fertilizers on-site,
c) sedimentation events caused by groundings, barge failure, sediment curtain failure or erosion control failure. Emergency booms should be on-site, and deployed immediately.

5.) All incident reports should have a 1-month and 6-month follow up by the Environmental Team with a report directly to Doug Shipman. Monthly reports should include the status of each incident to resolution. Resolution is defined as the area impacted returning to the pre-impacted conditions (or established restoration).

6.) Reports and follow up action will be documented and filed electronically on the project ftp site for team review

A review of incidents and incident reporting will be reviewed after one year to measure the success or shortcomings of the protocol. Residents in the adjacent community will be made aware of the incident reporting protocol. We would encourage people to file a report on observations that concern them so that we can either correct the problem, or explain any misconceptions.

Contact Information:

BBC Project Manager:
Doug Shipman
dshipman@discoverylandco.com

BBC Environmental and Community Relations Manager:
Livingston Marshall
lmarshall@discoverylandco.com

Environmental Management Team:
Kathleen Sullivan-Sealey
ksealey@bio.miami.edu

Nicolle Cushion
nicollec@bio.miami.edu

Figure 20. Baker's Bay Club Environmental Incident Report.

BAKERS BAY CLUB – ENVIRONMENTAL INCIDENT REPORT

DATE OF REPORT SUBMISSION: DATE or TIMEFRAME OF INCIDENT

AUTHOR:
SUMMARY OF EVENT: (BRIEF account of what happened, where did it occur, who was involved)

Action entity:
General contractors
Environmental Management Team
Trespassers
Sub-contractors
Other _________________
Unknown

Key Educational Points: One or more key points (short, several words) that indicate the lessons learned or reinforced by the incident (e.g. all crews should carry a first Aid kit, plants need to marked more visibly, etc.)

1.

2.

3.

Injuries and property damage (and any other negative impact) caused by incident: Describe the extent and nature of any damage and personnel injuries. Include a brief description of any "intangible" losses (e.g. worker moral, negative publicity, etc.)

Primary cause of the incident: Also include secondary and tertiary causes and mitigating factors as appropriate.

Recommended Corrective Action – Describe the recommendations that were made or programs implemented to prevent a reoccurrence of the incident.

Photographs: Digital or hard copies of photos would be very useful. The Environmental team will photograph the site within two weeks in no photos are taken.

Photos should be submitted with a brief description in .jpg, gif or other electronic format.

Incident Description: Specific description (two to three paragraphs) description of what happened – who, what, how, why? Please provide general information about the personnel involved.

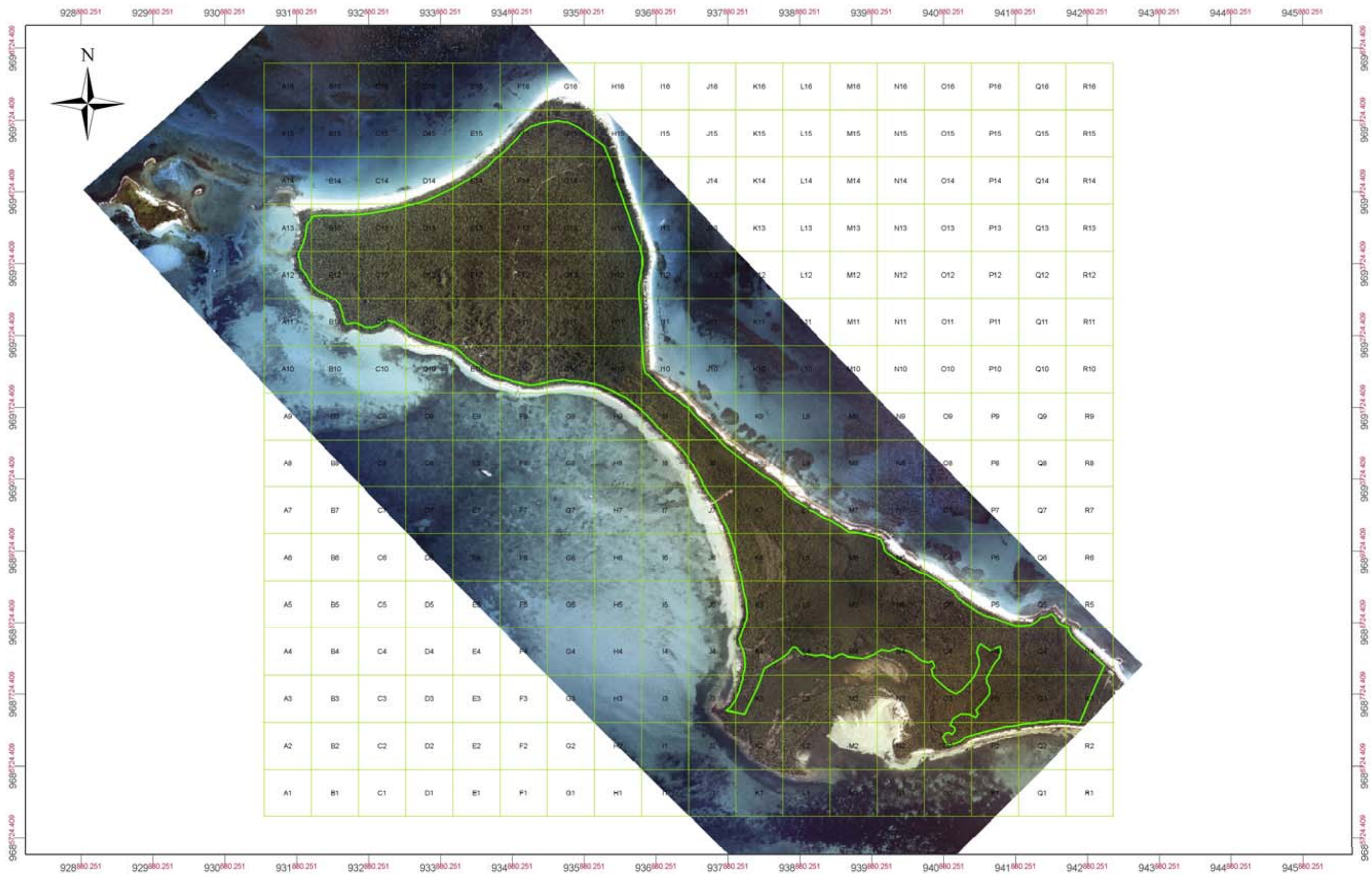
SIGNATURE OF AUTHOR ____

DATE RECEIVED BY DLC ______________________
DATE RECEIVED BY ENVIRONMENTAL TEAM _____________

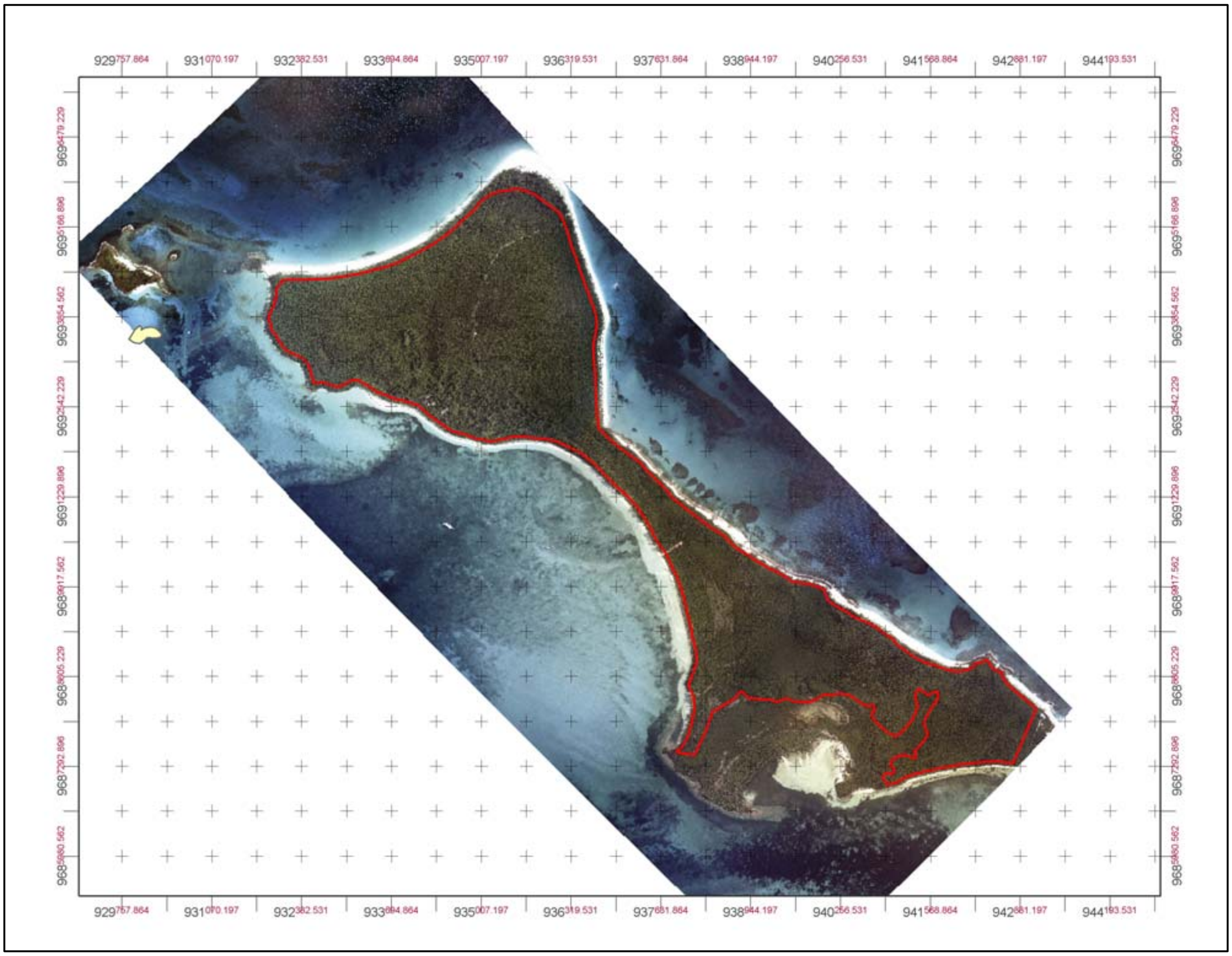
Appendix 1. Construction phase contact information.

