Baker's Bay Golf Course Best Management Practices and Environmental Guidelines

A. Background

The design and management of the proposed Baker's Bay Golf (BBC) and Ocean Club Golf Course outlines a prescriptive approach, based on *a-priori* specification of Environmental and Best Management Practice's (BMP's), detailed here. Development in sensitive environments, such as the property of Baker's Bay Club, must begin with an environmental inventory and an understanding of site attributes, their functions and interactions. This was accomplished for the BBC Environmental Impact Assessment (EIA) in 2004, lending a scientific aspect to the golf course design and management plan. Based on the ecology, geology and meteorological conditions of the property, the EIA identified BMP's which will be followed for the construction, design and management of the golf course. BBC strives to demonstrate BMP's to reduce the threat of Non-Point Source (NPS) Pollution to terrestrial, marine and wetland resources.

Golf Course Best Management Practices- *Development*

Thus far, the Golf Course development process has included the:

- Completion of a Pre-Development Environmental Impact Assessment
- Identification of Environmentally Sensitive Areas and Constraints
- Co-ordination of input from the developers, the architects, engineers, environmental specialists and review authorities
- Acquisition or request of the necessary legislated approvals
- Outline of a golf course management and monitoring program defining BMP's for the construction and operations phase, mitigation techniques, turf grass maintenance, irrigation, pesticide and fertilizer use, sediment control, maintenance of buffers, naturalized areas and wetlands
- Completion of response plans for environmental emergencies such as spills and major storm events. (LIVINGSTON -DO WE HAVE An ERP OR INSERT CHEMICAL SPILL RESPONSE IN THE CONTINGENCY PLAN SECTION OF THIS DOCUMENT…WHEREVER THE STORM EVENT PLAN IS.)

B. Construction and Design

The construction of the golf course will undoubtedly alter the ecology of the property. However, by following proper BMP's for construction and design impacts can be minimized. The most important ecological impacts to manage and mitigate for include:

- Loss or degradation of habitat for terrestrial and marine species,
- Introduction of fresh water and nutrients to island hydrology, and
- Introduction of land-based sources of pollutants and contaminants.

Table 1 outlines an impact matrix (EIA, 2004) to assess and mitigate the potential golf course impacts. Acknowledging and outlining these likely impacts previous to construction allows for preparedness and best suited-mitigations.

Table 1. Ecological Impact Matrix from Golf Course Construction.

Qualitative Criteria	Choices	Description
NATURE	Direct	Land cover alteration from shrub thicket and forests to open grassy areas will directly impact the overall plant diversity on the island
TYPE	Negative	Large area of continuous Broadleaf Evergreen Forest will be fragmented and converted to turf-grass fairways and greens. Of the original 372 acres, about 40% will remain in small patches and corridors. Patches of vegetation do not offer the same ecological value as a contiguous forest, and thus wildlife habitats and plant diversity may be lost.
	Positive	Upland vegetation communities will be fragmented, but a management program for the lobate lac scale will help control the current infestation on native trees,
LIKELIHOOD	Certainty	Impacts will occur with land conversion to golf course.
SCALE	Habitat–specific impact	Impacts are the further fragmentation of the contiguous coppice (broadleaf evergreen forest) areas. This fragmentation may lead to a long-term loss of plant diversity if not monitored. There are very specific threats to the groundwater quality throughout the project site.
DURATION	Long-term	Impacts will be more acute with construction, with some recovery of trees and vegetation with time. A KEY CONCERN is the use of Paspalum grasses that can grow with brackish water. This increased salinity of irrigation water, or contamination of ground waters may lead to the demise of native vegetation.
REVERSIBILITY	Irreversible	It is unlikely that a forest will ever recover from the golf course conversion, even if site is abandoned.
OVERALL SIGNIFICANCE	Moderate	This is a moderate impact overall on the project site. The current infestations of fire ants and lobate lac scale do pose a threat to native plants and wildlife, thus the management development does offer better long-term stewardship of island biological diversity, with removal of invasive pest species.

