Environmental Impact Assessment:
Cotton Bay Resort

Cotton Bay, Eleuthera, The Bahamas

MAY 2023

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Submitted to: Department of Environmental Planning & Protection
Submitted on behalf of: Cotton Bay Holdings Ltd.

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1 Executive Summary

This Environmental Impact Assessment (EIA) pertains to the proposed development of Cotton Bay, Eleuthera, The Bahamas. An EIA identifies potential environmental impacts based on site investigations and recommends measures for minimizing or mitigating those potential impacts with reference to local legislation, international conventions and/or best practices. This EIA was prepared in accordance with the EIA guidelines of the Department of Environmental Planning and Protection (DEPP) to secure a Certificate of Environmental Clearance (CEC). A CEC is required for full construction activities to commence.

Cotton Bay Holdings Ltd proposes to develop 220 acres of a 400-acre privately owned property located in South Eleuthera southeast of the settlement of Greencastle. The proposed new development of Cotton Bay is situated on the former Cotton Bay Club approximately 10 miles southeast of Rock Sound, Eleuthera and abutting the ocean to the immediate east.

The USD $200 million proposed development by Cotton Bay Holdings Ltd. project will entail a resort hotel branded by the Ritz Carlton with 90 keys, branded and unbranded residences and condominiums, 18-hole championship golf course and additional amenities such as restaurants, beach club, spa and fitness center. Back-of-house (BOH) operations will provide solid waste management, electricity, potable water, and sewerage facilities.

At present, there are several existing structures including several unoccupied residences and ancillary buildings which will be demolished during project construction. As evident by overgrown vegetation, the site remains largely untouched since the closure of the Cotton Bay Club with infrastructure deteriorating in the hot and humid tropical environment. While there may be some modification to the existing golf course layout and fairways, land-use stays the same with the addition of residences. Moreover, botanical composition supports this history of disturbance with recolonization of previously cleared areas by invasive species. Cotton Bay Road and Cocoplum Drive will be relocated prior to resort construction; a CEC was granted under a separate application.

Biological Baseline

Biological assessments (terrestrial, avian, and marine) were performed to document baseline conditions and assist with impacts analysis. Botanical surveys identified three (3) communities: Interior Upland, Coastal and Wetland. A total of 148 vascular species were recorded onsite including 10 invasive species and 18 protected tree species. Interior upland comprises approximately 41% (170 acres) of the surveyed area with human altered areas and man-made wetlands the remainder. Man-made wetlands include cisterns and golf course ponds to support irrigation as well the coastal lagoon which was a narrow land-locked pond excavated and connected to the sea between 1942 and 1958 to the sea to support a ‘yacht basin’.

Avian surveys identify the presence, abundance, and habitat utilization of bird species within the boundaries of a site. A total of 43 species were recorded over four (4) days (October 27-30, 2022) comprising fifteen hours of active avian and ecological observation. Wetland habitats supported use by waterfowl species with land birds foraging for insects along the vegetated perimeter. Of note, a Piping Plover, listed as near threatened on the IUCN Red List was observed along the coast.

Marine benthic surveys were performed to establish a baseline of existing conditions; there are no proposed coastal modifications at present. Surveys differentiate findings for the lagoon and coastal areas. While the eastern perimeter of the lagoon is outside the project scope, the golf course and proposed retail centre border the lagoon with the potential for direct and indirect impacts. It is known through historic aerial imagery that the lagoon is man-made. Originally a pond (likely hypersaline), it was excavated, expanded, and connected to the sea to be a yacht basin. The lagoon's marine benthic habitat comprises primarily macroalgae beds. Interestingly, while overall coral abundances were observed to be low during the coastal assessment, the highest coral and fish abundances and diversity were observed at the mouth of the lagoon. Coastal areas transition from sandy-bottom to hardbottom and from hardbottom to reef.

Impacts

Baseline studies facilitate review of proposed project features for impacts determination being positive, negative, or neutral over the short and long term. Project planning considered environmental due diligence as part of the master planning process to mitigate known and unknown impacts. With over 50% of the project site previously disturbed, the majority of the project's development occurs on previously disturbed land historically operated as a resort and golf course. Left to the natural elements since the resort's closure in the late 90s, buildings experienced significant deterioration and highly manicured areas were recolonized by weedy and invasive plant species.

Terrestrial impacts associated with upland development pertain primarily to loss of upland habitat associated with the branded and unbranded residences. The existing golf course will be rehabilitated with slight design modifications to accommodate an oceanfront restaurant and updated driving range. Setback from the coast, no direct impacts are anticipated to coastal benthic communities with adherence to best management practices for golf courses to manage potential runoff into the lagoon. Redevelopment of the property necessitates the removal of invasive species occupying the golf course and coastal areas. Leachate impacts will be controlled via the use of minimal applications of fertilizers and herbicides with an updated irrigation system. The fertigation system will manage leachate reducing potential impacts to the marine environment; with no coastal modifications, no long-term impacts are anticipated.

Socio-Economic

Situated in the constituency of South Eleuthera, the Cotton Bay Club will provide employment opportunities for the residents of Eleuthera and the greater Bahamas. Approximately 300 jobs will be generated during construction and 200 jobs are anticipated during operation. Employees will arrive to the hotel and residences via the Queen's Highway. Relating to antiquity, no structures or ruins have been discovered on the site to date. It is anticipated the USD$200 million development will contribute over $2 million per annum in Government taxes and fees.

Mitigation & Recommendations

1) **Golf Course Irrigation & Irrigation Pond Design.** Notably, the man-made golf-course irrigation ponds cater to avifauna and any course redesign should consider waterfowl habitat preferences. Other considerations include landscaped greenspace areas using xeriscape techniques to rely on natural rainfall; to incorporate more natural vegetation between fairways and around greens during golf course

reconfiguration to reduce required irrigated area; turf grasses that are either salt resist or require less water or combination thereof.

- **Removal of Invasive Species**. It is recommended that the development engage in a long-term invasive species monitoring and removal program to mitigate for the loss of habitat. The proliferation of invasive species on the golf course and coast poses a threat to biodiversity.

- **Native Nursery & Landscaping.** Landscaping will make use of the diverse selection of native vegetation identified on site with emphasis on reusing impacted trees, when feasible, listed under the Forestry Act 2010 and the Declaration of Protected Trees Order 2021. A native nursery for translocated trees and propagation of native vegetation, with particular attention to species listed on the Protected Tree Order 2021, will encourage biodiversity threatened by the ongoing existence of invasive species.

- **Environmental Management Plan.** The EMP will detail management programs for the construction and operation of the golf course and built infrastructure. The golf course will incorporate best management practices and state-of-the-art irrigation to manage stormwater runoff and leachate control to minimize environmental impacts.

Conclusion

Opened in 1959, the Cotton Bay Club boasted a resort and residential community complete with a golf course and yacht harbour. The proposed development by Cotton Bay Holdings Ltd envisions a renewed Cotton Bay Club complete with resort, golf course and expanded residential offerings both branded and unbranded. Situated on previously developed land, the revitalization of the golf course will remove the proliferation of invasive botanical species and rejuvenate man-made irrigation ponds to cater to visiting wildlife. Construction and operational activities will generate an economic influx to the community of South Eleuthera.

In accordance with this EIA document and with the proper planning, application, and monitoring of the EMP, and if best management practices (BMPs) are conscientiously planned, engineered and implemented, many of the impacts that are generated during construction and operation should be minimized or completely eliminated for the proposed project.

2 Purpose and Scope

This document serves as the EIA for Cotton Bay, Eleuthera, The Bahamas, a branded resort and residential community with branded and unbranded villas and town homes complete with amenities such as an 18-hole golf course. The purpose of this report is to assess and document the environmental impacts associated with the proposed project components in relation to the natural setting.

An EIA is prepared in accordance with DEPP EIA guidelines, the Environmental Impact Assessment Regulations 2020, and the Environmental Planning and Protection Act 2019. An EIA identifies potential environmental risks and impacts based on site investigations and recommends measures for minimizing or mitigating those potential impacts with reference to local legislation and international conventions. Importantly, an EIA is used for planning purposes to consider project features and impacts prior to construction. The determination of environmental impacts is limited to the project area and its area of influence, known as the site.

Terrestrial surveys, including botanical and wildlife, and marine surveys were performed to document existing site conditions. The terrestrial survey records observed flora and fauna to identify present vegetation communities. Botanical and wildlife assessments were performed October 27-30, 2022 by Design Elements. Marine benthic surveys were performed by JSS Consulting Ltd. from November 23-24, 2022 and January 17, 2023.

In support of this project CEC application, Cotton Bay Holdings Ltd. Development Manager, Daniel Zuleta, and Waypoint Director, Melissa Alexiou, accompanied DEPP Senior Project Officer, Gammell Deal, and DEPP Project Officer, Jonopia Fernander, to Cotton Bay, Eleuthera on December 16, 2022.

3 Project Description

Cotton Bay Holdings Ltd proposes to develop 220 acres of a 400-acre privately owned property located in South Eleuthera southwest of the settlement of Greencastle. The proposed new development of Cotton Bay is situated on the former Cotton Bay Club approximately 10 miles southeast of Rock Sound, Eleuthera and abutting the ocean to the immediate east.

The USD$200 million proposed development by Cotton Bay Holdings Ltd. project will entail a resort hotel branded by the Ritz Carlton with 90 keys, branded and unbranded residences and condominiums, 18-hole championship golf course and additional amenities such as restaurants, beach club, spa and fitness centre. Back-of-house (BOH) operations will provide solid waste management, electricity, potable water, and sewerage facilities.

The proposed development is a resort and residential development complete with an eighteen (18) hole golf course. Back-of-house operations will service waste management, electricity, potable water, and sewerage facilities. At present, there are several existing structures including several unoccupied residences and ancillary buildings which will be demolished during project construction.

As evident by overgrown vegetation, the site remains largely untouched since the closure of the Cotton Bay Club in the mid-1980s with infrastructure deteriorating in the hot and humid tropical environment. While there may be some modification to the existing golf course layout and fairways, land-use stays the same.

3.1 Master Plan Features

Master Plan Table of Project Features

Project Features	**Details**
Golf Course	• 18 Holes. • Practice Area (putting, driving range). • Golf Clubhouse. • Back-of-house maintenance area including Administration & Storage.
Hotel & Amenities	• Hotel Keys (89 Units). • Hotel Arrival Palo Moratos Pond. • Ritz Carlton Reserve Suite (Single unite). • Ambassadors of the Environment.
Amenities (Hotel)	• Central Lagoon (Spa, Fitness Center, Market Café & Retail). • Family Pool & Restaurant. • Signature Restaurant. • Function Space. • Wedding Lawn.
New Road Construction	• Relocation of Cotton Bay Road (public drive). • Relocation of Cocoplum Drive (public beach access). • New Main Arrival Roadway & Internal Road Network. • Secondary Hotel Access. • Service Access (unbranded). • North Access Junction/Roundabout.

	• Unbranded residences golf court road.
Back-of-House Operations	• Service Entrance. • Hotel & branded residences BOH. • Unbranded Residences BOH.
Residences & Amenities	• Residences Lounge. • Residences Beach Club. • Mountain Residences (20 units). • Oceanview Residences (9 units). • Beach Front (6 units). • Golf Residences (25 units).
Unbranded Residences & Amenities	• Unbranded Residences (54 lots). • Main Entrance for Unbranded Residences. • Club House (Unbranded). • Tennis & Padel Courts. • Service Access. • Unbranded Retail. • Future Premium Retail Development.

Table 3-1 Master Plan Project Features

3.2 Phasing

The project will have three (3) phases commencing with the relocation of Cotton Bay Road and Cocoplum Drive. Phase 2 is the hotel development and branded residences and Phase 3 the unbranded residents.