Discovery Land Company Ed Divita Doug Shipman Livingston Marshall	Developer Project Manager BBC Environmental manager www.discoverylandco.com	100 California St. Suite 700 San Francisco, CA 94111 edivita@discoverylandco.com dshipman@discoverylandco.com
VITA Don Vita	Landscape Design / Architecture/ Marina Development partner	181 Third St. Suite 250 San Rafael, CA 94901 dvita@vitainc.com
LACC International John Nartowicz	Landscape Architect	lacc@bellsouth.net
American Bridge Richard Kermode Rick Alexander Greg Harner	Construction	1509 West Swann Avenue Suite 250 Tampa, Fl 33606 rkermode@americanbridge.net ralexander@ americanbridge.net (Bahamas) gharner@americanbridge.net
Moffit & Nichol Jeff Malyszek	Engineers	1509 West Swann Ave Suite 250 Tampa, Fl 33606 jmalyszek@moffattnichol.com
Harris Civil Engineers Steven Dieter	Civil Engineers http://harriscivilengineers.com	631 South Orlando Ave. Suite 300 Winter Park, Florida 32789 steved@harriscivilengineers.com
University of Miami Kathleen Sullivan-Sealey Nicolle Cushion Keith Bradley	Environmental Management Environmental Project Manager http://henge.bio.miami.edu/coastalecology/ Communications / Environmental Monitoring Botanist / The Institute for Regional Conservation (EMT consultant) www.regionalconservation.org	P.O. Box 249118 Coral Gables, FL 33124 ksealey@bio.miami.edu nicollec@bio.miami.edu bradley@regionalconservation.org

Appendix 2. Map of grid system for monitoring.



Appendix 3. Map of buffer zones for Baker's Bay Club.



Appendix 4. References for monitoring protocols and procedures.

Bowker, J M. Leeworthy, Vernon R. “Nonmarket Economic User Values of the Florida Keys/Key West.” *Linking the Economy and Environment of Florida Keys/Florida Bay*. Monroe County Tourist Development Council. Florida. ©October 1997.

Chiappone, Mark: Editor. “Fisheries Investigations and Management Implications in Marine Protected Areas of the Caribbean” *A Series on Science Tools for Marine Park Management, Part One*. The Nature Conservancy. Arlington, Virginia. ©2001

Chiappone, Mark: Editor. “Water Quality Conservation in Marine Protected Areas.” *A Series on Science Tools for Marine Park Management*, *Part Two*. The Nature Conservancy. Arlington, Virginia. ©2001.

Chiappone, Mark: Editor. “Coral Reef Conservation in Marine Protected Areas” *A Series on Science Tools for Marine Park Management*, *Part Three*. The Nature Conservancy. Arlington, Virginia. ©2001.

English, Donald B K. Kriesel, Warren. Leeworthy, Vernon R. Wiley, Peter C. “Economic Contribution of Recreating Visitors to the Florida Keys/Key West.” *Linking the Economy and Environment of Florida Keys/Florida Bay*. Monroe County Tourist Development Council. Florida. ©November 1996.

Leeworthy, Vernon R. Wiley, Peter C. “A Socioeconomic Analysis of the Recreating Activities of Monroe County Residents in the Florida Keys/Key West.” *Linking the Economy and Environment of Florida Keys/Florida Bay*. Monroe County Tourist Development Council. Florida. ©August 1997.

Lalli, Carol M. Maita, Yoshiaki. Parsons, Timothy R. *A Manual of Chemical and Biological Methods for Seawater Analysis*. Pergamon International Library. New York, New York. ©1984.

Sullivan Sealey, Kathleen. “Assessment Methods and Protocols: 2004 Field Guide.” *Coastal Ecology of The Bahamas*. University of Miami Department of Biology. Coral Gables, Florida. ©2004.

Appendix 5. References on the ecological impacts of development.

Coastal Ecology of the Bahamas Website, University of Miami. http://henge.bio.miami.edu/coastalecology/

Diaz, P, JJ Lopez & ML Piriz. 2002. Symptoms of eutrophication in intertidal macroalgal assemblages of Nuevo Gulf (Patagonia, Argentina). Botanica Marina 45: 267-273.

Dubinsky, Z & N Stambler. 1996. Marine pollution and coral reefs. Global Change Biology 2: 511-526.

Grigg, RW. 1994. Effects of sewage discharge, fishing pressure, and habitat complexity on coral ecosystems and reef fishes in Hawaii. Marine Ecology Progress Series 103: 25-34.

Guidetti, P, G Fanelli, S Fraschetti, A Terlizzi & F Boero. 2002. Coastal fish indicate human-induced changes in the Mediterranean littoral. Marine Environmental Research 53: 77-94.

Herrnkind, W, MJ Butler IV & RA Tankersley. 1988. The effects of siltation on recruitment of spiny lobsters, *Panulirus argus*. Fishery Bulletin 86: 331-338.

Hourigan, T, TC Tricas & ES Reese. 1988. Coral reef fishes as indicators of environmental stress in coral reefs. In D. Soule & GS Kleppel (eds.) *Marine organisms as indicators.* Springer-Verlag, New York. 342pp.

Jackson, JBC, MX Kirby, WH Berger, KA Bjorndal, LW Botsford, BJ Bourque, RH Bradbury, R Cooke, J Erlandson, JA Estes, TP Hughes, S Kidwell, CB Lange, HS Lenihan, JM Pandolfi, CH Peterson, RS Steneck, MJ Tegner, & RR Warner. 2001. Historical Overfishing and the recent collapse of coastal ecosystems. Science 293: 629-638.

Lapointe, B. 1997. Nutrient thresholds for bottom-up control of macroalgal blooms on coral reefs in Jamaica and southeast Florida. Limnology and Oceanography 42: 1119-1131.

Lapointe, B, DA Tomasko & WR Matzie. 1994. Eutrophication and trophic state classification of seagrass communities in the Florida Keys. Bulletin of Marine Science 54: 696-717.

LaPointe, B, PJ Barile & WR Matzie. 2004. Anthropogenic nutrient enrichment of seagrass and coral reef communities in the Lower Florida Keys: discrimination of local versus regional nitrogen sources. Journal of Experimental Marine Biology and Ecology 308: 23-58.

Lin, H & J Hung 2004. Factors affecting macroalgal distribution in a eutrophic tropical lagoon in Taiwan. Marine Biology 144: 653-664.

Sealey, K, B Brunnick, S Harzen, C Luton, V Nero & L Flowers. 2002. An Ecoregional Plan for the Bahamian Archipelago. The Nature Conservancy, Taras Oceanographic Foundation, Jupiter, FL.

Sealey, K. 2004. Large-scale ecological impacts of development on tropical island systems: comparison of developed and undeveloped islands in the central Bahamas. MEPS. &5(2)

295-320.

Sealey, K, AL Flowers, VL Nero, KL Semon & J Wilson. 2004. Characterization and Ranking of Coastal Environments of the Bahamian Archipelago: a database for protection and policy. Bahamas Journal of Science 11(2), 12-25.

Sealey, NE. 1985. *Bahamian landscapes; an introduction to the physical geography of the Bahamas*. Collins Caribbean, London.

Smith, G, FT Short & DI Kaplan. 1990. Distributions and biomass of seagrasses in San Salvador, Bahamas. In R Smith (ed.) *Proceedings of the Third Symposium on the Botany of the Bahamas*.

Smith, J, CM Smith & CL Hunter. 2001. An experimental analysis of the effects of herbivory and nutrient enrichment on benthic community dynamics on a Hawaiian reef. Coral Reefs 19: 332-342.

Stephens, A, JE Hose & MS Love. 1988. Fish assemblages as indicators of environmental change in nearshore environments. In D. Soule & GS Kleppel (eds.) *Marine organisms as indicators.* Springer-Verlag, New York. 342pp.

Umar, M, LF McCook & IR Price. 1998. Effects of sediment deposition on the seaweed *Sargassum* on a fringing coral reef. Coral Reefs 17: 169-177.

Wenner, A. 1988. Crustaceans and other invertebrates as indicators of beach pollution. In D. Soule & GS Kleppel (eds.) *Marine organisms as indicators.* Springer-Verlag, New York. 342pp.

Appendix 6. Plants found on Bakers Bay Club property listed by nativity, conservation status and landscape potential.