Golf Course Best Management Practices- *Design and Construction*

Important guidelines and BMP's to be followed for the design and construction of the golf course to minimize ecological impact that include:

- Sites have been selected and designed to allow the golf course to be routed in such a way as to minimize the need to alter or remove existing native landscapes, trees, and vegetation, and which provide opportunities for restoration/enhancement of valuable habitat.
- Natural rock outcroppings that are archaeologically or geologically significant, and sensitive or critical habitat (e.g. wetlands) and environmental features will be preserved through careful golf course design.
- Representatives of each vegetation habitat on the island will be protected throughout the course area; this includes grassy wetlands, coppice and broadleaf evergreen forest communities.
- The site plan has identified areas for restoration, replanting, and enhancement of disturbed habitat to re-establish wildlife migration corridors and linkages between fragmented habitat areas. This includes areas dominated by Australian pines and coconut trees that will require some restoration.
- Buffers of natural vegetation or "no cut" areas of rough where sensitive features cannot be avoided will be included. Areas between fairways will retain and restore existing native vegetation, where possible (see Section D).
- Native habitats and communities of special value to threatened/endangered species will be preserved to the greatest extent possible
- The site drainage plan will be centralized and drain to vegetated areas.
- Fairways in sensitive areas will be lined to minimize nutrient run-off and Non-point source pollution (Appendix 1).
- Drainage ponds will be developed mimicking natural conditions in terms of both aesthetics and habitat, to the extent feasible.

Erosion management

Erosion control is the single most important needed sensitivity of the construction process. Vegetation is removed, soils are exposed, removed, imported and compacted and a tight time schedule is followed. The BBC site is vulnerable to extreme storm events and during construction and planned mitigations, contingency plans and control measures have been outlined (Appendix 2). In order to protect significant natural features from negative impacts due to sedimentation during construction, a sediment and erosion control plan that illustrates the measures that are to be taken is being prepared. The EIA (2004) outlined the following BMP's and sediment controls, several of which will be incorporated into the design and construction process:

- Grassed Waterways and Swales: This practice involves using grassed surfaces to reduce runoff velocities, enhance infiltration and remove runoff contaminants, thus improving runoff quality and reducing the potential for downstream channel degradation and sediment pollution.

- Temporary Gravel Construction Entrance: A gravel pad, located at the points of vehicular ingress and egress on a construction site, to reduce the mud transported onto public roads and other paved areas.
- Mulch Bale Barriers: A temporary sediment barrier composed of **native** mulch placed across or at the toe of a slope to intercept and detain sediment and decrease flow velocities from drainage areas of limited size.
- Silt Fences: A temporary sediment barrier constructed of posts, filter fabric and, in some cases, a wire support fence, placed across or at the toe of a slope or in a minor drainage way to intercept and detain sediment and decrease flown velocities from drainage areas of limited size.
- Temporary Sediment Trap: A small ponding area, formed by constructing an excavated shallow area or earthen embankment with a gravel outlet across a drainage swale, to detain sediment-laden runoff from small disturbed areas for enough time to allow most of the sediment to settle out.
- Riprap: A permanent, erosion-resistant ground cover of large, loose, angular stone usually underlain by erosion matt of filter fabric installed wherever soil conditions, water turbulence and velocity, expected vegetative cover, etc., are such that soil may erode under storm water flow conditions.
- Temporary Seeding: Establishment of temporary vegetative cover on disturbed areas by seeding with appropriate rapidly growing plants on sites that will not be brought to final grade for a period of 30 days.
- Permanent Planting: Establishment of perennial vegetative cover by planting seed or native plants from the on-site nursery area on the rough graded areas that will not be brought to final grade for a year or more or where permanent, long-lived vegetative cover is needed on fine graded areas.
- Sodding: Stabilizing fine graded areas by establishing permanent grass stands with sod. This provides immediate protection against erosion, and is especially effective in grassed swales and waterways or in areas where an immediate aesthetic effect is desirable.