3.3 Utilities

3.3.1 Potable Water & Wastewater

The water treatment plant will be located in the designated back-of-house. Potable water will be derived from reverse osmosis with an additional 25% supplied by government. The wastewater treatment plant will be comprised of activated sludge with an anticipated demand of 270m3/day.

3.3.2 Stormwater

The stormwater system will consist of inlets, manholes as required, piping, ponds, and control structures. Rainfall runoff will be collected along roadside ditches and other natural conveyance areas and then transported to discharge sites via BMPs. Generally, the piping will be sized based on a 10-year/24-hour rainfall event. The developer will be using hard pipe systems as well as vegetative buffers and other natural features for green and grey infrastructure.

3.3.3 Golf Course Irrigation

The irrigation system may include lakes or other storage facilities, a pumping station, controlling valves, control lines, sprinkler heads and fertigation system. At present, water resources located on the property include 10 ponds within the golf course. Irrigation water will be sources from groundwater, recycled water or other source. With an area of approximately 150 acres, 100 acres are assumed to be irrigated with a maximum demand of 580,000 gpd. This demand is based on an irrigation application rate of 1-1/2 inch per week to be provided over a six-hour period in any twenty-four-hour period.

3.3.4 Electricity

The power generation facility will be located in the back-of-house area. With an estimated demand of 5,000KvA, electricity production is anticipated to be generated by diesel generators with 30% of production met by renewable energy sources such as solar.

At present, residences and ancillary uses are powered by BPL. Conversations will be held with BPL in the future for potential supplement to the renewable energy production.

3.3.5 Solid Waste

The solid waste that is generated by the development will be stored onsite in dumpsters or compactors located near the BOH area. Designated staff will be responsible for gathering the solid waste and transporting it to the BOH and/or recycling area. The waste will be recycled, composted or baled with other waste and barged offsite to an approved landfill and in coordination with the Department of Environmental Health Services (DEHS). Incineration is a waste disposal method that will also be evaluated. A waste elimination program will also be launched.

3.4 Transportation

The Cotton Bay Club is a private development accessible directly from Cotton Bay Road. Cotton Bay Road is being relocated to the west to accommodate increased vehicular traffic and residential development. An internal road network will provide for vehicle, golf cart, and pedestrian use. Roadways will be reengineered utilizing crushed lime rock, concrete and/or asphalt, depending on the location. Drainage design details will be done in accordance with the standards and specifications of the Ministry of Works and Utilities and BMPs.

Residents and guests will arrive to the island of Eleuthera most frequently by air landing at the Rock Sound International Airport. Some guests may arrive by air to alternate airports (North Eleuthera or Governor's Harbour) depending on flight availability and drive to the Cotton Bay Club.

LEGEND *LEYENDA*

OVERALL MASTER PLAN ***MASTER PLAN GENERAL***

1 New main arrival roadway *Nueva vialidad principal de acceso*
2 Hotel & branded residences main entrance *Acceso principal de Hotel y Residencias Ritz Carlton Reserve*
3 Hotel & branded residences service entrance *Acceso de Servicio Hotel y Residencias Ritz Carlton Reserve*
4 Hotel BOH building *Edificio de Servicio Hotel y Residencias Ritz Carlton Reserve*
5 Hotel arrival Palo Moratos Pond *Plaza de Acceso a Hotel Palo Moratos Pond*
6 Central Lagoon *Laguna Central*
Spa / *Spa*, Fitness center / *Gimnasio*, Market café & retail / *Tienda-Café*
7 Family pool & Three meal restaurant *Junkanoo Club - Casa Club Hotel*
8 Signature restaurant *Restaurante de Especialidades*
9 Grand reserve suite *Ritz Carlton Reserve Suite*
10 Ambassadors of the Environment *Ambassador of the Enviroment*
11 Beach *Playa*
12 Proposed secondary hotel access *Acceso Secundario al Hotel*
13 Function Space *Salón de Eventos*
14 Residences lounge *Salón para Residencias*
15 Golf club house *Casa Club Campo de Golf*
16 Mountain Residences *Residencias de montaña*
• 20 units / *20 Unidades*
17 Oceanview residences *Residencias Vista al Mar*
• 9 units / *9 Unidades*
18 Beach front units *Residencias Pie de Playa*
• 6 units / *6 Unidades*
19 Residences beach club *Casa Club Residencias Ritz Carlton Reserve*
20 Golf residences *Residencias de Golf*
• 25 units / *25 Unidades*
21 Future development *Futuro desarrollo*
22 Main entrance (unbranded) *Acceso Principal (Sin Marca)*
23 Club house(unbranded) *Casa Club (Sin Marca)*
24 Unbranded residences *Residencias (Sin Marca)*
• 54 lots / *54 Lotes*
25 Tennis & Padel Courts (unbranded)
Canchas Padel y Tenis
26 Service access (unbranded) *Acceso de Servicio (Sin Marca)*
27 North access *Acceso Norte*
28 Mountain residences & Retail (unbranded) *Residencias de montaña y Comercio (Sin Marca)*
29 Existing residences road *Vialidad Residencias Existentes (Sin Marca)*
30 Lagoon *Laguna*
31 Existing ponds *Elementos de Agua Existentes*
32 Unbranded residences connecting road (golf cart) *Vialidad de Conexión a residencias sin marca (carro de golf)*
33 Existing golf course *Campo de Golf Existente*
34 New practice golf area *Nueva Área de Práctica de Golf*
35 Modified golf holes *Modificación de Hoyos de Golf*
36 New golf holes *Nuevos Hoyos de Golf*
37 Future premium retail development *Futuro Desarrollo Premium Comercial*
38 Existing residences *Residencias Existentes*
39 Public beach access road *Acceso Público a la Playa*
40 Front of the beach club. *Frente de Club de Playa.*

4 Alternatives

There are no alternatives to the referenced master plan for Cotton Bay Club, Eleuthera The Bahamas. Since baseline biological data was collected in coordination with the Master Plan design, project features were located with consideration for the natural setting and environmental constraints.

4.1 No Action Alternative

The "no action alternative" pertains to the site-specific environmental impacts if no activity relative to the proposed project occurs. The site would remain as is, undeveloped, and would continue to be influenced by natural environmental processes. In the absence of development elsewhere, the economy of Eleuthera would remain as is.

5 Geographic Location & Present Land Use

The Bahamas is an archipelagic nation comprising 700 islands and cays situated over 100,000 square miles of the Atlantic Ocean. Located east of Florida and north of Cuba, The Bahamas has a population of 399,314 persons of which 70% reside on New Providence. Collectively New Providence, Grand Bahama, and Abaco represent 90% of the population. According to the preliminary results of the 2022 Census, Eleuthera has a population of 9,247 of which South Eleuthera accounts for 5,324 persons excluding Harbour Island and Spanish Wells[1].

5.1 Geographic Location

Eleuthera is located east of the capital, Nassau, on island of New Providence. The narrow island is 110 miles long from the settlement of Current in the North to Bannerman Town in the south. Cotton Bay is situated within the constituency of South Eleuthera and southwest of the settlement of Greencastle. Cotton Bay is accessed via Cotton Bay Road which will be relocated to accommodate the Cotton Bay development.

Figure 5-1 Cotton Bay, The Bahamas

[1] Census 2022: Preliminary Results. Bahamas National Statistical Institute, Nassau, Bahamas.

Figure 5-2 Cotton Bay, Eleuthera, The Bahamas

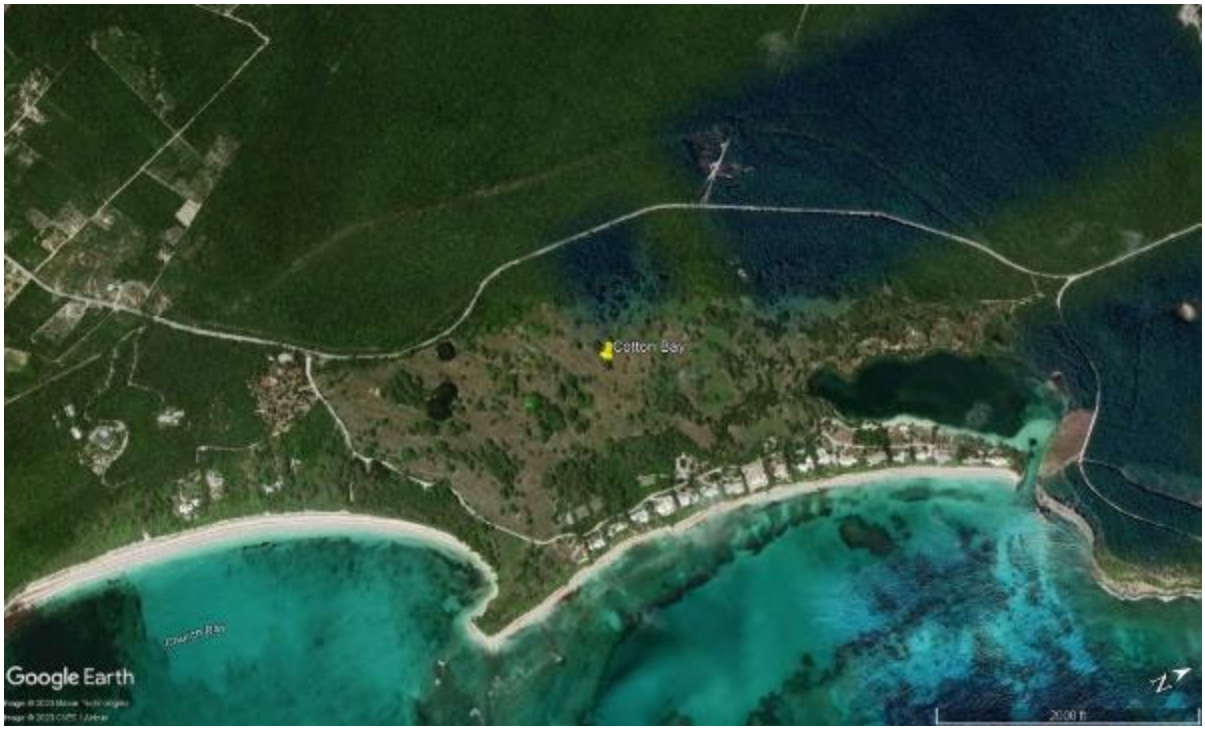


Figure 5-3 Cotton Bay, South Eleuthera

5.2 Area of Influence

Cotton Bay Holdings Ltd proposes to develop 220 acres of a 400-acre privately owned property located in South Eleuthera southeast of the settlement of Greencastle. The proposed new development of Cotton Bay is situated on the former Cotton Bay Club approximately 10 miles southeast of Rock Sound, Eleuthera and abutting the ocean to the immediate east. Given its proximity to Rock Sound and the settlements of South Eleuthera, the project's influence will extend beyond its immediate footprint.

Local areas of influence include:

- Direct and indirect economic impacts to South Eleuthera for labour, transportation, and supplies and community support initiatives.
- Upland onsite influence areas include land clearing associated with development of the roadways, residences, and BOH.

The Bahamas has a population of 399,314 persons, of which 74% reside on New Providence. According to the preliminary. Eleuthera accounts for 2.32% (9,247 person) of the total population of The Bahamas; the fourth most populous island. Of this total figure for Eleuthera, 5,324 persons reside in South Eleuthera. Between 2010 and 2022, Eleuthera experienced an influx of 1,045 persons resulting in a 12.74% change in population.

5.3 National Parks & Protected Areas

There are no National Parks or Protected Areas in the immediate vicinity of Cotton Bay, Eleuthera.