I

Nativity	FullName (Corrells)	CommonName	Abundance	Rare	CPPLB	CITES	LandscapePotential
Native	Acacia choriophylla	Cinnecord	R	NO	NO		Residences, Parks, Medians, Buffers
Native	Acrostichum aureum	Giant Fern	R	NO	NO		A large accent fern in wet areas along the coast. It is especially useful along the edges of brackish or saltwater ponds and marshes.
Native	Acrostichum danaeifolium	Giant leather fern	R	NO	NO		
Exotic	Agave sisalana	Sisal	R	NO	NO		
Unknown	Agave sp.		R	NO	NO		
Native	Alternanthera maritima	Beach Alternanthera	R	NO	NO		Best used as a componant of beach dune or coastal strand habitat planting.
Native	Ambrosia hispida	Sweet Bay	U	NO	NO		Groundcover in open, coastal uplands; herb in beach dunes
Native	Amyris elemifera	Torchwood	U	NO	NO		Small specimen tree; buffer plantings; edges of coastal hammocks
Native	Andropogon glomeratus var. pumilus	Bushy Beard Grass	R	NO	NO		
Native	Andropogon longiberbis	Broom sedge	R	NO	NO		-
Native	Ardisia escallonioides	Marlberry	R	YES	NO		Specimen shrub; buffer plantings; edge or understory shrub in hammocks
Native	Mallotonia gnaphalodes	Bay Lavender	U	NO	NO		Specimen shrub; shrub in beach dunes
Native	Aristolochia pentandra	Pitcher plant	R	NO	NO		
Native	Avicennia germinans	Black Mangrove	U	NO	NO		In coastal areas where protected from wind and boat wake; tidal swamps
Native	Baccharis angustifolia	NO Willow	R	NO	NO		Accent shrub in moist areas; tidal marshes

Native	Baccharis dioica	Broom brush, Vahl's Baccharis	U	NO	NO	
Native	Baccharis halimifolia	Groundsel	R	NO	NO	(Accent shrub; forest edges)
Native	Batis maritima	Saltwort	R	NO	NO	Coastal marshes and swamps
Native	Bidens alba	White Beggars Tick	R	NO	NO	-
Native	Caraxeron vermicularis	Samphire, Saltweed	R	NO	NO	
Native	Borrichia arborescens	Sea Ox-eye	U	NO	NO	Accent coastal wildflower; bedding plant; coastal wetlands
Cultivated Exotic	Bouganvillea glabra	Bouganvillea	R	NO	NO	
Native	Bourreria ovata	Strong-back	C	NO	NO	Specimen shrub; rockland hammocks and hammock edges
Native	Bumelia americana	Wild Saffron, Milk-Berry	C	NO	NO	
Native	Bursera simaruba	Gum-elemi,Gumbo Limbo, West Indian Birch	C	NO	NO	Shade tree; canopy tree in hammocks
Native	Byrsonima lucida	Locust Berry	R	NO	NO	Accent flowering shrub; buffer plantings; rockland hammock edges
Native	Caesalpinia bonduc	Gray Nickers	R	NO	NO	(Thorny barriers; coastal strand and edges of maritime hammocks)
Native	Cakile lanceolata	Southern Sea Rocket, Pork Bush	C	NO	NO	
Native	Calyptranthes pallens	Spice-wood	R	NO	NO	Specimen tree or shrub; buffer plantings; informal hedges; rockland hammocks
Native	Calyptranthes zuzygium	Myrtle-of-the-river	R	YES	NO	Specimen shrub; buffer plantings; rockland hammocks
Native	Canavalia rosea	Bay-bean, Horse-bean	U	NO	NO	Vine on trellis; coastal beaches and coastal strand
Exotic	Carica papaya	Papaya	R	NO	NO	
Native	Casearia nitida	Smooth Casearia	R	NO	NO	
Native	Cassytha filiformis	Love Vine	R	NO	NO	-
Exotic	Casuarina equisetifolia	Australian Pine	C	NO	NO	

Exotic	Catheranthus rosea	Madagascar Periwinkle	R	NO	NO		
Native	Cattleyopsis lindenii	Linden's Cattleyopsis Orchid	R	YES	NO	II	
Native	Cenchrus echinatus	Southern burgrass	U	NO	NO		
Native	Cenchrus incertus	Sand spur	R	NO	NO		-
Native	Centrosema virginianum	Butterfly-pea, Lady's Slipper	R	NO	NO		Vine on trellis; wildflower gardens; understory wildflower in pinelands and coastal uplands
Native	Cephalocereus bahamensis	Bahama Dildo	R	YES	NO	II	
Native	Cestrum bahamense	Cestrum	U	NO	NO		
Native	Euphorbia blodgettii	Spurge	R	NO	NO		
Native	Euphorbia hypericifolia	Eyebane	R	NO	NO		-
Native	Euphorbia mesembryanthemifolia	Coast Spurge	U	NO	NO		
Native	Cassia nictitans	Hairy sensitive-pea	R	NO	NO		-
Native	Chiococca alba	Snowberry	C	NO	NO		Buffer plantings; hammock edges
Native	Eupatorium odoratum	Bitter bush, Tonka bean	R	NO	NO		
Native	Chrysobalanus icaco	Cocoplum	R	NO	NO		Specimen shrub; trimmed hedge; buffer plantings; wet forests
Native	Citharexylum fruticosum	Long Tom, Spicate Fiddlewood	R	NO	NO		Buffer plantings; hammock edges
Native	Cladium jamaicense	Sawgrass	R	NO	NO		
Native	Coccothrinax argentata	Silver Thatch, Silver-top, Bay-Top	C	NO	NO		Small accent palm; narrow road medians; understory shrub in pine rocklands and coastal hammocks
Native	Coccoloba diversifolia	Pigeon Plum	C	NO	NO		Specimen tree; buffer plantings; canopy tree in hammocks
Native	Coccoloba swartzii	Tie-tongue	R	NO	NO		
Native	Coccoloba tenuifolia	Bahama Pigeon-plum	R	NO	NO		

Native	Coccoloba uvifera	Sea Grape	U	NO	NO	Large shade tree; buffer plantings; canopy tree in coastal hammocks
Exotic	Cocos nucifera	Coconut	U	NO	NO	
Native	Conocarpus erectus	Buttonwood	U	NO	NO	Specimen tree; trimmed hedge (silver buttonwood); canopy tree in coastal hammocks along edges of mangrove forests
Native	Conyza canadensis	Smooth Horseweed	R	NO	NO	-
Native	Corchorus hirsutus	Wooly corchorus, Jack switch	R	NO	NO	
Native	Cordia bahamensis	Cocobey	U	NO	NO	
Native	Cordia sebestena	Geiger Tree, Anaconda, Spanish Cordia	U	NO	NO	
Native	Crossopetalum rhacoma	Poison Cherry	R	NO	NO	Accent shrub; edges of pine rocklands and rockland hammock
Native	Cynanchum eggersii	Eggers' milkvine	R	NO	NO	
Native	Cynanchum northropiae	Northrop's milkvine	R	NO	NO	
Exotic	Cynodon dactylon	Bermuda Grass, Bahama Grass	R	NO	NO	
Native	Cyperus planifolius	Sand Cyperus, Coast Cyperus	C	NO	NO	Coarse sedge in open coastal uplands
Exotic	Dactyloctenium aegyptium	Crowfoot Grass, Egyptian Grass	U	NO	NO	
Native	Desmodium canum	Common Tick-trefoil, Wild Granite	R	NO	NO	-
Native	Dicliptera sexangularis	NO-mint	R	NO	NO	Wildflower beds; hammock edges
Native	Distichlis spicata	Seashore Salt-grass	R	NO	NO	Wet hypersaline areas; tidal marshes
Native	Drypetes diversifolia	Whitewood	C	NO	NO	Specimen tree; rockland hammocks

Native	Echites umbellata	Devil's Potato-root, Wild Potato, Rubber Vine, Danish	C	NO	NO		Vine on trellises and fences; hammock edges; understory wildflower in pine rocklands and coastal strand
Native	Cassine xylocarpa	Olive Wood	U	NO	NO		
Native	Encyclia boothiana	Dollar Orchid	R	YES	NO	II	Epiphyte on hardwood trees
Native	Encyclia rufa	Bahama Encyclia orchid	U	YES	NO	II	
Native	Eragrostis ciliaris	Lovegrass	R	NO	NO		
Native	Eragrostis elliottii	Elliott's lovegrass	R	NO	NO		
Native	Eragrostis excelsa	Tall Lovegrass	C	YES	NO		
Native	Erithalis fruticosa	Black Torch	C	NO	NO		Buffer plantings; hammock edges
Native	Ernodea littoralis	Common Ernodea	C	NO	NO		Groundcover in dry, open areas; rock gardens; pine rocklands and coastal strand
Native	Erythroxylum rotundifolium	Rat-wood	R	NO	NO		
Native	Eugenia axillaris	White Stopper, Wattle	C	NO	NO		Buffer plantings; mid-story in hammocks
Native	Eugenia confusa	Ironwood	R	NO	NO		
Native	Eugenia foetida	Spanish Stopper, Black Wattle	C	NO	NO		Accent shrub or small tree; buffer plantings; coastal hammocks and hammock edges
Native	Eugenia rhombea	Red stopper	R	NO	NO		
Native	Eupatorium capillifolium	Dog Fennel	R	NO	NO		-
Native	Eupatorium havanense	Havana Thoroughwort, Cat Tongue	U	YES	NO		
Native	Eupatorium lucayanum	Lucayan Thoroughwort	U	YES	NO		
Native	Euphorbia cayensis	Bahama Spurge	R	YES	NO		
Native	Euphorbia trichotoma	Sanddune spurge	R	YES	NO		
Native	Eustachys petraea	Finger-grass, West Indian Grass	U	NO	NO		Seasides, Adaptable, Dry open areas