Golf Course Best Management Practices- *Erosion Control*

Important guidelines and BMP's to be followed for the design and construction of the golf course to minimize erosion problems:

- Erosion and sediment control measures are to be placed prior to, or as the first step in, construction. Sediment control practices will be applied as a perimeter defense against any transportation of silt and/or water turbidity off the site. The contractor shall provide a plan and written notice to the owner and engineer 10 days prior to commencing work. The contractor shall accept and will be responsible for maintaining existing erosion control facilities.
- Silt screens and turbidity barriers must remain in place and in good condition at all locations shown in the plans and as required until the contract is completed and soils are stabilized and vegetation has been established.
- The erosion control measures set forth in the plans are intended as minimum standards. Any erosion control requires beyond that specified shall be considered as included within the contract.
- Materials from work shall be contained, and not allowed to collect on any off-site perimeter areas or in waterways. These include both natural and man-made open ditches, streams, storm drains, lakes and ponds.
- Weekly, or after raining, inspections shall be made by the contractor to determine the effectiveness of these efforts. Any necessary remedies or repairs shall be performed without delay and at no cost to the owner.
- All mud, dirt or other materials tracked or spilled onto existing roads and facilities from the site, due to construction, shall be promptly removed by the contractor/builder. Deviation from this will cause Owner notification, and all work will stop until corrected.
- Permanent soil erosion control measures for all slopes, channels, ditched or any disturbed land areas shall be completed immediately after final grading. When it is not possible to permanently protect a disturbed area immediately after grading operations, temporary erosion control measures shall be installed. All temporary erosion control measures shall be maintained until permanent measures are in place and established. Temporary erosion control may consist of but not be limited to grass, sod, mulch, sand bags, piping, slope drains, settlement basins, artificial coverings, berms, hay bales, straw and dust control.
- All erosion prevention and control measures must be inspected and approved by the Owner prior to any construction activities. Removal of these same erosion controls and prevention measures may be done only after authorization by the Owner is obtained.
- In the event that the erosion prevention and control devices shown on the plans prove not to be effective, alternate methods for maintaining water quality standards for discharge from the construction site will be required. The Owner prior to placement must approve all alternate erosion prevention and control devices.

C. Lining and drainage

Golf courses rely heavily on water for the maintenance of the turf areas and accordingly there is potential for disturbance of the natural water quality of the property. A main objective of the golf course development is to maintain pre-development water quality conditions. This is important in order to minimize impacts on the natural features and adjacent to the property and protect areas that may rely upon the natural water quality.

The location of golf courses near the coastline causes concern about NPS pollution effects on the water quality of surrounding marine and wetland environments. Of particular interest is the impact of herbicides, fungicides and fertilizers on groundwater quality. Golf courses are intensive production systems, and the frequent mowing and application of fertilizers or pesticides requires careful management to avoid damage to the surrounding environment. Nitrogen, phosphorus and many pesticides are potential pollutants of groundwater, and monitoring of their movement from turf grass areas to receiving waters is needed. In coordination with the drainage plan, several areas have been deemed environmentally sensitive, thus requiring lining (Appendix 1) to alleviate these potential impacts.

The golf course lake and certain holes will be lined to abate nutrient seepage and run-off. A 30mm liner will be used for the lake and a 20mm for the areas listed below. Lining has been agreed to be placed on the following holes and/or tees (Appendix 1):

1. The greens of hole 8
2. All of hole 9
3. The tees of hole 10
4. The greens of hole 12
5. All of hole 13
6. The greens of hole 17
7. All of hole 18

Golf Course Best Management Practices- *Drainage*

Important guidelines and BMP's to be followed pertaining drainage include:

- Surface waters and wetland features have been delineated and their on-site linkage to off-site investigated
- Pre-development water quality and weather conditions are being investigated to determine baseline conditions.
- Designing site drainage to maximize infiltration and mimic pre-development conditions.
- Using buffer zones around all water bodies to intercept runoff
- An on site weather station will be installed to make monthly/seasonal estimates of precipitation, evapotranspiration, infiltration and runoff.
- Vegetated buffer zones will outline greens and water bodies.
- Greens are designed to drain inward to a centralized drainage system.
- Greens will drain to vegetated lakes or vegetated retention ponds.
- A locally compatible, salt-water tolerant species of turf will be utilized to minimize water needs and utilize gray water.
- Signage and educational materials will be place in the buffers to make them nature education features

D. Buffer zones

An overall environmental goal of the Baker's Bay Club development is to maintain a viable representation 80% of the natural vegetation communities on the island. Native buffer zones will be incorporated into the design of all golf holes and surround all water features on the BBC golf course to meet this goal. The design of native buffer zones around all water features and greens will be the primary means to mitigate the impacts of construction and operation of the golf course. Buffer zones function by:

- intercepting surface run-off to decrease peak storm runoff to surface waters;
- promoting infiltration into non-compacted soils;
- enhancing bank stability;
- trapping sediments and related surface-bound contaminants;
- advancing uptake of nutrients into vegetation;
- providing habitat and corridors for native flora and fauna; and
- providing shade and coarse organic detritus to aquatic habitat.

Buffer zones may take one of three forms, listed here in decreasing order of preference:

- natural areas which are not disturbed at any stage of design or construction are the preferred design characteristics for the protection of surface waters;
- if disturbance cannot be avoided then areas which are naturalized with native species of vegetation after construction are an option; and
- at the minimum, areas of no or reduced mowing are better than manicured turf or the protection of surface water. (Gartner Lee Limited, 2001)

Buffer zones, whether natural or planted, have been cited as effective means of reducing phosphorus and sediment transport from source areas such as urban development, logging activities or feedlots. A paper by Woodard and Rock (1995) measured sediment and phosphorus attenuation from urban areas by natural forest buffer zones on steep and shallow slopes in Maine. Although in a different environment, on average, a 15m vegetated buffer zone reduced phosphorus concentrations of 1 - 9 mg/L to "background" levels (0.7 - 2.0 mg/L). The slope of the monitored area (1 - 5% vs. 10 - 15%) had little influence on attenuation but maintenance of ground cover in the source areas was highly effective. Phosphorus in runoff was reduced, from 5 - 9 mg/L to 1 - 2 mg/L as lawns became established.

While the environmental benefits are widely accepted, quantitative and relevant studies of their effectiveness are few and buffer zones cannot be considered to be 100% effective in mitigating for the habitat losses entailed. Thus, all efforts will be made to minimize the use of excess water and chemicals (Environmental Management and Monitoring Plan, Section E).

E. Vegetated Retention Ponds and Revegetation

An integral part of the drainage plan for the BBC proposed golf course are vegetated retention ponds. The holes will drain to these filtering ponds and lakes to abate excess nutrients. The vegetated retention ponds are slated be designed by a specialized consultant. The ponds would be dominated around the edged by native grasses and sedges such as *Cyperus planifolius, Sand Cyperus, Spartina spp.* and *Cladium jamaicense* . Larger shrubs and trees will be planted in areas of occasional flooding and low-lying areas of moist or wet soils (especially during the rainy season) (Table 1).

Table 1. Suggested plants to be used in the vegetated retention ponds.