6 Physical and Biological Baseline

6.1 General Climate of The Bahamas

The climate of The Bahamas is considered sub-tropical; it lies in a transition zone between the temperate and tropical zone. The archipelago spans 450 miles in longitudinal extent from 21°N to 27.5°N. The northern Bahamas experiences cooler winters and higher amounts of rainfall compared to the southern Bahamas, where annual temperatures deviate less, and the climate is markedly drier. The climate of The Bahamas is influenced by the sea, particularly, the Gulf Stream, which lies between Florida and the Great Bahama Bank.[2]

Table 6-1 Average High and Low Air Temperature for Nassau (in degrees Fahrenheit)

Temperature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
High	77.3	77.5	79.7	81.8	84.6	87.3	89.1	89.3	88.4	85.4	81.8	78.7
Low	62.1	62.5	63.8	66.2	69.8	73.3	74.7	74.8	74.4	71.9	68.0	63.8

New Providence can expect 57.1 inches of rain and 137 rain days[3]. Rainfall is highest between the months of May and November, with peaks during June and October. Generally, prevailing winds are from the northeast, with a rotation to the southeast during the summer months, May to September. In winter, wind may shift to the northwest due to cold fronts emanating from North America. According to The Bahamas Department of Meteorology, the average wind speed is 8 knots.

6.2 Geology

The Bahamas archipelago exists on a partially exposed carbonate platform between the Atlantic Ocean and the North American Plate. The platform surface geology is composed mostly of oolitic limestones. Pleistocene limestones, Holocene sands and marshland sediments extend to a depth of more than 4 miles below the surface. Fourteen marine banks make up the surface plateaus, the largest being the Great Bahama Bank, followed by the Little Bahama Bank. New Providence forms part of the Great Bahama Bank.

Carbonate geology is highly porous and subject to atmospheric erosion, leading to the formation of karst solution systems, including vast networks of subterranean caverns and blue holes. Rainfall and surface discharges quickly infiltrate the permeable limestone. Most surface runoff drains into the porous ground or brackish tidal creeks; The Bahamas has no freshwater rivers. In general, the landscape of The Bahamas is flat, with undulating ridges averaging 30 to 45 m (meters) in height. Cat Island has the highest point of elevation, 206 ft, at Mount Alvernia. Given these physical properties, The Bahamas is subject to storm surge and wave action during tropical cyclone events.

2 Sealey, Neil E. Bahamian Landscapes. 3rd Edition. 2006
3 Ibid.

6.3 Topography

The project is situated on 400 acres along a north-south axis with the eastern boundary bounded by the Atlantic Ocean. Topography at the site varies from the low-lying golf course to expansive view offered by elevations in excess of 45ft along the ridgeline to the west of the golf course.

6.4 Hydrological and Hydrogeological Resources

In The Bahamas, groundwater comprises the fresh, brackish, saline and hypersaline waters found in the near and deep subsurface and in the lakes and ponds that intercept the surface. The Bahamas has no fresh surface water and therefore, no freshwater lakes, rivers, or creeks.

Freshwater resources in The Bahamas originate from rainfall only and accumulate in Ghyben-Hertzberg lenses. The Ghyben-Hertzberg lens consists of three lateral zones: 1) freshwater where chloride ranges from 90 to 400 parts per million (ppm); 2) a transition zone (brackish), approximately 1 to 2 m thick where chlorides increase rapidly from 400 to 1200 ppm; and 3) a saline zone where chlorides rise above 1,200 ppm. Freshwater is less dense than salt water, thus sits above the saline zone, separated by a brief mixing layer of brackish water.

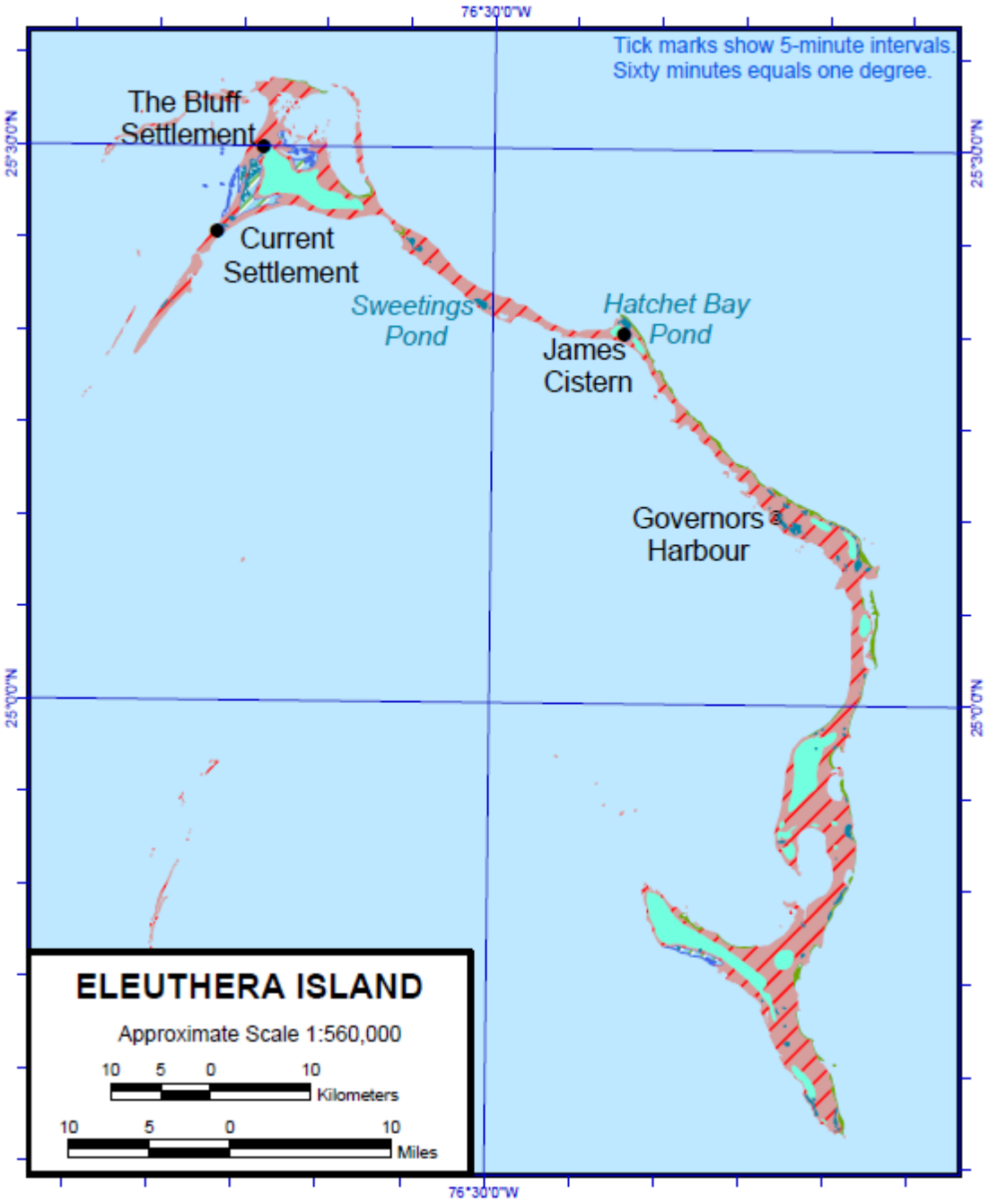
On average, the freshwater lens occurs at a depth of 2 to 5ft below the surface. Ninety percent of freshwater lens resources in The Bahamas are within 5 ft of the surface. Given the proximity of fresh water to the surface and the high porosity of limestone, over-extraction and pollution may lead to depletion, saltwater intrusion, and/or contamination, impairing the fragile layer of freshwater over salt. Threats to groundwater resources include the following.

- **Saltwater Intrusion**. Saltwater intrusion to groundwater may occur due to 1) storm surge generated by tropical disturbances; 2) sea level rise due to climate change; and 3) over-pumping/extraction of freshwater aquifers.
- **Development/Building Features.** Canals and marinas have the potential to disturb subsurface freshwater lens by allowing the sea to connect at the inland surface.
- **Climate Change.** Based on the United Nations Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report and the Coupled Model Intercomparison Project 5 (CMIP5), climate change will alter existing rainfall patterns in The Bahamas. Climatology data suggest that The Bahamas region will incur a 3 percent decrease in monthly rainfall averages, with an increase of intensity of rainfall events between October and February. Overall, total rainfall is expected to decrease, placing additional pressure on freshwater resources.
- **Contamination.** Groundwater is susceptible to contamination from untreated sewage, industrial wastes, and leaking fuels; this vulnerability is particularly true for New Providence. New Providence is the most populated island and has the highest population density.

6.4.1 Hydrological Conditions – Cotton Bay, Eleuthera

According to the U.S. Army Corps of Engineers Water Resources Assessment of The Bahamas and associated water resources map, freshwater lenses vary in thicknesses of 10ft to 30ft with the water table within 3ft to 6ft of the

surface. [4] Annual rainfall averages approximately 110 centimetres (cm) (43 inches) per year per data retrieved on Eleuthera between 1961 and 1990. Freshwater resources may exist to the west of the Cotton Bay development where there were former cisterns. The golf course at Cotton Bay also has several cisterns for irrigation purposes. Large scale groundwater exploitation is not recommended for aquifers with lenses less than 30ft (9m).



4 U.S. Army Corps of Engineers. Water Resources Assessment of The Bahamas. United States Southern Command. December 2004. BAHAMASWRA.pdf (army.mil)

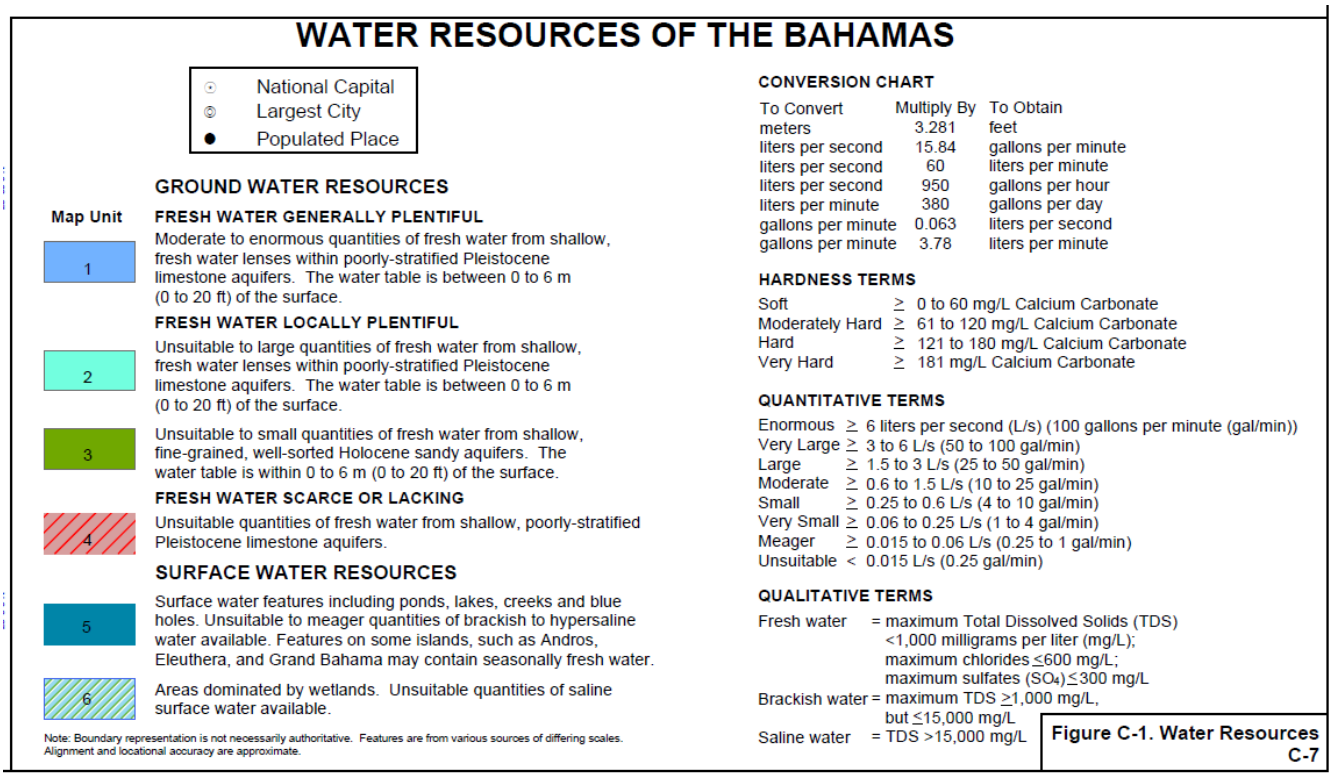


Figure 6-1 USACE Water Resources of The Bahamas

6.4.2 Hydrological Reports – Cotton Bay Resort

Several hydrological reports have been prepared for the redevelopment of the Cotton Bay golf course. In May 2000, Camp Dresser & McKee (CDM) prepared a "Water Resources: Feasibility Study." This study provided Cotton Bay Holdings with recommendations for potable water service, wastewater service and irrigation water for at the time a 300 residential, 225-room hotel, 50 condominium units, a spa area, and refurbished 18-hole golf course.