Native	Exothea paniculata	Butter Bough	R	NO	NO	Accent tree; mid-story in hammocks
Native	Ficus aurea	Golden Wild Fig	R	NO	NO	Specimen tree; hammocks
Native	Ficus citrifolia	Short-leaved Wild Fig	U	NO	NO	Specimen tree; hammocks
Native	Forestiera segregata	Ink Bush, Florida Privet, Blueberry	C	NO	NO	Accent shrub or tree; buffer plantings; hammocks and hammock edges
Native	Galactia rudolphioides	Red milk pea	R	NO	NO	
Native	Casasia clusiifolia	Seven Year Apple	C	NO	NO	Specimen shrub or small tree; buffer plantings; coastal hammocks and coastal strand
Native	Guapira discolor	Beefwood, Pigeon-berry, Narrow-leaved Blolly	C	YES	YES	Accent tree or shrub; buffer plantings; hammocks and hammock edges
Native	Guapira obtusata	Broad-leaved Blolly	R	NO	NO	
Native	Guettarda krugii	Frogwood	U	NO	NO	
Native	Gyminda latifolia	NO Boxwood, Walla-berry	U	NO	NO	Specimen tree or shrub; hammocks
Native	Ateramnus lucidus	Crabwood	C	NO	NO	Accent tree; buffer plantings; rockland hammocks
Native	Heliotropium curassavicum	Seaside Heliotrope, Pondweed	R	NO	NO	Disturbed wet coastal sites; tidal marshes
Cultivated Exotic	Hibiscus rosa-sinensis var. rosa-sinensis	Hibiscus	R	NO	NO	
Native	Hippomane mancinella	Manchineel	R	NO	NO	Accent tree; hammocks
Native	Hydrocotyle sp.	Marsh pennywort	R	NO	NO	
Native	Hymenocallis arenicola	Spider Lilly	U	NO	NO	
Native	Ipomoea alba	Moon-vine	R	NO	NO	Fence covering; buffer plantings; hammock edges
Native	Ipomoea indica	Morning Glory	R	NO	NO	Fence covering; buffer plantings; hammock edges
Native	Ipomoea micradactyla	Wild Potato	R	NO	NO	Rock gardens; understory wildflower in pine rocklands

Native	Ipomoea pes-caprae	Bay Hops, Bay Winders	R	NO	NO	Groundcover in open, coastal uplands; wildflower in beach dunes and coastal strand
Exotic	Ipomoea triloba	Three-lobed morningglory	R	NO	NO	
Native	Ipomoea violacea	Moon vine	R	NO	NO	
Native	Iresine canescens	New-burn Weed	U	YES	NO	Hammocks and edges
Native	Iva imbricata	Beach Iva	R	NO	NO	Groundcover in open, coastal uplands; shrub in beach dunes and coastal strand
Native	Jacquemontia cayensis	Clustervine	U	NO	NO	
Native	Jacquinia keyensis	Joe-wood, Joe-bush, Ironwood	U	NO	NO	Specimen shrub
Native	Eupatorium villosum	Jackmada, Bitter sage	R	NO	NO	
Native	Krugiodendron ferreum	Strong Back	R	NO	NO	Specimen tree; hammocks
Native	Laguncularia racemosa	White Mangrove, Bastard Buttonwood, Green Turtle Bough	U	NO	NO	In coastal areas where protected from wind and boat wake; tidal swamps
Native	Lantana bahamensis	Bahama sage	R	NO	NO	
Native	Lantana involucrata	Wild Sage, Big Sage	C	NO	NO	Accent shrub; buffer plantings; hammock edges
Native	Lasiacis divaricata	Wild Cane, Cane-grass, Tibisee	U	NO	NO	Accent grass; hammocks and hammock edges
Native	Leiphaimos parasitica	Ghost plant	R	NO	NO	-
Exotic	Leucaena leucocephala	Jumbie Bean, Jimbay, Cowbush, Jump-and-go	R	NO	NO	
Native	Malpighia polytricha ssp. confusa	Touch-me-not, Wild-cherry	U	NO	NO	
Native	Malvaviscus arboreus var. cubensis	Sagra's Malvaviscus	C	YES	NO	
Native	Manilkara bahamensis	Wild Dilly	C	NO	NO	Specimen tree or shrub; buffer plantings; coastal hammocks and hammock edges
Exotic	Manilkara zapota	Sapodilla	R	NO	NO	
Native	Maytenus phyllanthoides	Mayten	R	YES	NO	Specimen shrub; edges of tidal swamps and marshes

Native	Melanthera aspera	Snow squarestem	C	NO	NO		Accent wildflower; wildflower in open, coastal uplands
Native	Metopium toxiferum	Poison Wood, Poison Tree	C	NO	NO		Canopy tree in rockland and coastal hammocks; shrub along pine rockland edges
Native	Morinda royoc	Wild Mulberry, Rhubarb	R	YES	NO		Rock gardens; viney understory shrub in pine rocklands, hammocks and coastal uplands
Exotic	Nephrolepis multiflora	Asian sword fern	R	NO	NO		
Cultivated Exotic	Nerium oleander	Common Oleander	R	NO	NO		
Native	Neurodium lanceolatum	Narrow-leaved-brake	R	YES	NO		
Native	Nectandra coriacea	Bastard Torch, Black Torch, Sweet Torchwood	R	NO	NO		Specimen tree; buffer plantings; rockland and coastal hammocks
Exotic	Oeceoclades maculata	African ground orchid	R	NO	NO	II	
Native	Oncidium floridanum	Florida dancinglady orchid	R	YES	NO	II	
Native	Oncidium sasseri	Sasser's dancing lady orchid	R	YES	NO	II	
Native	Opuntia stricta	Prickly Pear	R	YES	NO	II	Specimen shrub; understory shrub in pinelands and coastal uplands
Native	Panicum amarulum	Sea-beach grass	U	YES	NO		Accent grass; large grass in open, coastal uplands
Exotic	Panicum maximum	Guinea Grass	R	NO	NO		
Native	Paspalum caespitosum	Slender Paspalum	C	NO	NO		Informal groundcover; rock gardens;understory of hammocks and pinelands
Native	Paspalum paniculatum		R	NO	NO		
Native	Paspalum setaceum	Thin paspalum	R	NO	NO		
Native	Passiflora cupraea	Devil's Pumpkin, Wild Watermelon, Smooth Passion-flower	C	NO	NO		

Native	Passiflora suberosa	Juniper-berry, Small Passion flower	C	NO	NO		Informal groundcover; understory herb in pinelands, hammocks, and coastal uplands
Native	Urechites lutea	Wild Unction, Catesby's Vine	C	NO	NO		Fence and trellis covering. In restorations, in rockland and coastal hammock edges.
Native	Picramnia pentandra	Bitter Bush, Snake-root	R	NO	NO		Screening, Yard tree/shrub, Butterfly garden shrub
Native	Piscidia piscipula	Fish Poison, Jamaica Dogwood	R	NO	NO		Accent tree; coastal forests
Native	Pithecellobium keyense	Black bead, Ram's-horn	C	NO	NO		Specimen shrub or small tree; coastal hammocks
Native	Pluchea symphytifolia	Bushy Fleabane, South-bush, Cough-bush, Wild Tobacco	R	NO	NO		-
Native	Euphorbia cyathophora	Paintedleaf	R	NO	NO		-
Cultivated Exotic	Polyscias guilfoylei	Geranium aralia, Wild coffee	R	NO	NO		
Native	Psychotria ligustrifolia	Smmoth Wild Coffee	C	NO	NO		Informal hedges; buffer plantings; understory of rockland hammocks
Native	Pteridium aquilinum var. caudatum	Southern bracken	R	NO	NO		
Native	Randia aculeata	Box Briar	C	NO	NO		Accent shrub; buffer plantings; understory and mid-story of hammocks; hammock edges
Native	Myrsine floridana	Myrsine	R	NO	NO		Accent shrub; buffer plantings; hammock edges
Native	Reynosia septentrionalis	Darling Plum	U	NO	NO		Specimen shrub or small tree; rockland hammock edges
Native	Rhabdadenia biflora	Mangrove swamp vine	R	NO	NO		
Native	Rhachicallis americana	Hog-bush, Sandfly-bush, Saltwater-bush, Sea-weed, Wild Thyme	R	NO	NO		

Native	Rhizophora mangle	Red Mangrove	U	NO	NO	In coastal areas where protected from wind and boat wake; tidal swamps
Native	Rhynchosia minima	Least snoutbean	R	NO	NO	-
Native	Rivina humilis	Wild Tomato, Pigeon-berry	U	NO	NO	Groundcover in forests
Native	Ruppia maritima	Widgeon-grass	R	NO	NO	
Native	Salicornia virginica	Woody Glasswort, Wild Coral, Guinea-bead	R	NO	NO	
Native	Salmea petrobioides	Shanks, Bush Salmea	U	NO	NO	
Native	Savia bahamensis	Maiden Bush	R	NO	NO	Accent shrub; buffer plantings; rockland hammocks and rockland hammock edges
Native	Scaevola plumieri	Inkberry, Black Soap, Mad Moll	R	NO	NO	Accent shrub; beach dunes and coastal strand
Exotic	Scaevola taccada	Hawaiian-seagrape	U	NO	NO	
Exotic	Schefflera actinophora	Queensland umbrella tree	R	NO	NO	
Native	Serjania subdentata		R	NO	NO	-
Native	Sesuvium portulacastrum	Sea pickle, seapurslane	C	NO	NO	Groundcover in open, coastal areas; beach dunes and coastal marshes
Native	Sida acuta	Wire-weed	R	NO	NO	-
Native	Bumelia celastrina	Narrow-leaved Bumelia	R	NO	NO	Spiny barrier; coastal berms; edges of mangrove swamps
Native	Mastichodendron foetidissimum	Mastic Ironwood, Mastic-bully	U	NO	NO	Specimen or shade tree. Highly recommended for rockland and coastal hammock restorations throughout much of South Florida.
Native	Sideroxylon salicifolium	Wild Cassada, Cassada-wood	R	NO	NO	Accent tree; buffer plantings; canopy in hammocks
Native	Simarouba glauca	Paradise tree	R	YES	NO	
Native	Smilax auriculata	Auricled Green Briar, China-brier	C	NO	NO	-