SCIENTIFIC NAME	COMMON NAME	NATIVITY	Wetland Conditions
Acrostichum aureum	Giant Fern	Native	Moist
Acrostichum danaeifolium	Giant leather fern	Native	Moist
Andropogon longiberbis	Broom sedge	Native	Standing Water
Annona glabra	Pond apple	Native	Standing Water
Avicennia germinans	Black Mangrove	Native	Wet Soil
Baccharis angustifolia	False Willow	Native	Wet Soil
Batis maritima	Saltwort	Native	Wet Soil
Chrysobalanus icaco	Cocoplum	Native	Wet Soil
Cladium jamaicense	Sawgrass	Native	Standing Water
Coccothrinax argentata	Silver Thatch, Silver-top, Bay-Top	Native	Moist
Conocarpus erectus	Buttonwood	Native	Wet Soil
Erithalis fruticosa	Black Torch	Native	Moist
Heliotropium curassavicum	Seaside Heliotrope, Pondweed	Native	Wet Soil
Hydrocotyle sp.	Marsh pennywort	Native	Wet Soil
Laguncularia racemosa	White Mangrove, Bastard Buttonwood, Green Turtle Bough	Native	Standing Water
Rhizophora mangle	Red Mangrove	Native	Standing Water
Spartina patens	Saltmeadow Cordgrass	Native	Standing Water
Spartina spartinae	Gulf Cordgrass	Native	Standing Water
Thrinax morrissii	Small-fruited Thatch-palm, Buffalo-top	Native	Moist
Typha domingensis	Cattail	Native	Standing Water

Additionally, much of the golf course area has been disturbed by invasive species and is need of restoration. These areas along with the buffer zones and those altered by construction will be revegetated and landscaped with native vegetation (Appendix 4).

E. Water quality and Waste management

A main objective of BBC development is to maintain pre-development water quality conditions. Throughout the proposed golf course area, ground and near shore water quality is of critical concern due to the sandy soil and near-surface groundwater. Concerns with the interaction of golf course development with surface waters relate to site runoff and the potential for erosion, and the transport of sediment, nutrients, or pesticides to surface waters. These impacts can be minimized through BMP's, technology and site design. Techniques such as: a) underdrain systems or some other approved means for capturing and directing leachate away from ground water, and b) directing flow from underground drains to peat-sand filters in areas of permeable soils to ensure adequate filtration will be used (Appendix 2).

Composting toilets are very appropriate for situations such as BBC, where water use must be minimized and there is a severe need to remediate nutrient loading. Thus, composting toilets are being recommen for the golf course and permits will be applied for. Composting toilets can be used to alleviate eutrophication problems caused by nitrogen and phosphorus in ground and coastal waters. While composting toilets do very little to change the quantity of the major nutrients (nitrogen and phosphorus) in they can:

- Reduce the volume of solid waste by turning it into compost;
- Prevent the addition of pathogens to the groundwater by removing human waste from the septic system; and
- Significantly reduce water consumption.

Golf Course Best Management Practices- *Water quality and Waste management*

Important guidelines and BMP's to be followed to manage water and waste include:

- Paved areas will be limited in order to minimize impermeable surfaces and, thereby, reduce surface runoff. When possible, cart paths will be mulched and not paved.
- The golf course will be graded such that water either infiltrates or runs off in a diffuse manner.
- Lined artificial storage ponds will not be located in prime groundwater recharge areas
- Impervious liners will be used for detention/retention ponds and water hazards to protect ground and surface water quality. Areas of critical concern on the golf course can use water-retaining buffers underground ("aquacludes").
- Buffer strips, oil/grease separators or other recommended techniques for parking area drainage systems.
- Grease traps and other recommended technologies for facilities such as golf cart maintenance or wash areas to prevent untreated runoff from entering the natural groundwater environment.
- A state-of-the-art irrigation systems with site meteorological monitoring capability should be installed to minimize water use.
- The overall drainage system is designed to insure that there is no increase in the velocity or amount of off-site flows during major storm events.
- Composting toilets will be installed throughout the course.

F. Integrated Pest Management and Chemical usage

On site Environmental Management will address Integrated Pest Management Practices as BMPs during the operational phase of the course. The term 'pests' includes diseases, fungi, weeds, insects, and animals that destroy or reduce turfgrass quality. The goal of Integrated Pest Management (IPM) is to limit pest populations to sufficiently low thresholds to avoid economic damage to golf course operations with the least possible hazard to people, property, and the environment. The IPM favors natural pest manipulation by selecting proper turfgrass, seeding, irrigation, and fertilization practices, however it does not exclude chemical controls when required. A qualified pest control advisor certified in groundwater protection should prepare a plan for the course which minimizes or avoids potential adverse impacts to surface water or ground water.