Cotton Bay has several existing water resources including wellfields and reservoirs. CDM notes that the three (3) reservoirs located to the west of Cotton Bay Road provided water to the golf course ponds for irrigation use to supplement rainfall. A rainfall catchment area which occupies six (6) acres and visible on the 1958 aerial allowed for additional water storage. Apparently, the catchment area and reservoir were only used for a short period of time; the catchment area is now overgrown with vegetation and severe damage to the asphalt surface.

CDM found that based on field investigations and design abstraction rate for irrigation, the golf course ponds do not appear to be a suitable water supply source. The developer proposes reverse osmosis treatment from seawater wells to meet any projected usage need, both for potable and for irrigation. Wastewater treatment plant will offer a second benefit of providing a source of reclaimed water to the golf course. The wastewater treatment process to produce treatment effluent for public access irrigation would be termed as advanced secondary, which would use biological secondary treatment process followed by filtration and high-rate disinfection by chlorination.

Recommendations

2) To landscape greenspace areas in a xeriscape manner which uses natural vegetation along with minimal water trees and plants that rely on the natural, available rainfall.
3) The golf course reconfiguration can incorporate more natural vegetation between fairways and around greens. Such a reconfiguration could be directly related to reducing the required irrigated area.
4) Turf grasses that are either more salt resist or require less water or both.
5) On concern of irrigating with a saline source is getting increasingly more saline water because of the over-pumping and thus creating an environment that could eventually damage the turf grasses and underlying soil.

6.5 Climate Change

Climate change will contribute to greater climate variability where changes may occur to precipitation patterns, increase in frequency and intensity of storm events, extreme heat, global sea level rise, and alteration of wave patterns, leading to shoreline erosion. Given this climate variability, engineering and building designs should plan for a scenario for future high anthropogenic greenhouse gas emissions.

Based on the IPCC Fifth Assessment Report and the CMIP5, climate change will alter existing rainfall patterns in The Bahamas. Climatology data suggest that The Bahamas region will incur a 3 percent decrease in monthly rainfall averages, with an increase of intensity of rainfall events between October and February. Overall, total rainfall is expected to decrease, placing additional pressure on freshwater resources.

6.5.1 Climate Change & Cotton Bay, Eleuthera

With elevations in excess of 45ft along the ridgeline where the residences are location, Cotton Bay is positioned above the expected sea level rise and protected from storm surge. Similarly, the Cotton Bay Resort is located at elevations greater than 10ft with first floor elevations anticipated to be greater than 12ft. The golf course is located at the lowest elevation.

Potable water demand will be met via a reverse osmosis plant and energy demand generated in part by renewable energy sources such as solar. All structures will be built in accordance with The Bahamas Building Code to withstand tropical disturbances. The developer will maintain limited building footprints to encourage preservation of the existing vegetation to maintain biodiversity and limit desertification.

6.6 Hurricanes

The Bahamas is situated in the hurricane zone. Hurricane season begins June 1 and ends November 30, although tropical cyclones may form outside this period. According to the coastal dataset of the NOAA Coastal Service Center, 80 tropical disturbances (tropical storms and hurricanes) have come within 60 nautical miles of Cotton Bay between 1859 and 2020 (Figure 7-7).[5]

In 2016, Hurricane Matthew, a dangerous Category 4, passed to the west of New Providence, sparing it a direct hit; however, western New Providence experienced sustained periods of hurricane force winds and the southern and

5 Hurricane history tracker and database can be found at this link: http://coast.noaa.gov/hurricanes/

eastern coastal areas of the island incurred a storm surge that caused coastal flooding. Storm surges up to 8 ft inundated the southern coastal area of New Providence and Grand Bahama.

Hurricane Dorian, one of the strongest hurricanes on record, made landfall at Elbow Cay, Abaco, in September 2019, with sustained winds of 160 knots. Although more than 90 nautical miles away, New Providence received high winds and rains over several days.

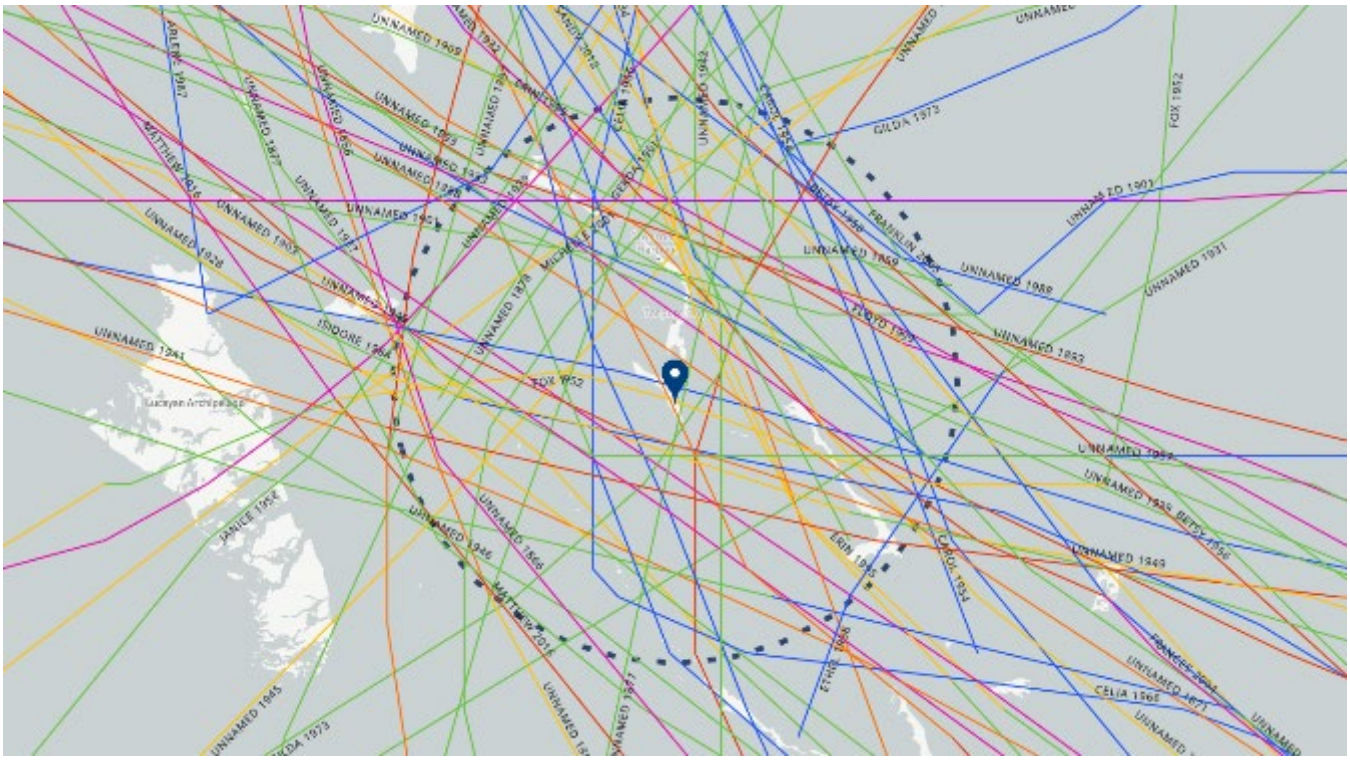


Figure 6-2 NOAA Historical Hurricanes within 60 Nautical Miles of Cotton Bay, Eleuthera, The Bahamas

6.7 Marine Survey Assessment

A marine biological baseline assessment was performed by JSS Consulting Ltd from November 23-24, 2022 and January 17, 2023.

6.7.1 Methodology

The benthic ecosystem of the proposed area for the marine development was assessed using a roving transect method. Three divers swam along transects both parallel and perpendicular to the shoreline. Parallel transects ran the length of the survey area to record shoreline conditions. The perpendicular transects were taken from the shoreline to approximately 250 to 300 ft offshore, with divers swimming in an area approximately 50 ft wide. All flora and fauna species and substrate types were recorded. Species abundance was recorded as Single, Few (2 to 10) or Many (more than 10). The lead diver was responsible for recording fish species presence and abundance so that counts were not duplicated. The other divers would also record observations in the event the lead diver did not observe a certain species. Also, general observations were made for the surveyed areas. Data were collected underwater on slates and transcribed at the end of each day. Photographs and videos were taken. Species

identification was confirmed using Humann et al. (2013), Reef Coral Identification, Humann et al. (2013), Reef Fish Identification, and Humann et al. (2013), Reef Creature Identification. It is highly unlikely that this assessment identifies all the marine species, but it provides a representation of those present on the site.

6.7.1.1 Lagoon Area - Methodology

The lagoon area was assessed using the transect method from the mouth of the lagoon to the mid-inner portion of the lagoon. Spot checks were made around the inner most perimeters. The inventory of the fauna and flora located in the area was recorded. See figure 2 for a benthic habitat map which depicts the areas of observation.

6.7.1.2 Coastal Areas - Methodology

Coastal areas were assessed using random spot checks. Divers randomly selected areas offshore within a 500 feet radius of the proposed area. The benthic substrate of these areas was characterized and inventory of the fauna and flora located in the area were recorded. General observations were also made for the surveyed areas.

6.7.1.3 Water Quality Samples - Methodology

Water quality samples were taken using a multipurpose probe in the surveyed areas during the assessment. A total five (5) samples were taken and recorded.