Native	Smilax havanensis	Prickly Green-brier, Saw brier, Chaney-vine	U	NO	NO		-
Native	Solanum americanum	Ink berry, Gooma bush	R	NO	NO		
Native	Solanum bahamense	Canker-berry	C	NO	NO		Specimen shrub; coastal hammocks
Native	Solanum erianthum	Salve-bush, Wild Tobacco	R	NO	NO		Buffer plantings; hammock edges
Native	Sophora tomentosa	Coast Sophora	R	NO	NO		Specimen shrub; buffer plantings; coastal hammock edges; coastal strand
Native	Spartina patens	Saltmeadow Cordgrass	U	NO	NO		Groundcover in coastal areas; coastal marshes and beach dunes
Native	Spartina spartinae	Gulf Cordgrass	R	NO	NO		Coarse groundcover in brackish coastal areas; coastal marshes
Exotic	Borreria verticillata	Shrubby NO buttonweed	R	NO	NO		
Native	Sporobolus domingensis	Dominican dropseed grass	R	NO	NO		-
Native	Sporobolus virginicus	Seashore Rush-grass	U	NO	NO		Groundcover in coastal areas; coastal marshes and beach dunes
Exotic	Stenotaphrum secundatum	St. Augustine Grass, Running Crabgrass	R	NO	NO		
Native	Suaeda linearis	Tall Sea-blite	R	NO	NO		-
Native	Suriana maritima	Bay Cedar, Tassel Plant	U	NO	NO		Specimen shrub; coastal strand and thickets
Native	Swietenia mahagoni	Madeira, Mahogany	R	YES	YES	II	Specimen tree; canopy tree in rockland hammocks
Native	Tabebuia bahamensis	Five finger	R	NO	NO		
Native	Tabebuia bahamensis	Beef-bush, Fumwood, Above-all, White Cedar	U	NO	NO		
Exotic	Terminalia catappa	Indian Almond, Almond-tree	R	NO	NO		
Exotic	Thespesia populnea	Seaside Mahoe, Cork-	R	NO	NO		

		tree, Spanish Cork				
Native	Thrinax morrissii	Small-fruited Thatch-palm, Buffalo-top	C	NO	NO	Specimen tree; buffer plantings; hammock edges; shrub in pine rocklands
Native	Tillandsia balbisiana	Cuttlefish	R	NO	NO	
Native	Tillandsia circinnata	Silvery wild-pine	R	NO	NO	
Native	Tillandsia utriculata	Swollen Wild Pine	U	NO	NO	Accent epiphyte; on live oaks along forest edges
Native	Tournefortia volubilis	Soldier-bush	R	NO	NO	-
Native	Trema lamarckianum	Pain-in-back	R	NO	NO	
Native	Triopteris jamaicensis		R	NO	NO	
Native	Turnera ulmifolia	Yellow elder, Ram-goat-dash-along	R	NO	NO	
Native	Uniola paniculata	Sea Oats	U	NO	NO	Accent grass in coastal uplands; dominant grass in beach dunes and also in coastal strand
Native	Vitis munsoniana	Wild grape	R	YES	NO	
Native	Waltheria indica	Sleepy Morning	R	NO	NO	-
Native	Zanthoxylum coriaceum	Hercules' Club, Doctor's Club	U	NO	NO	Residences, Parks, Specimen plant
Native	Zanthoxylum flavum	Yellow-wood, Satin wood	R	NO	NO	
Native	Ziziphus taylori	Ziziphus	R	YES	NO	

Appendix 7. Critical Conservation Plants of Baker's Bay Club

"Critical Conservation Status" Plants of Baker's Bay Club

One environmental goal of the Baker's Bay Club is to maintain AT LEAST 80% of the 213 plant species currently on the property in healthy populations post-construction. To achieve this goal, some plants need special consideration during construction. This document outlines priority plant species to be conserved or relocated. This list represents a diverse group of trees, grasses, shrubs and flowers of which the Bahamian Government and the international community have recognized as warranting protection. Some of the rare tropical plants listed here have been formally recognized by Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). Many species on the property have been listed in Appendix II, which includes species which are not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.

For construction, the plants have been ranked in order of removal and transplantation priority.

RANK 1 = Every specimen is important. These species must be left in place or removed with extreme care and transplanted to the nursery.

RANK 2 = Save as many specimens as possible, but not as vulnerable as the first set. Loss on individuals must be recorded in an incident report.

RANK 3 = Important conservation species for propagation and landscaping, Save or salvage as many as possible.

RANK 1 – PRESERVE OR RELOCATE ALL SPECIMENS

Marlberry

Ardisia escallonioides

This known from the Bahamas only on the northern islands. It also occurs in Florida, the Greater Antilles, and Central America. At Baker's Bay is grows in coppices. It is a large evergreen shrub and usually grows to about 12 feet in height.

Photo Courtesy of IRC

Photo Courtesy of IRC

RANK 2 – PROTECT AS MANY AS POSSIBLE – RECORD AREAS WHERE SPECIMENS ARE LOST

Photo Courtesy of IRC

Bushy Seaside Oxeye

Borrichia frutescens

This small shrub is known to grow in the Bahamas only in Grand Bahama and the Abacos. It occurs in sunny to partially shaded habitats with periodically flooded brackish or saline soils. It usually grows to about 1 meter tall (3 feet) and leaves may appear gray because of their fine silvery hairs.

RANK 1 – PRESERVE OR RELOCATE ALL SPECIMENS

Myrtle-of-the-River

Calyptranthes zuzygium

This small tree is known to grow in the Bahamas only on the northern Islands. It occurs in coppices and can reach a mature height of 20 feet.

Photo Courtesy of IRC

RANK 1 – PRESERVE OR RELOCATE ALL SPECIMENS

Photo Courtesy of IRC

Cattleyopsis Orchid

Cattleyopsis lindenii

This is an epiphytic orchid that is listed by CITES in Appendix II. The species is widespread in the Bahamas and also occurs in Cuba. It grows on a variety of trees in shade and partial shade.

Key Tree Cactus

Cephalocereus bahamensis

This large cactus listed by CITES in Appendix II. It is known to grow in the Bahamas only from Cat Island, Andros Island, and northwards. It grows in coppices on sand or rock. At Baker's Bay it is found in the coastal coppice just east of Jones's Bay. It can reach a mature height of 10 meters (30 feet).

RANK 1 – PRESERVE OR RELOCATE ALL SPECIMENS

RANK 1 – PRESERVE OR RELOCATE ALL SPECIMENS

Dollar Orchid

Encyclia boothiana

This is an epiphytic orchid that is listed by CITES in Appendix II. It is known to grow in the Bahamas only in the northern islands.

RANK 1 – PRESERVE OR RELOCATE ALL SPECIMENS

Rufous Butterfly Orchid
Encyclia rufa

This is an epiphytic or terrestrial orchid that is listed by CITES in Appendix II. The species is widespread in the Bahamas and may also occur in Cuba. It grows on a variety of trees in shade and partial shade.


Photo Courtesy of IRC

RANK 2 – PROTECT AS MANY AS POSSIBLE – RECORD AREAS WHERE SPECIMENS ARE LOST

Lovegrass
Eragrostis excelsa

This grass is known to grow in the Bahamas only in the northern islands. It is also found in Cuba. At Baker's Bay it is found in a variety of open sunny habitats including dunes and disturbed areas.

RANK 2 – PROTECT AS MANY AS POSSIBLE – RECORD AREAS WHERE SPECIMENS ARE LOST

Havana Snakeroot

Eupatorium havanense

This small shrub is known to grow in the Bahamas only on the northern islands. It also occurs in Cuba, Texas, and Mexico. At Baker’s Bay it is found in coppices and slightly disturbed uplands.

Photo Courtesy of IRC

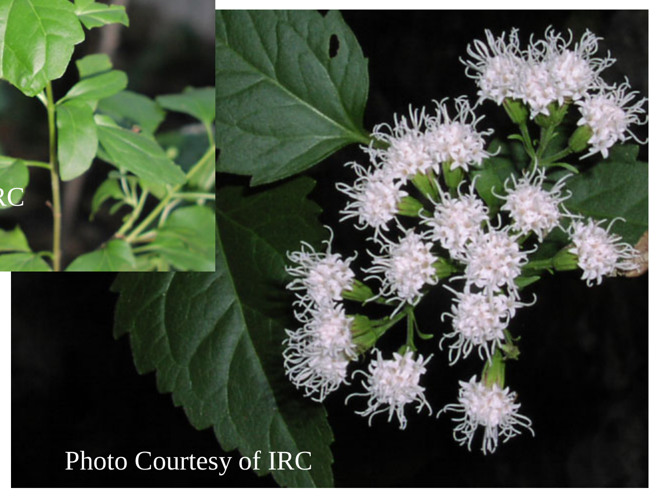


Photo Courtesy of IRC

RANK 2 – PROTECT AS MANY AS POSSIBLE – RECORD AREAS WHERE SPECIMENS ARE LOST

USDA NCRS

Lucayan Thoroughwart

Eupatorium lucayanum

This small shrub is endemic to the Bahamas and occurs throughout the archipelago. At Baker’s Bay it is found in coppices and slightly disturbed uplands.