Chemical use, and cutting requirements vary depending on the turf grass type, the specific site environs and weather, and season thus a test plot utilizing the chosen sea grass paspallum strain will be incorporated to determine the specific….**KATHLEEN PLEASE INSERT.**

Fertilizers and pesticides are an integral part of golf course turf management. The monitoring strategy will combine routine weekly inspections with increased monitoring, as required, to identify pest conditions at early stages and evaluate pest treatment effectiveness. Populations can then be contrasted to established threshold levels to decide appropriate action and treatment, if required. The main objective for fertilizer and pesticide management is to ensure that they are used in response to needs demonstrated by a monitoring program and *not used in broad application as a **"preventive"*** measure. One of the major concerns of excess fertilization is nitrogen and phosphorus migration by surface runoff. Newly seeded and erosion sensitive areas as well as damaged turf areas have the highest potential for elevated nutrient concentrations in runoff. Thus, fertilization will be minimized in these areas. As well, slow-release nitrogen fertilizers will be used where possible as this will minimize the potential for increased concentrations of nitrogen in surface runoff.

Golf Course Best Management Practices- *Chemical usage*

Important guidelines and BMP's to be followed for chemical usage:

- Integrated Pest Management plan will be employed to insure judicious use of pesticides, which will be applied by certified applicators.
- Treatment thresholds will be defined prior to application. Treatment thresholds must be clearly established to assure that pest problems are kept under control, but also to prevent treatment when it is not required and not economical.
- Measures to reduce the potential for pesticide loss by:
  - specifying stringent controls over timing and application rate of pesticides;
  - using non-chemical or proven biological control methods as the preferred alternative to chemical pesticides
- Detailed trigger mechanisms for pesticide use will be specified, such as:
  - high temperature and humidity to control soil fungi outbreaks;
  - weed observations at a pre-determined density;
  - soil monitoring results indicating pesticide application is required; and
  - site-specific information that indicate a lifestage of a specific pest is likely to harm the turfgrass.
- Fertilizers will not be applied during dry soil conditions and/or prior to major rainfall events, and never around water bodies or adjacent to watercourses.
- Periodic soil testing should be done to determine nutrient requirements of the soils.
- To minimize the need for chemical application, turf areas will be of sufficient size to accommodate the use, but should allow for native vegetation to remain between fairways.
- Drainage design and buffers will be utilized to minimize any adverse impacts of runoff.
- Storage and use of pesticides, herbicides, and fertilizers will be limited to and in conformance with US EPA and State of Florida standards. Chemical use is minimized through spot treatment and applicators are licensed and trained in all safety-related aspects of chemical use.
- Storage, mixing and disposal of pesticides only in secure areas; and implementation of plans to prevent and mitigate spills.
- Advanced technology/monitoring equipment will be used to insure minimal application of pesticides, herbicides, and fertilizers.
- Slow-release, less soluble, and least mobile chemical fertilizers, pesticides, and herbicides available is encouraged. These products should be used at the smallest rates of active ingredient to accomplish the desired result.
- A drought, pest, and disease resistant grass species has been selected.
- Natural buffer areas will maintained by minimizing the use of fertilizers, pesticides, and herbicides.

References:

Environmental Impact Assessment for Baker's Bay Club. University of Miami. 2004.

Gartner Lee Limited. Best Management Practices and Guidelines for the development and Review of Golf Course Proposals. September, 2001

Woodard, S.E. and C.A. Rock, 1995. Control of residential storm water by natural buffer strips. Lake and Reserve. Manage. 11: 37-45.

Appendix 1. Liner plan for the golf course.
Appendix 2. Erosion control measures.
Appendix 3. Drainage and storm sewer details.
Appendix 4. Revegetation map.