6.7.1.4 Survey Location

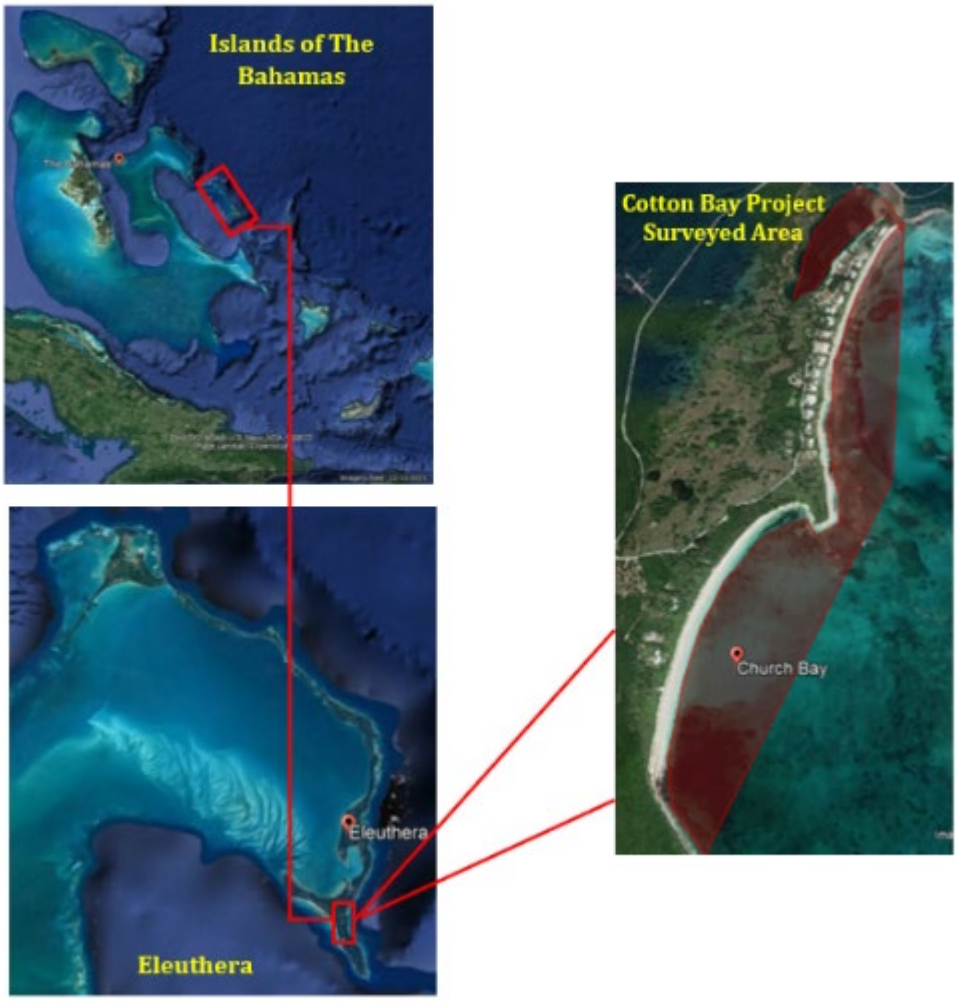


Figure 6-3 Marine Benthic Survey Area

6.7.2 General Site Observation & Description

The weather conditions during this assessment were clear and sunny. High tide was observed as the assessment began at 11:30 am. Water depth was measured to be one to seven feet (0ft- 7ft) in lagoon areas and a maximum depth of twenty-five feet (25ft) in coastal areas. During the assessment ground swells were observed to be three to four feet (3-4ft). Water temperature was 80.2°F. Based on a range of one to ten (1-10), with one (1) being zero visibility and ten (10) being transparent, visibility in the lagoon near the mouth area was seven (7) and near the shoreline was zero (0). While visibility in the coastal areas was nine (9).

A barge and tugboat were observed to have run aground on the coast, south of the lagoon entrance. An excavator, likely to have been on the barge, was observed on the beach. Based on google imagery, it appears that the tugboat

went aground around end of October 2022. Of note, the stretch of homes along the ridge are outside the project area.

Figure 6-4 Immobilized Barge (Outside project area)

Figure 6-5 Immobilized Barge (Outside project area)

6.7.3 Benthic Description

Benthic habitats are comprised of rocky ironshore, rocky shore, mixed sandy bottom & hardbottom, and sandy bottom & seagrass beds. Below are detailed descriptions segregated by location: lagoon and coastal.

6.7.3.1 Lagoon

The benthic composition of the lagoon site had areas that transitioned from macroalgae beds to areas of sparse macroalgae. The main substrate was silt that transitioned to sand near the mouth of the lagoon. The predominant epifauna observed throughout this area was Upsidedown Jellyfish (*Cassiopea spp.*).

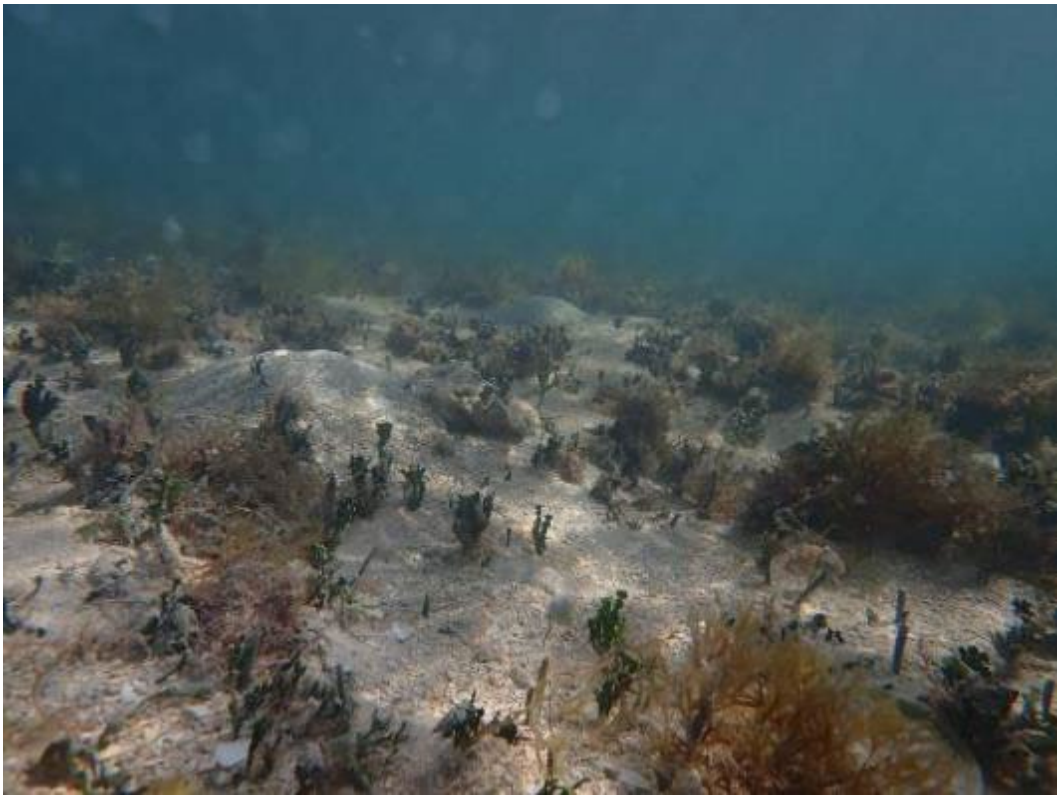


Figure 6-6 Sand with sparse Macroalgae

6.7.3.2 Coastal Area

Coastal areas were observed to transition from sandy-bottom to hardbottom and from hardbottom to reef. Various fleshy, film, and calcareous macroalgae was observed within the assessed areas. The various macroalgae observed in the area were determined to be the predominant flora species. Coral abundance was observed to be relatively low within the assessed areas.

Figure 6-7Hardbottom with macroalgae

6.7.3.3 Marine Benthic Habitat Map

Please see next page.

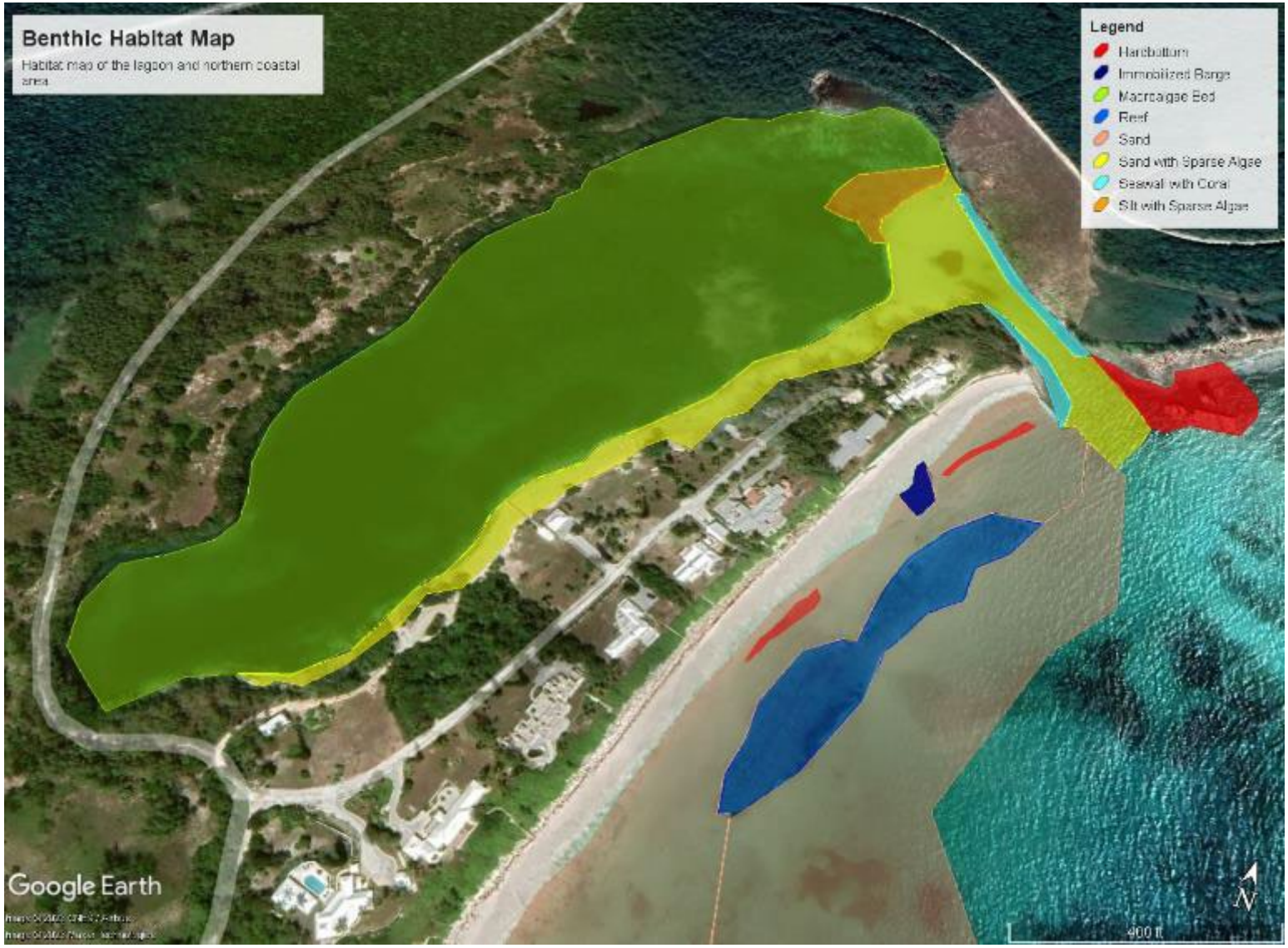


Figure 6-8 Cotton Bay Benthic Habitat Map (Lagoon and Coastal Habitat)

Figure 6-9 Cotton Bay Benthic Habitat Map (Coastal Habitat)

Figure 6-10 Cotton Bay Benthic Habitat Map (Coastal Habitat)

6.7.4 Findings – Marine Benthic Surveys

6.7.4.1 Fish Species - Lagoon

Eight (8) fish species were seen existing in mangrove areas of the proposed site areas.

Table Key for following Tables: Single (1), **Few** (2-9), **Abundant** (10+)

Common Name	Scientific Name	Quantity
Schoolmaster Snapper	*Lutjanus apodus*	Abundant
French Grunt	*Haemulon flavolineatum*	Few
Great Barracuda	*Sphyraena barracuda*	Few
Yellowfin Mojarra	*Gerres cinereus*	Abundant
Gray Snapper	*Lutjanus griseus*	Few
Sergeant Major	*Abudefduf saxatilis*	Few
Silversides, Herrings, Anchovies**	*Atherinidae, Clupeidae*	Abundant
Lemon Shark	*Negaprion brevirostris*	Single

Table 6-2 Fish Species observed during assessment

***Note:** The common name Silverside refers to a group of fish from several different families that are usually found together. It is difficult to distinguish any one particular species when in a large group.

Figure 6-11 Hardbotton with sparse Macroalgae and school of French Grunts (Haemulon flavolineatum)

6.7.4.2 Coral Species - Lagoon

Eight (8) Coral species were observed near lagoon opening areas during the assessment.