RANK 2 – PROTECT AS MANY AS POSSIBLE – RECORD AREAS WHERE PECIMENS ARE LOST

Bahama Spurge

Euphorbia hayensis

This herb is endemic to the Bahamas where it occurs in San Salvador, the northern islands, and Cay Sal or the Angular Cays . At Baker's Bay it is found in open sand in full sun on dunes or slightly disturbed areas.

Photo Courtesy of IRC

RANK 2 – PROTECT AS MANY AS POSSIBLE – RECORD AREAS WHERE SPECIMENS ARE LOST

Offwell

Sanddune Spurge

Euphorbia trichotoma

This herb is known to grow in the Bahamas only on the northern islands. At Baker's Bay it grows on dunes.

Beeftree; Blolly

Guapira discolor

This tree is listed by the Bahamas. It occurs throughout the Bahamas, Florida, the Greater Antilles, and Grand Cayman. At Baker's Bay it is a common to abundant tree. A survey done by Bethell Environmental found that in coppices this species occurs at high densities in the coppices.

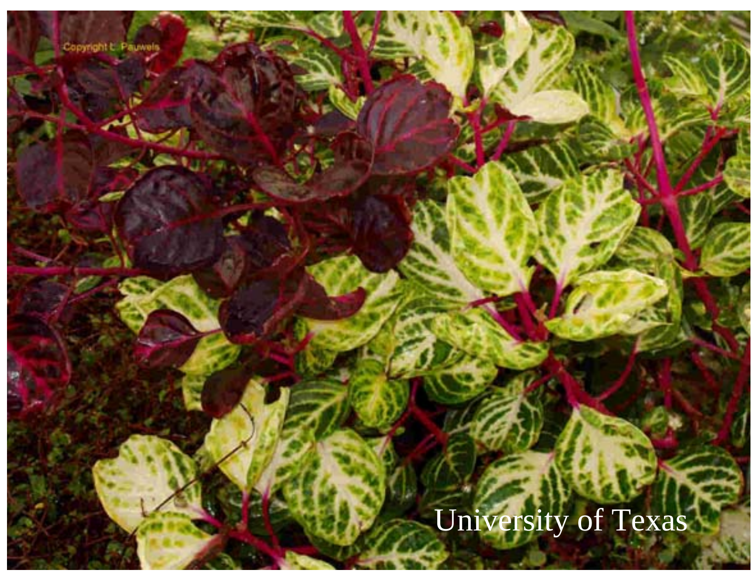
RANK 2 – PROTECT AS MANY AS POSSIBLE – RECORD AREAS WHERE SPECIMENS ARE LOST

RANK 1 – PRESERVE OR RELOCATE ALL SPECIMENS

Juba's Bush

Iresine canescens

This herb is known in the Bahamas only in the Abacos and Grand Bahama Island. It also occurs in the southeastern United States, the Caribbean, and continental tropical America. At Baker's Bay it occurs on the windward side of the island in coppices.



RANK 3 : SAVE AS POSSIBLE, IMPORTANT FOR LANDSCAPING

Wax Mallow; Turk's Cap

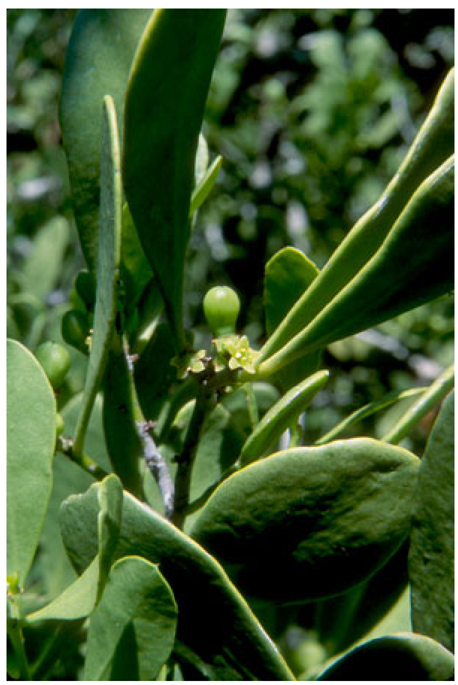
Malvaviscus arboreus var. cubensis

This shrub is known in the Bahamas only on the Abacos and Grand Bahama Island. It also occurs in Cuba. At Baker's Bay it is frequent in coppices and in the abandoned Disney area.

Florida Mayten

Maytenus phyllanthoides

This shrub is known in the Bahamas only in the Abacos and Grand Bahama Island. It is also known from Florida, Cuba, Texas, and Mexico. At Baker's Bay it occurs at the ecotone between mangrove wetlands and coppice in the northern part of the island.



RANK 2 – PROTECT AS MANY AS POSSIBLE – RECORD AREAS WHERE SPECIMENS ARE LOST

RANK 2 – PROTECT AS MANY AS POSSIBLE – RECORD AREAS WHERE SPECIMENS ARE LOST

Redgal

Morinda royoc

This scandent shrub is known to grow in the Bahamas only in the northern islands. It is also known to grow in Florida, the Caribbean, Central and northern South America. At Baker's Bay it grows in coppices.

RANK 1 – PRESERVE OR RELOCATE ALL SPECIMENS

Countryside Orchid

Oncidium sasseri

This epiphytic orchid is endemic to the northern Bahamas and is listed by CITES in Appendix II. **This is the most endangered plant species at Baker's Bay.** Only a few collections of this species have been found in the Bahamas, including two from Andros, five from Great Abaco

Erect Pricklypear; Shell-Mound Pricklypear

Opuntia stricta

This cactus is listed by CITES in Appendix II. It occurs throughout the Bahamas, and also occurs in Florida, Mexico, and the Caribbean. At Baker's Bay it grows on dunes in cells I8 and I9, and at the edge of coppice in cell 12 in slightly disturbed soil.

RANK 1 – PRESERVE OR RELOCATE ALL SPECIMENS

Bitter Panicgrass

Panicum amarulum

This grass is known to grow in the Bahamas only on the northern islands. It also occurs in the southeastern United States, Mexico, and the Caribbean. At Baker's Bay it is frequently found on beach dunes.

RANK 3 : SAVE AS POSSIBLE, IMPORTANT FOR LANDSCAPING

West Indian Mahogany

Swietenia mahagoni

This tree is listed as protected in the Bahamas and is listed by CITES in Appendix II. It occurs throughout the Bahamas and also in Florida, Central and South America, and the Caribbean. It is protected because of extensive logging for the valuable wood. At Baker's Bay

RANK 1 – PRESERVE OR RELOCATE ALL SPECIMENS

Photo courtesy of IRC

Taylor's Jujube

Ziziphus taylori

This small tree is endemic to the Bahamas. It occurs throughout the archipelago. At Baker's Bay it is frequent in coppices.

RANK 2 – PROTECT AS MANY AS POSSIBLE – RECORD AREAS WHERE SPECIMENS ARE LOST

Appendix 8. Epifauna (sea floor) diversity of near shore reefs of Great Guana Cay (*-unknown).