Common Name	Scientific Name	Quantity
Finger Coral	*Porites porites*	Few
Mustard Hill Coral	*Porites astreoides*	Few
Boulder Star Coral	*Orbicella annularis*	Few
Lesser Starlet Coral	*Siderastrea radians*	Few
Symmetrical Brain Coral	*Pseudodiploria strigosa*	Few
Boulder Brain Coral	*Colpophyllia natans*	Few
Massive Starlet Coral	*Siderastrea siderea*	Few
Lesser Starlet Coral	*Siderastrea radians*	Few

Table 6-3 Coral species observed during assessment

Figure 6-12 Macroalgae with Lesser Starlet Coral (Siderastrea sp.)

Figure 6-13 Mustard Hill Coral (Porites astreoides)

6.7.4.3 Fauna - Lagoon

Majority of the epifauna species were found either on the sea floor or on rocks that sat on the seafloor and fauna species were found in the surrounding area. Names of Fauna and Epifauna species that were observed during the survey. Three (3) epifauna and two (2) fauna species were observed during this survey.

Common Name	Scientific Name	Quantity
Upsidedown Jellyfish	*Cassiopea spp.*	Abundant
Branching Tube Sponge	*Aiolochria crassa*	Few
Spiny Lobster	*Panulirus argus*	Few
Green Turtle	*Chelonia mydas*	Few
Donkey Dung Sea Cucumber	*Holothuria mexicana*	Few

Table 6-4 Fauna and Epifauna species observed during the assessment.

6.7.4.4 Flora- Algae, Seagrass, and Seaweed Species - Lagoon

Nine (9) Flora species were found throughout the survey site.

Common Name	Scientific Name
Red Algae	*Rhodophyta spp.*
Mermaid's Fan	*Udotea sp.*
White Mermaid's Wineglass	*Acetabularia crenulata*

Green Jointed Stalk Algae	*Halimeda monile*
Fuzzy Tip Algae	*Dasycladus vermicularis*
Y Branched Algae	*Dictyota sp.*
Mermaid Shaving Brush	*Penicillus capitatus*
Bristle Ball Brush	*Penicillus dumetosus*
Flat Top Bristle Brush	*Penicillus pyriformis*

Table 6-5 Flora Species observed during assessment

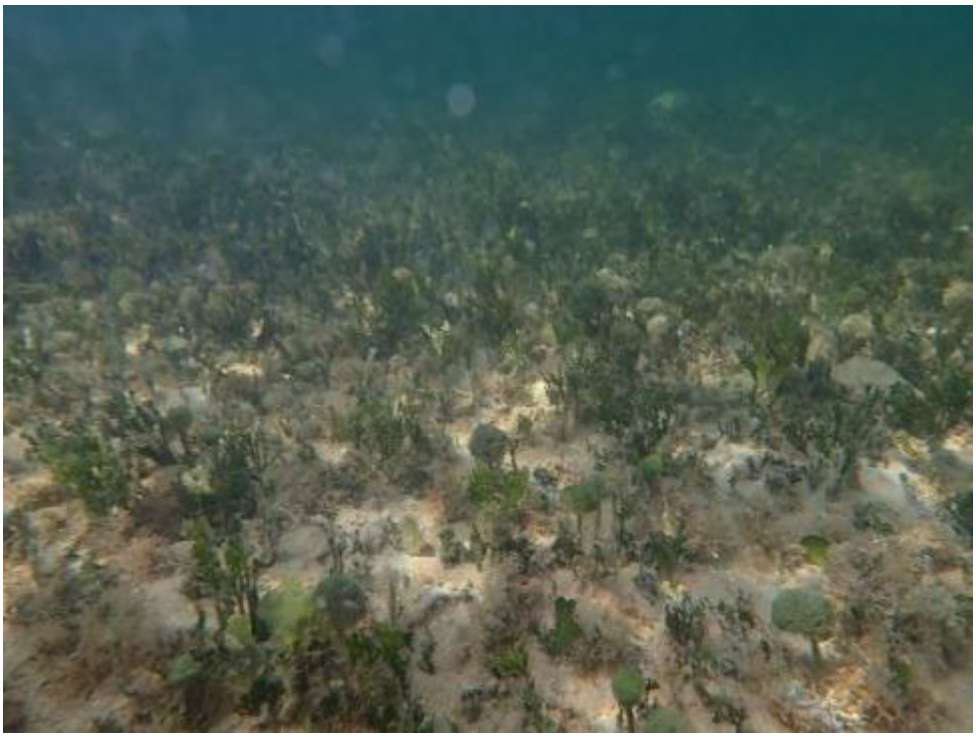


Figure 6-14 Green Macroalgae Bed

6.7.4.5 Fauna - Coastal Area

Table Definitions Key: Single (1), **Few** (2-9), **Abundant** (10+)

6.7.4.6 Fish Species

Three (3) Fish species were seen existing in lagoon areas and offshore from the coastline of the proposed site areas.

Common Name	Scientific Name	Quantity
Schoolmaster Snapper	*Lutjanus apodus*	Few
Yellowfin Mojarra	*Gerres cinereus*	Few
Gray Snapper	*Lutjanus griseus*	Few

Table 6-6 Fish Species observed during assessment

6.7.4.7 Coral Species – Coastal area

Seven (7) Coral species were observed on reef and hard bottoms areas during the assessment.

Common Name	Scientific Name	Quantity
Mustard Hill Coral	*Porites astreoides*	Abundant
Finger Coral	*Porites porites*	Few
Massive Starlet Coral	*Siderastrea siderea*	Few
Boulder Star Coral	*Orbicella annularis*	Few
Mountainous Star Coral	*Orbicella faveolata*	Few
Symmetrical Brain Coral	*Pseudodiploria strigosa*	Few
Knobby Brain Coral	*Pseudodiploria clivosa*	Few

Table 6-7 Coral species observed during assessment

Figure 6-15 Reef system showing coral and algae in the coastal area.

Figure 6-16 Mustard Hill Coral (Porites astreoides) and Mountainous Star Coral (Orbicella faveolate)

6.7.4.8 Other Fauna – Coastal Area

Majority of the epifauna species were found either on the sea floor or on rocks that sat on the seafloor during this assessment and fauna species were found in the surrounding area. One (1) epifauna species and one (1) fauna species was observed during the survey.

Common Name	Scientific Name	Quantity
Southern Stingray	*Dasyatis americana*	Single
Donkey Dung Sea Cucumber	*Holothuria mexicana*	Single

Table 6-8 Epifauna and Fauna species observed during the assessment.

6.7.4.9 Flora, algae, Seagrass, and Seaweed Species – Coastal Areas

Nine (9) Flora species were found throughout the survey site.

Common Name	Scientific Name
Sargassum	*Sargassum fluitans*
Fuzzy Tip Algae	*Dasycladus vermicularis*
Tubular Thicket Algae	*Galaxaura sp.*
Green Jointed Stalk Algae	*Halimeda monile*
Bristle Ball Brush	*Penicillus dumetosus*
Red Calcareous Algae	*Galaxaura sp.*
White Scroll Alga	*Padina jamaicensis*
Y Branched Algae	*Dictyota sp.*
Turtle Grass	*Thalassia testudinum*

Table 6-9 Flora species observed during the assessment

Figure 6-17 Sandybottom with Seagrass

Figure 6-18 Hardbottom with attached macroalgae.

6.7.5 Commercially Important, Endangered & Invasive Species

Commercially important species observed include the queen conch and Nassau grouper though in low abundance. There were no invasive species observed.

6.7.6 Water Quality

Water quality readings were taken using an Apera Instrument LLC-AI3719, which measured pH, conductivity, temperature and salinity. Turbidity was measured by a SPER Scientific 860040 turbidity meter. Readings were taken prior to divers entering the water.

The purpose of the testing was to provide baseline water quality information for Cotton Bay. All the parameters measured were within the normal range and did not show signs of any abnormalities, such as issues with runoff or pollution. Depending on the proposed activities, it is recommended that the water quality be monitored during construction and operation phases of the development to identify data trends and potential impacts on the environment. For example, if the range of readings expands substantially for a particular parameter or becomes markedly inconsistent over a period of time, it could mean that the environment is being stressed.

Cotton Bay Water Quality Results

Water Sample	Latitude	Longitude	Temperature (ºC)	PH	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Total Dissolved Solids (g/L)
1	24°45'56.94"N	76°11'23.86"W	24.9	8.4	39	0.0	0.00	35.0
2	24°45'59.19"N	76°11'12.79"W	25.9	8.4	39	0.0	0.00	34.8
3	24°45'52.69"N	76°11'14.29"W	24.7	8.4	37	1.3	0.00	33.4
4	24°45'25.15"N	76°11'15.52"W	24.7	8.4	37	2.1	0.00	33.4
5	24°45'9.06"N	76°11'31.59"W	23.7	8.3	38	0.5	0.00	34.4

Table 6-10 Cotton Bay Water Quality Results

6.7.7 Discussion

The project area consists of a lagoon that is surrounded by healthy Red Mangrove (*Rhizophora mangle*). The benthic habitat composition of the lagoon consisted predominately of green macroalgae. The benthic habitat for the coastal areas consists of sandy bottom, reef and hardbottom areas. The sandy bottom areas were observed to have sparse macroalgae, predominately calcareous green macroalgae and seagrass. On the reef, the dominant algae type observed was red calcareous algae and fleshy green macroalgae. In hardbottom areas some sections were covered in sargassum seaweed and others had sparse macroalgae. Clear sandybottom areas were observed in the coastal areas near the shoreline. Additionally, patches of dead seagrass were also observed in the coastal areas near the shoreline.

The fish activity throughout the site varied from low to moderate in the lagoon and coastal areas. Fish diversity in the lagoon site ranged from low to moderate, from the inner lagoon area to the mouth. Fish activity was observed to be relatively low in the coastal areas when compared to the lagoon. This may be due to the area assessed being considered an area of high energy. Overall, most of the fish activity occurred near the mouth of the lagoon area.

Coral abundances were observed to be low during the coastal assessment. The overall density increased from the fore reef to the back reef of the assessed area. All corals that were observed in this area were observed to be in relatively good condition. No bleaching or signs of Stony Coral Tissue Loss Disease were observed during this assessment. In the lagoon area, the highest coral density and abundance were in the mouth of the lagoon.

The potential threat to this area would be leeching. However, based on the proposed work the potential risk of chemicals leaking into the area is considered to be a moderate risk and the risk of long-term effects is considered to be low, due to the consistently high energy observed. This high energy supports a natural flushing system that allows for the threats of the proposed works and its long-term effects to be low.

Overall, the benthic habitats appeared healthy and consist of typical flora and fauna populations. The water quality parameters were also within normal range.

6.8 Botanical Assessment

Field studies were conducted on 27-30 October 2022 by Design Elements. The purpose of the study was to map vegetation types, determine floristic diversity, identify the presence and abundance of invasive species and to conduct a protected species survey.

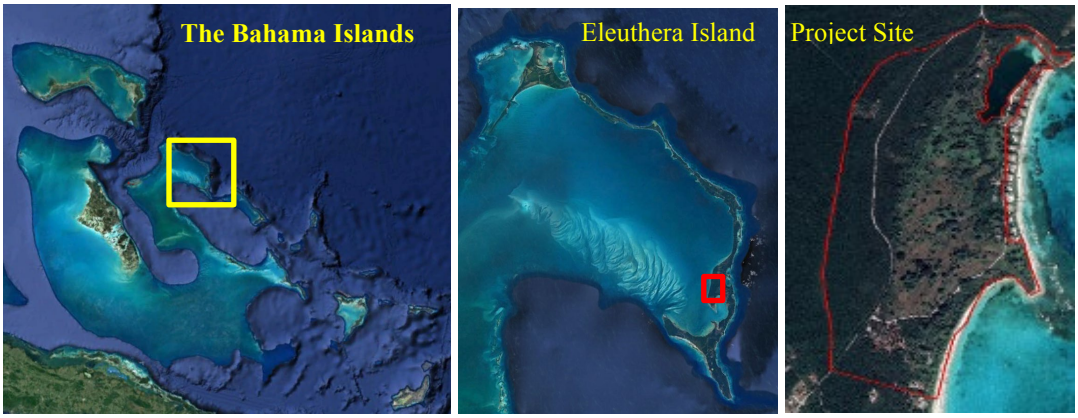


Figure 6-19 Project Location, Cotton Bay, Eleuthera

6.8.1 Methodology

Vegetation types were mapped by examining aerial photography then verified by walking along the shoreline, roads and within interior upland vegetation. Vegetation Type taxonomy are based on Areces et al. (1999). Vascular plant species occurring in each vegetation type were recorded and used to compile a floral list. Plant taxonomy is based on Corell and Corell (1982) and

http://www.levypreserve.org/_m1810/Plants-Scientific-Name. The presence, location and abundance of vascular species listed on the National Invasive Species Strategy for The Bahamas, 2013 were noted when encountered. A protected species survey was conducted for species listed on the Forestry Act Declaration of Protected Trees Order (2021); a detailed method statement on the protected species survey is provided.

6.8.2 Terrestrial Ecosystems Identified

The three (3) major categories of non-terrestrial and terrestrial ecosystems at the site are Coastal, Wetland and Interior Upland.

The results of the quantitative analysis of the vegetation types represented are detailed in the table below. Descriptions and qualitative analysis are detailed in the sections that follow.

Vegetation Cover	Area (Acres)	% Survey Area
Interior Upland		
Dry Broadleaf Evergreen Formation	**169.80**	**40.72**
Wetlands		
Coastal lagoon	2.36	0.57
Cisterns	0.3	0.07
Golf Course Ponds	17.94	4.30
	20.6	**4.94**
Human Altered Areas		
Existing Asphalt Road	5.20	1.25
Invasive Species dominated (including Sandy Shore & Rocky Shore)	217.94	52.26
	223.14	**53.51**
	413.54	**99.17**

Table 6-11 Quantitative Description of Vegetation Types for Cotton Bay, Eleuthera, The Bahamas

6.8.3 Coastal

Coastal terrestrial ecosystems are those areas that are near the shoreline which are exposed to wind, salt spray and or periodic inundation. The Eastern boundary of the site lies along the coastline. Land cover along the coast at the site include Sandy shoreline and Rocky shoreline which are described in the sections that follow; and coastal wetland features, and Human Altered areas.

Sandy shoreline is present along the southeastern boundary of the project site. There are two formations separated by a section of Rocky shoreline. The shoreline is human impacted and the vegetation present is dominated by invasive species including *Casuarina equisetifolia* (Australian Pine) and *Scaevola taccada*

(Hawaiian Sea grape). Other vegetation present in lesser quantities include native species typical of sandy shorelines in The Bahamas such as *Uniola paniculata* (Sea Oats), *Tournfortia gnapholodes* (Bay Lavander) *Suriana maritima* (Bay Cedar) and *Sesuvium portulacastrum* (Sea purslane).

Figure 6-20 Southeastern Sandy shore (Left - view facing South, Right - view facing West)

Figure 6-21Interior of Southeastern Sandy shoreline showing invasive species

Figure 6-22 Eastern Sandy Shoreline (view facing North)

6.8.3.1 Coastal – Rocky Shoreline

Rocky shoreline formation along the coast includes accumulated gravel with no vegetation present along the coast and within the lagoon perimeter as well as ironshore with the invasive *Casuarina equisetifolia* (Australian Pine) and *Scaevola taccada* (Hawaiian Sea grape). Native species included *Sesuvium portulacastrum* (Sea purslane) and *Sporobolus virginicus* (Seashore rush grass) sparsely distributed in rock crevice in front of invasive species. *Rhachicallis americana* (Sandfly Bush) that typically dominates rocky shorelines was noticeable absent.

Figure 6-23 Ironshore along coastline (view facing west)

Figure 6-24 Gravel Rocky Shore along coast (view facing North to Ironshore)

Figure 6-25 Section of Gravel Rocky shoreline on perimeter of lagoon

6.8.4 Wetland

Wetlands exist in a transition zone between the aquatic and terrestrial environments. Neither terrestrial nor aquatic, wetlands have unique characteristics that allow for a distinct classification. The Bahamas is a signatory to the Convention on Wetlands of International Importance for Waterfowl Habitat, also known as the Ramsar Convention. Ramsar defines wetlands as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters." Wetlands of The Bahamas are categorized as either coastal or inland wetlands. Wetland features on the site included a natural coastal feature and inland man-made formations.

6.8.4.1 Coastal Lagoon

There is a large lagoon that has an opening to the coast in the northernmost section of the site. This feature has human alterations primarily along the eastern perimeter however, the majority of the western boarder has *Rhizophora mangle* (Red Mangrove) with an average of 15-20 feet in height along the fringe. Other vegetation present include species typically associated with Red Mangrove formations such as *Avicennia germinans* (Black Mangrove), *Laguncularia racemosa* (White mangrove), *Conocarpus erectus* (Buttonwood) and *Thespesia populnea* (Cork Tree).

Figure 6-26 Red Mangrove along lagoon fringe

6.8.4.2 Golf Course Ponds

There are fifteen (15) small man-made ponds within the golf course area of the site. These features range in size from 0.11 to 1.2 acres. Substrate conditions within the ponds ranged from saturated to standing water 1-2 feet in depth. Vegetation surrounding the ponds was typically *Cladium jamaicense* (Sawgrass). Associated species included wetland species such as *Thespesia populnea* (Cork Tree), *Sabal palmetto* (Sabal Palm), *Sesuvium portulacastrum* (Sea purslane) and *Typha domingensis* (Cattail). The invasive *Casuarina equisetifolia* (Australian Pine) is present on the outer periphery of many of the formations.There is a large *Ficus benghalesis* (Banyan Tree) on periphery of one of the Golf Course Ponds.

Figure 6-27 Golf Course Pond with Saw grass and Australian Pine

Figure 6-28 Large Banyan Tree on periphery of Golf Course Pond

6.8.4.3 Cisterns

There are three (3) concrete cisterns in the interior upland vegetation that has rainwater accumulation. *Eleocharis cellulosa* (Spike rush grass) is the predominant vascular plant species within these structures. Other species present include *Cladium jamaicense* (Sawgrass) and *Casuarina equisetifolia* (Australian Pine).

Figure 6-29 Cisterns in the interior upland vegetation

Interior upland habitats are terrestrial areas that are located at a distance from the coastline where they are protected from salt spray and wind impact. These areas typically have a greater species diversification in comparison to coastal and wetland habitats and can be highly variable in vegetation height and species composition depending on location and physical parameters such as soil and moisture availability.

Upland vegetation within the survey area include human altered sections on the eastern side of the site closer to the coastal vegetation and native Dry Broadleaf Evergreen Formation (DBEF) vegetation on the western elevated side of the site.

DBEF vegetation on the site is 25-30 feet in height with a closed canopy. Growth forms present including trees, shrubs, vines and epiphytes. Trees common in the canopy area include native species such as *Bursera simarouba* (Gum Elemi), *Thounia discolor* (Quicksilver), *Coccoloba diversifolia* (Pigeon Plum) and *Metopium toxiferum* (Poisonwood). There is no distinct shrub layer present. Shrubs are more prevalent along road verges and include native species such as *Croton linearis* (Granny bush), *Croton eluteria* (Cascarilla), *Erithalis fruticosa* (Black torch) and *Lantana involucrata* (Wild Sage). Vines including *Smilax havanensis* (China Brier), *Passiflora suberosa* (Juniper Berry) and *Cassytha filiformis* (Love vine). Other herbaceous species include an abundance of *Tillandsia utriculata* (Wild Pine).

Karst features (dissolution holes) are common in the DBEF.

Figure 6-30 Interior of DBEF (right - Section with concentration of Tillandsia utriculata (Wild Pine))

Figure 6-31Abundance of karst features (dissolution holes) in DBEF

6.8.5 Human Altered

The site is previously developed and there are large areas in the eastern section that were cleared of native vegetation. Human altered areas which include the golf course and surrounding areas are dominated by invasive species.

Figure 6-32 Stand of Casuarina glauca (Suckering Australian Pine) on Golf Course

Figure 6-33 Stand of Casuarina equisetifolia (Australian Pine) in background with field of Ipomoea purpurea (Morning Glory) in foreground

Figure 6-34 Interior of Casuarina equisetifolia (Australian Pine) stand near lagoon

6.8.6 Vegetation Map

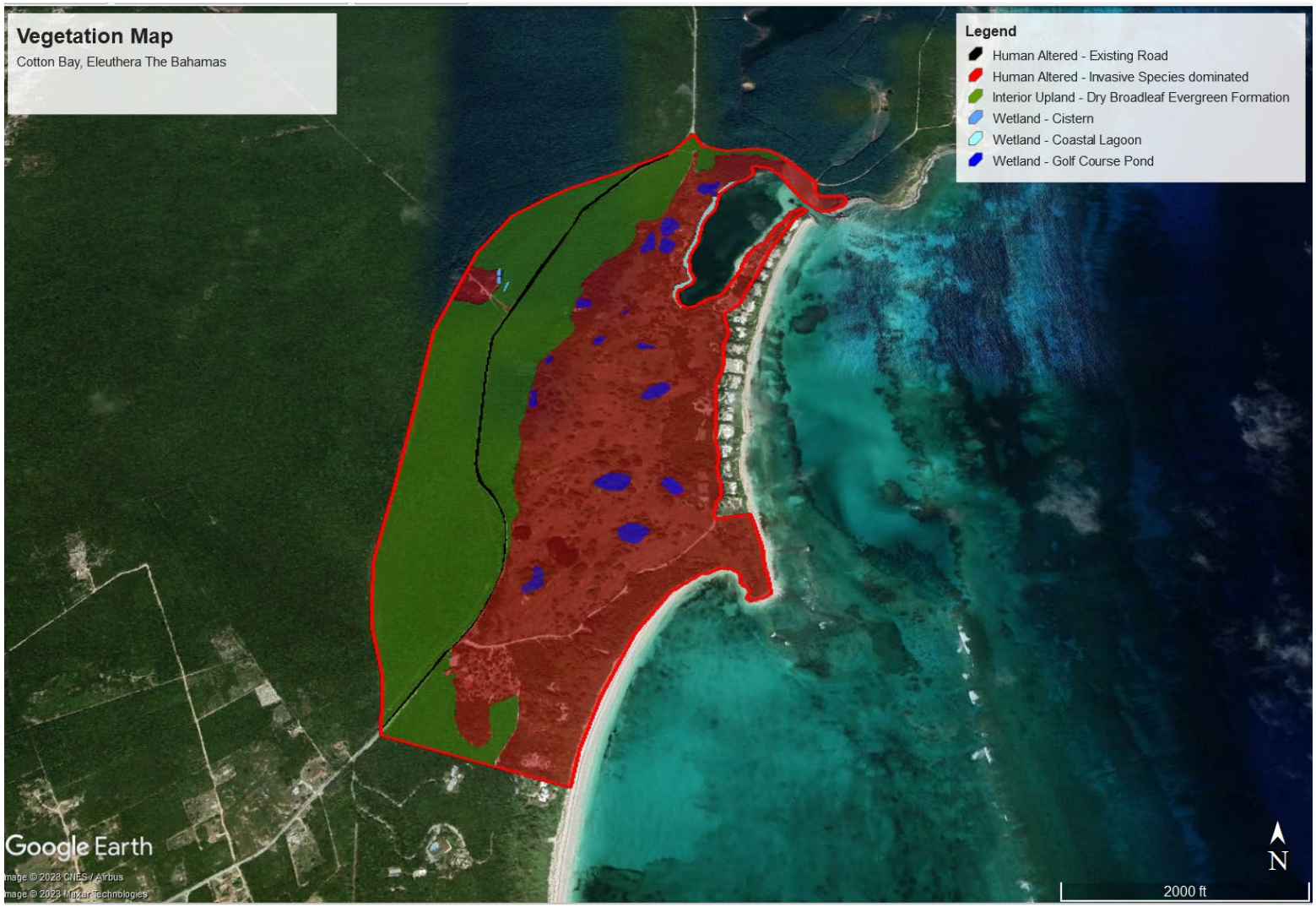


Figure 6-35 Vegetation Map, Cotton Bay, Eleuthera

6.8.7 Vascular Plant Diversity

A total of one hundred & forty-eight (148) species were recorded on the site. It is highly unlikely that this number represents all the species present on the site, however it is a fair representation of the species common in the vegetation types on the site.