FAMILY	GENUS	SPECIES	FAMILY	GENUS	SPECIES
ANEMONES			***MOLLUSKS***		
Actiniidae	*Condylactis*	*gigantea*	Arcidae	*Arca*	*zebra*
Aiptasiidae	*Bartholomea*	*annulata*	Limidae	*Lima*	*scabra*
Aiptasiidae	*Aiptasia*	*tagetes*	Cardiidae	*Trachycardium*	*muricatum*
Zoanthidae	*Palythoa*	*caribaeorum*	Cardiidae	*Trachycardium*	*magnum*
Stichodactylidae	*Stichodactyla*	*helianthus*	Cardiidae	*Americardia*	*media*
Zoanthidae	*Zoanthus*	*sociatus*	Pinnidae	*Atrina*	*rigida*
Zoanthidae	*Zoanthus*	*pulchellus*	Cardiidae	*Laevicardium*	*laevigatum*
Aliciidae	*Lebrunia*	*coralligens*	Lucinidae	*Codakia*	*orbicularis*
Aliciidae	*Lebrunia*	*danae*	Veneridae	*Chione*	*cancellata*
Corallimorphidae	*Ricordea*	*florida*	Tellinidae	*Tellina*	*radiata*
			Aplysiidae	*Aplysia*	*dactylomela*
ANNELIDS			Olividae	*Oliva*	*reticularis*
Terebellidae	*	*	Calyptraeidae	*Crepidula*	*convexa*
Capitellidae	*	*	Littorinidae	*Littorina*	*sp.*
Amphinomidae	*Hermodice*	*carunculata*	Pinnidae	*Pinna*	*carnea*
*	*Notaulax*	*occidentalis*	Fasciolariidae	*Fasciolaria*	*tulipa*
*	*Notaulax*	*nudicollis*	Psammobiidae	*Asaphis*	*deflorata*
Sabellidae	*Bispira*	*brunnea*	Isognomonidae	*Isognomon*	*alatus*
Serpulidae	*Spirobranchus*	*giganteus*	Cerithiidae	*Cerithium*	*muscarum*
Serpulidae	*Spirorbis*	*spirorbis*	Cerithiidae	*Cerithium*	*litteratum*
*	*	** Ribbon Worm*	Neritidae	*Nerita*	*versicolor*
			Batillariidae	*Batillaria*	*minima*
CRUSTACEANS			Trochidae	*Tegula*	*lividomaculata*
Portunidae	*	*	Calliostomatidae	*Calliostoma*	*adelae*
Mithracidae	*Mithrax*	*	Ovulidae	*Cyphoma*	*gibbosum*
Xanthidae	*	*	Cassidae	*Cassis*	*tuberosa*
Diogenidae	*Petrochirus*	*diogenes*	Strombidae	*Strombus*	*gigas*
Portunidae	*Callinectes*	*sp.*	Strombidae	*Strombus*	*costatus*
Palinuridae	*Panuliris*	*argus*	Chitonidae	*Acanthopleura*	*granulata*
Stenopodidae	*Stenopus*	*hispidus*	Neritidae	*Neritina*	*virginea*
Gonodactylidae	*Gonodactylus*	*oerstedii*	Muricidae	*Chicoreus*	*brevifrons*
Diogenidae	*Paguristes*	*erythrops*	Muricidae	*Thais*	*deltoidea*
Diogenidae	*Paguristes*	*punticepts*	Acmaeidae	*Acmaea*	*sp.*
Diogenidae	*Paguristes*	*sp.*	Littorinidae	*Littorina*	*angulifera*
Diogenidae	*Calicinus*	*tibicen*	Architectonicidae	*Architectonica*	*nobilis*
Alpehidae	*Alpheus*	*armatus*	Turbinidae	*Turbo*	*castanea*
Diogenidae	*	** hermit*	Semelidae	*Semele*	*proficua*
Corystidae	*Corystes*	*cassivelaunus*	*	*	** scallop*
*	*	** Mantis Shrimp*	Cassidae	*Phalium*	*granulatum*
Hippidae	*Emerita*	*talpoida*	Tellinidae	*Tellina*	*listeri*
Mithracidae	*Mithrax*	*spinosissimus*	Littorinidae	*Tectarius*	*muricatus*
Alpehidae	*Synalpheus*	*sp.*	Ischnochitonidae	*Stenoplax*	*limaciformis*
Palaemonidae	*Brachycarpus*	*biunguiculatus*	Trochidae	*Cittarium*	*pica*
Lysiosquillidae	*Lysiosquilla*	*scabricauda*	Octopodidae	*	** octopus*
*	*	** crab*	Littorinidae	*Littorina*	*ziczac*
Diogenidae	*Dardanus*	*venosus*	Ostreidae	*Crassostrea*	*rhizophorae*

Diogenidae	*Pagurus*	*sp.*	Chitonidae	*Chiton*	*tuburculatus*
Inachidae	*Stenorhynchus*	*seticornis*		*Barbatia*	*cancellaria*
Pycnogonidawe	*Pycnogonium*	*sp*	Cerithiidae	*Cerithium*	*eburneum*
				Tridachia	*crispata*
ECHINODERMS				*Scyllaea*	*pelagica*
Clypeasteridae	*Clypeaser*	*roseaceus*	Turbinidae	*Astraea*	*phoebia*
Holothuriidae	*Holothuria*	*mexicana*			
Toxopneustidae	*Lytechinus*	*variegatus*	***SOFT CORALS***		
Oreasteridae	*Oreaster*	*reticulatus*	Briareidae	*Briareum*	*asbestinum*
Toxopneustidae	*Tripneustes*	*ventricosus*	Gorgoniidae	*Pterogorgia*	*anceps*
Diadematidae	*Diadema*	*antillarum*	Gorgoniidae	*Pseudopterogorgia*	*sp.*
Ophiocomidae	*Ophiocoma*	*echinata*	Gorgoniidae	*Pseudopterogorgia*	*americana*
Ophidermatidae	*Ophioderma*	*appressum*	Gorgoniidae	*Gorgonia*	*sp.*
Ophiocomidae	*Ophiocoma*	*paucigranulata*	Gorgoniidae	*Gorgonia*	*sp.2*
Ophiodiasteridae	*Ophidiaster*	*sp. (comet star)*	Gorgoniidae	*Gorgonia*	*sp.3*
Echinasteridae	*Echinaster*	*sentus*	Plexauridae	*Plexaurella*	*fusifera*
Astropectinidae	*Astropecten*	*articulatus*	Anthothelidae	*Erthryopodium*	*caribaeorum*
Echinometridae	*Echinometra*	*lucunter*	Plexauridae	*Eunicea*	*sp.*
Echinmetridae	*Echinometra*	*viridis*	Plexauridae	*Eunicea*	*calyculata*
Holothuriidae	*Holothuria*	*glabberrima*	Plexauridae	*Eunicea*	*succinea*
Ophiodiasteridae	*Linckia*	*guildingii*	Plexauridae	*Eunicea*	*mammosa*
Holothuriidae	*Actinopyga*	*agassizi*	Plexauridae	*Muricea*	*elongata*
Brissidae	*Meoma*	*ventricosa*	Plexauridae	*Plexaura*	*flexuosa*
Cidaridae	*Eucidaris*	*tribuloides*	Plexauridae	*Plexuara*	*sp.*
Mellitidae	*Mellita*	*sexiesperforata*	Plexauridae	*Plexaura*	*homomalla*
Holothuriidae	*Holothuria*	*sp.*	Gorgoniidae	*Pseudopterogorgia*	*anceps*
Astropectinidae	*Astropecten*	*duplicatus*	Gorgoniidae	*Pseudopterogorgia*	*guadalupensis*
Echinometridae	*Echinometra*	*sp.*			
Ophiodermatidae	*Ophioderma*	*sp.*	***SPONGES***		
Ophiocomidae	*Ophiocoma*	*sp.*	Chondrillidae	*Chondrilla*	*nucula*
Amphiuridae	*Ophionereis*	*reticulata*	Dysideidae	*Dysidea*	*etheria*
*	*	* *Crinoid*	Spongiidae	*Ircinia*	*felix*
			Spirastrellidae	*Speciospongia*	*vesparium*
HARD CORALS			Spongiidae	*Ircinia*	*strobolina*
Scleractinia	*Siderastrea*	*radians*	Adociidae	*Siphonodictyon*	*coralliphagum*
Scleractinia	*Siderastrea*	*siderea*	Clionidae	*Cliona*	*sp.*
Scleractinia	*Manicina*	*areolata*	Spirastrellidae	*Anthosigmella*	*varians*
Scleractinia	*Favia*	*fragum*	Myxillidae	*Tedania*	*ignis*
Scleractinia	*Porites*	*porites*	Spongiidae	*Aplysina*	*fistularis*
Scleractinia	*Porites*	*astreoides*	Spongiidae	*Aplysina*	*cliona*
Scleractinia	*Meandrina*	*meandrites*	Spongiidae	*Aplysina*	*sp.*
Scleractinia	*Agaricia*	*agaricites*	Raspailiidae	*Ectyoplasia*	*ferox*
Scleractinia	*Dichocoenia*	*stokesii*	Agelasidae	*Agelas*	*schmidti*
Scleractinia	*Montastrea*	*annularis*	Clionidae	*Cliona*	*langae*
Scleractinia	*Diploria*	*strigosa*	Spongiidae	*Spongia*	*equina*
Scleractinia	*Diploria*	*clivosa*	Haliclonidae	*Haliclona*	*viridis*
Scleractinia	*Diploria*	*labyrinthiformis*	Haliclonidae	*Haliclona*	*sp.*
Scleractinia	*Colpohyllia*	*natans*	*	*	* *black boring*
			Clionidae	*Cliona*	*sp.2*
HYDROIDS			Mycalidae	*Mycale*	*sp.*

Plumulariidae	*Macrorhynchia*	*allmani*	Mycalidae	*Ulosa*	*hispida*
Plumulariidae	*Macrorhynchia*	*philippina*		*Callyspongia*	*vaginalis*
SERTULARIIDAE	*Cnidoscyphus*	*marginatus*			
Plumulariidae	*Dentitheca*	*dendritica*	***TUNICATES***		
	Millepora	*complanata*	Perophoridae	*Ecteinascidia*	*turbinata*
	Millepora	*alcicornis*	Styelidae	*Symplegma*	*viride*
Cassiopeidae	*Cassiopea*	*xamachana*	Polycitoridae	*Distaplia*	*corolla*
Cassiopeidae	*Cassiopea*	*frondosa*	Styelidae	*Botrylloides*	*nigrum*
			*	*	*Pork Rind Tunicate*
			Perophoridae	*Ecteinascidia*	*turbinata*
			Perophoridae	*Mnemiopsis*	*mccradyi*

Appendix 9. Fish diversity for near shore R.E.E.F counts and beach seines for Great Guana Cay.

Family	Species (common Name)	Family	Species (common Name)
Acanthuridae	Blue Tang	Muglidae	White Mullet
Acanthuridae	Doctorfish	Mullidae	Spotted Goatfish
Acanthuridae	Surgeonfish	Mullidae	Yellow Goatfish
Atherinidae	Silversides	Mullidae	Yellow Goatfish
Atherinidae	Silversides	Ostraciidae	Honeycomb Cowfish
Balistidae	Queen Triggerfish	Ostraciidae	Trunkfish
Belonidae	Redfin Needlefish	Pomacanthidae	French Angelfish
Carangidae	Bar Jack	Pomacanthidae	Gray Angelfish
Carangidae	Yellow Jack	Pomacanthidae	Queen Angelfish
Carangidae	Bar Jack	Pomacentridae	Blue Chromis
Carangidae	Permit	Pomacentridae	Brown Chromis
Carangidae	Palometa	Pomacentridae	Beaugregory
Chaetodontidae	Banded B-fly	Pomacentridae	Bicolor Damsel
Chaetodontidae	Spotfin B-fly	Pomacentridae	Cocoa Damsel
Clinidae	Dusky Blenny	Pomacentridae	Dusky Damsel
Cyprinidae	Unknown Cyprinidon	Pomacentridae	Longfin Damsel
Dactylopteridae	Flying Gurnard	Pomacentridae	Sergeant Major
Gerreidae	Yellowfin Mojarra	Pomacentridae	Threespot Damsel
Gerreidae	Flagfin Mojarra	Pomacentridae	Yellowtail Damsel
Gerreidae	Yellowfin Mojarra	Rhinocodontidae	Nurse Shark
Gobiidae	Bridled Goby	Scaridae	Bucktooth Parrotfish
Grammatidae	Fairy Basslet	Scaridae	Greenblotch Parrot
Haemulidae	Bluestriped Grunt	Scaridae	Princess Parrot
Haemulidae	Caesar Grunt	Scaridae	Queen Parrot
Haemulidae	Cottonwick	Scaridae	Rainbow Parrot
Haemulidae	French Grunt	Scaridae	Redband Parrot
Haemulidae	Sailors Choice	Scaridae	Redfin (Yellowtail) Parrot
Haemulidae	Smallmouth Grunt	Scaridae	Stoplight Parrot
Haemulidae	Tomtate	Scaridae	Striped Parrot
Haemulidae	White Grunt	Scaridae	Unknown Parrotfish
Haemulidae	White Margate	Sciaenidae	High Hat
Haemulidae	Bluestriped Grunt	Serranidae	Black Grouper
Holocentridae	Blackbar Soldier	Serranidae	Coney

Holocentridae	Squirrelfish	Serranidae	Nassau Grouper
Kyphosidae	Chub	Serranidae	Harlequin Bass
Labridae	Hogfish	Soleidae	Scrawled Sole
Labridae	Spanish Hogfish	Sparidae	Jolthead Porgy
Labridae	Bluehead Wrasse	Sparidae	Pluma
Labridae	Clown Wrasse	Sparidae	Saucereye Porgy
Labridae	Puddingwife	Sparidae	Sheepshead Porgy
Labridae	Slippery Dick	Sphyraenidae	Barracuda
Labridae	Yellowhead Wrasse	Sphyraenidae	Great Barracuda
Labridae	Blackear Wrasse	Synodontidae	Bluestriped Lizardfish
Labridae	Slippery Dick	Tetraodontidae	Sharpnose Puffer
Lutjanidae	Gray Snapper	Tetraodontidae	Checkered Puffer
Lutjanidae	Mahogany Snapper	Sphyraenidae	Barracuda
Lutjanidae	Mutton Snapper	Sphyraenidae	Great Barracuda
Lutjanidae	Schoolmaster	Synodontidae	Bluestriped Lizardfish
Lutjanidae	Yellowtail Snapper	Tetraodontidae	Sharpnose Puffer
Lutjanidae	Schoolmaster	Tetraodontidae	Checkered Puffer
Malacanthidae	Tilefish, Sand		
Monacanthidae	Scrawled Filefish		

Appendix 10. Near shore macro algae / plant diversity for Great Guana Cay.

Group	Species	Group	Species
Blue-Green	*Aphanothece stagnina*	Calcareous/Jointed	*Jania adherens*
Blue-Green	*Schizothrix*	Calcareous/Jointed	*Penicillus capitatus*
Branched/Corticated	*Acanthophora spicifera*	Calcareous/Jointed	*Penicillus dumetosus*
Branched/Corticated	*Batophora oerstedii*	Calcareous/Jointed	*Penicillus pyriformis*
Branched/Corticated	*Caulerpa cupressoides*	Calcareous/Jointed	*Rhipocephalus phoenix*
Branched/Corticated	*Caulerpa prolifera*	Calcareous/Jointed	*Udotea conglutinata*
Branched/Corticated	*Chondria capillaris*	Calcareous/Jointed	*Udotea cyathiformis*
Branched/Corticated	*Chondria littoralis*	Calcareous/Jointed	*Udotea flabellum*
Branched/Corticated	*Codium isthmocaldum*	Crustose Coralline	*Neogoniolithon spectabile*
Branched/Corticated	*Dasycladus vermicularis*	Crustose Coralline	*Neogoniolithon strictum*
Branched/Corticated	*Dictyota bartayresii*	Crustose Coralline	*Porolithon pachydermum*
Branched/Corticated	*Dictyota cervicornis*	Fan-Shaped	*Avrainvillea fulva*
Branched/Corticated	*Dictyota divaricata*	Filamentous	*Cladophora catenata*
Branched/Corticated	*Dictyota jamaicensis*	Filamentous	*Derbesia sp.*
Branched/Corticated	*Heterosiphonia gibbesei*	Foliose/Leafy	*Anadyomene stellata*
Branched/Corticated	*Hypnea spinella*	Foliose/Leafy	*Lobophora variegata*
Branched/Corticated	*Laurencia intricata*	Foliose/Leafy	*Microdictyon marinum*
Bubble Shaped	*Dictyosphaeria cavernosa*	Foliose/Leafy	*Padina sanctae-crucis*
Bubble Shaped	*Ventricaria ventricosa*	Foliose/Leafy	*Stypopodium zonale*
Calcareous/Jointed	*Amphiroa fragilissima*	Leathery	*Dictyopteris jamaicensis*
Calcareous/Jointed	*Galaxaura obtusata*	Leathery	*Dictyopteris justii*
Calcareous/Jointed	*Galaxaura rugosa*	Leathery	*Sargassum hystix*
Calcareous/Jointed	*Halimeda goreauii*	Leathery	*Sargassum natans*
Calcareous/Jointed	*Halimeda incrassata*	Leathery	*Sargassum platycarpum*
Calcareous/Jointed	*halimeda lacrimosa*	Leathery	*Turbinaria tricostata*
Calcareous/Jointed	*Halimeda monile*	Leathery	*Turbinaria turbinata*
Calcareous/Jointed	*Halimeda opuntia*	seagrass	*Halodule beaudettei*
Calcareous/Jointed	*Halimeda tuna*	seagrass	*Syringodium filiforme*
		seagrass	*Thalassia testudinum*

Appendix 11. Outline of environmental report for B.E.S.T. Commission

MONTHLY ENVIRONMENTAL REPORT TO B.E.S.T. COMMISSION BAKERS BAY CLUB

Environmental Monitoring for Sustainable Development: Baker's Bay Club
Prepared by Dr. Kathleen Sullivan-Sealy and Ms. Nicolle Cushion
University of Miami
DATE

PROJECT MISSION AND OBJECTIVES

- Document best practices in sustainable development in the Bahamas.
- Report on the performance of the Baker's Bay Club development in meeting prescribed environmental goals.

The overall environmental goals of the Baker's Bay Club (BBC) are (EIA, 2004):

1. To maintain representation of all the natural vegetation communities on the island.
2. To maintain water quality parameters in coastal groundwater and near shore marine waters at pre- construction levels.
3. To enhance wildlife habitat quality in the coastal zone, wetlands and preserve areas, with measurable increases in targeted conservation species.
4. To maintain coastal stability with the measurable maintenance of beaches, and natural recovery of beaches from storm disturbances.

Monthly highlights: Describe the major progresses made by the Environmental Management Team (EMT), updates related to the Environmental Management Plan (EMP) and Environmental Monitoring Program (EMPr). Note any field excursions or data gatherings or finished analyses.

Work progress: Describe projects in progress, being developed or being completed.

Preliminary results: Describe any results related to the EMP or EMPr (e.g. waste disposal, environmental monitoring results, surveys/workshops conducted. Also note if any incident reports were filed and incident number.

Upcoming activities: Describe any planned activities in the near future.

Photographs: Digital or hard copies of photos of field excursions.

Literature cited:

Appendix 12. Outline of the Baker's Bay Club Integrated Pest Management Plan.

<u>Integrated Pest Management (IPM) Plan</u>

The IPM for BBC's will take a proactive approach to abating insects and pests on the property and in residential areas. The IPM will address the following areas:

1. Biting Insects outdoors and outdoor recreation areas.

    a) maintenance practices to reduce mosquito/sand fly breeding cycles;

    b) Eliminating the risk of importing exotic mosquitoes and potential disease vectors;

    c) Smoke, CO2 traps, options in biodegradable pesticides and other outside mosquito deterrents (NO ORGANOCHLORIDES); and

    d) Guest education, culture and preparation for the island environment- this section will outline all possible pest hazards like scorpions and centipedes.

2. Inside pests:

    a) waste management and control of rats (preventing new rats, trapping existing population now threatening wildlife);

    b) Internal insect pest control - include interior design options, cleaning practices, use of borax crystals in food areas; and

    c) termite prevention,

3. Use of environmentally friendly products in industrial and home use:

    a) Acceptable cleaning products - orange oil products, vinegar, Toms of Maine for personal use. Biodegradable products going down the drain.

4. Pets, feral animals and wildlife.