Table Key: SS = Sandy Shoreline, **RS** = Rocky Shoreline, **DBEF** = Dry Broadleaf Evergreen Formation, **W** = Wetland, **HA =** Human Altered

Botanical Name	Common Name	Location				
		SS	RS	DBEF	W	HA
1. *Acacia choriophylla*	Cinnecord			√		
2. *Agave sisalana*	Sisal			√		√
3. *Amyris elemifera*	White torch			√		
4. *Andropogon glomeratus*	Bushy beard grass					√
5. *Angadenia sargraei*	Liceroot			√		
6. *Araucaria heterophylla*	Norfolk Pine					√
7. *Asystasia gangetica*	Creeping Foxglove					√
8. *Avicennia germinans*	Black mangrove	√	√		√	
9. *Baccharis angustifolia*	Saltbush			√	√	√
10. *Bidens alba*	Shepherd's needle					√
11. *Borrichia arborescens*	Bay marigold				√	
12. *Bourreria ovata*	Strongback			√		
13. *Bursera simaruba*	Gum elemi			√		√
14. *Caesalpinia bonduc*	Nicker Bean					√
15. *Cakile lanceolata*	Sea rocket	√			√	
16. *Capraria biflora*	Goat weed					√
17. *Carissa macrocarpa*	Natal Plum					√
18. *Casasia clusifolia*	Seven-year apple	√				
19. *Casearia nitida*	Smooth Casearia			√		
20. *Cassytha filiformis*	Love Vine			√		√
21. *Casuarina equisetifolia*	Australian Pine	√	√			√
22. *Casuarina glauca*	Suckering Australian Pine					√

Botanical Name	Common Name	Location				
		SS	RS	DBEF	W	HA
23. *Cenchrus incertus*	Sand Bur	√				√
24. *Chiococca alba*	Snowberry			√		
25. *Chrysobalanus icaco*	Coco plum					√
26. *Cladium jamaicense*	Saw grass				√	
27. *Coccoloba diversifolia*	Pigeon plum			√		
28. *Coccoloba swartzi*	Tie tongue			√		
29. *Coccoloba tenuifolia*	Bahama Pigeon plum			√		
30. *Coccoloba uvifera*	Sea grape	√	√	√		
31. *Coccothrinax argentata*	Silver top palm			√		√
32. *Cocos nucifera*	Coconut Palm	√				√
33. *Colubrina arborescens*	Soap bush			√		
34. *Conocarpus erectus*	Buttonwood				√	
35. *Conocarpus erectus var. sericeus*	Silver Buttonwood			√	√	
36. *Corchorus hirsutus*	Wholly booger			√		
37. *Crossopetalum ilicifolium*	Wild cherry			√		√
38. *Croton eluteria*	Cascarilla			√		
39. *Croton linearis*	Granny bush			√		√
40. *Cynanchum sp.*	Cynanchum			√		
41. *Cyperus planifolius*	Coastal sedge	√				
42. *Dactyloctenium aegyptium*	Crow foot grass					√
43. *Delonix regia*	Poinciana					√
44. *Dichromena colorata*	Star sedge			√	√	
45. *Diospyros crassinervis*	Featherbed			√		
46. *Dracena sp.*	Dracena					√
47. *Drypetes diversifolia*	Whitewood			√		
48. *Echites umbelatta*	Devil's potato			√		√
49. *Eleocharis cellulosa*	Spike rush grass				√	

Botanical Name	Common Name	Location				
		SS	RS	DBEF	W	HA
50. *Eleusine indica*	Fowl foot grass					√
51. *Encyclia sp.*	Orchid			√		√
52. *Erithalis fruticosa*	Black torch			√		
53. *Erythroxylum areolatum*	Paper berry			√		
54. *Erythroxylum rotundifolium*	Rat wood			√		
55. *Eugenia axillaris*	White stopper			√		
56. *Eugenia foetida*	Spanish stopper			√		
57. *Euphorbia heterophylla*	Jacob's ladder					√
58. *Exostema caribaeum*	Princewood			√		
59. *Exothea paniculata*	Inkwood			√		
60. *Ficus aurea*	Golden Wild Fig			√		√
61. *Ficus benghalesis*	Banyan Tree					√
62. *Ficus citrifolia*	Short leaf Ficus			√		
63. *Galatchia rudolphioides*	Milk pea			√		
64. *Guaiacum sanctum*	Lignum Vitae			√		
65. *Guapira discolor*	Longleaf blolly			√		
66. *Guapira obtusata*	Broad leaf blolly			√		
67. *Guettarda elliptica*	Smooth velvet leaf			√		
68. *Gymnanthes lucidus*	Crabwood			√		
69. *Haematoxylum campechianum*	Log wood			√		
70. *Helicteres jamaicensis*	Cow bush			√		√
71. *Heliotropium angiosperum*	Rooster comb					√
72. *Hymenocallis arenicola*	Spider lily	√				
73. *Hypelate trifoliata*	White Ironwood			√		
74. *Ipomoea imperati*	Beach Morning Glory					√
75. *Ipomoea pes-caprae*	Railroad vine					√
76. *Ipomoea purpurea*	Morning Glory					√

Botanical Name	Common Name	Location				
		SS	RS	DBEF	W	HA
77. *Jacaranda caerulea*	Jacaranda			√		√
78. *Jacquemontia havanensis*	Havana Cluster vine			√		
79. *Jacquinia berteroi*	Coppice Joewood			√		
80. *Jasminum fluminense*	Jasmine vine					√
81. *Krugiodendron ferreum*	Black iron wood			√		
82. *Laguncularia racemosa*	White mangrove				√	
83. *Lantana bahamensis*	Wild Sage			√		
84. *Lantana involucrata*	White Sage			√		
85. *Lasiacis divarcata*	Wild bamboo			√		
86. *Leucaena leucocephala*	Jumbay					√
87. *Lysiloma latisiliquum*	Wild Tamarind			√		
88. *Malpighia polytricha*	Touch me not			√		
89. *Manilkara jaimiqui subsp. emarginata*	Wild dilly				√	
90. *Manilkara zapota*	Sapodilla			√		
91. *Melochia tomentosa*	Tea Bush					√
92. *Metopium toxiferum*	Poison wood			√		
93. *Myricanthes fragrans*	Pale Stopper			√		
94. *Myriopus volubilis*	Soldier Vine			√		
95. *Oeceoclades maculata*	Spotted ground orchid			√		
96. *Oplonia spinosa*	Prickly bush			√		
97. *Pandanas sp.*	Screw Pine					√
98. *Passiflora suberosa*	Devil Pumpkin			√		√
99. *Phyla nodiflora*	Cape weed					√
100. *Phyllanthus epiphyllanthus*	Rock bush			√		
101. *Piscidia piscipula*	Jamaica Dogwood			√		
102. *Pithecellobium keyense*	Ram's horn			√		
103. *Pseudophoenix sargentii*	Buccaneer palm					√

Botanical Name		Common Name	Location				
			SS	RS	DBEF	W	HA
104.	*Psidium guajava*	Guava					√
105.	*Psychotria ligustrifolia*	Bahama Wild coffee			√		
106.	*Randia aculeata*	Randia			√		
107.	*Reynosia septentrionalis*	Darling plum			√		
108.	*Rhizophora mangle*	Red Mangrove				√	
109.	*Sabal palmetto*	Sabal Palm				√	√
110.	*Scaevola taccada*	Hawaiian Sea Lettuce	√	√			
111.	*Schinus terebinthifolia*	Brazilian Pepper					√
112.	*Scleria lithosperma*	Slender-nut Rush			√		
113.	*Sesuvium portulacastrum*	Sea Purslane	√	√		√	
114.	*Sida acuta*	Wire weed					√
115.	*Sideroxylon americana*	Milkberry			√		
116.	*Sideroxylon foetidissimum*	Mastic			√		
117.	*Sideroxylon salicifolia*	Willow Bustic			√		
118.	*Smilax auricalata*	Green China berry			√		
119.	*Smilax havanensis*	China brier			√		
120.	*Solanum bahamense*	Canker berry					√
121.	*Solanum erianthum*	Salve Bush					√
122.	*Spermacoce laevis*	Button weed					√
123.	*Spigelia anthelmia*	West India Pinkroot					√
124.	*Sporobolus virginicus*	Seashore rush grass	√			√	
125.	*Stacytarpheta jamaicensis*	Blue flower					√
126.	*Stemodia maritima*	Obeah bush				√	
127.	*Suriana maritima*	Bay cedar	√	√		√	
128.	*Tabebuia bahamensis*	Five finger			√		
129.	*Terminalia catappa*	West Indian Almond					√
130.	*Terminalia spinosa*	Black Olive					√

Botanical Name		Common Name	Location				
			SS	RS	DBEF	W	HA
131.	*Thespesia populnea*	Cork tree					√
132.	*Thounia discolor*	Quicksilver			√		
133.	*Tillandsia utriculata*	Wild Pine			√		
134.	*Tournfortia gnapholodes*	Bay Lavander	√				
135.	*Tradescantia spathacea*	Moses in basket					√
136.	*Tridax procubense*	Goat bush					√
137.	*Turnera ulmifolia*	Buttercup			√		√
138.	*Typha domingensis*	Cattail				√	
139.	*Uniola paniculata*	Sea Oats	√				
140.	*Vallesia antillana*	Pearl Berry			√		
141.	*Varronia bahamensis*	Blood berry			√		
142.	*Vinca rosea*	Periwinkle					√
143.	*Waltheria indica*	Sleeping Morning					√
144.	*Wedelia bahamensis*	Rong Bush					√
145.	*Yucca aloifolia*	Yucca					√
146.	*Zanthoxylum coriaceum*	Hercules Club			√		
147.	*Zanthoxylum fagara*	Wild lime			√	√	√
148.	*Zapoteca formosa*	White Zapoteca			√		

Table 6-12 Table of Floristic Diversity, Cotton Bay, Eleuthera

6.8.8 Invasive Species

Ten (10) invasive species were observed on the site. These species are listed below along with recommendations for management as outlined in the National Invasive Species Strategy for the Bahamas, 2013.

Table 6-13 Invasive Species Recorded on Cotton Bay, Eleuthera, The Bahamas		
Botanical Name	Common Name	Management
Casuarina equisetifolia	Australian pine	Control
Casuarain glauca	Suckering Australian Pine	Eradication
Delonix regia	Royal poinciana	Control
Haematoxylum campechianum	Logwood	Control
Ipomoea purpurea	Morning Glory	Control

Table 6-13 Invasive Species Recorded on Cotton Bay, Eleuthera, The Bahamas		
Botanical Name	Common Name	Management
Jasminum fluminense	Jasmine vine	None listed
Leucaena leucocephala	Jumbay	Control
Scaevola taccada	Hawaiian seagrape	Eradication
Thespesia populnea	Cork Tree	None listed
Schinus terebinthifolia	Brazilian Pepper	Eradication

6.8.9 Protected Tree Species & Native Species of Conservation Concern

The Forestry Act Declaration of Protected Trees Order 2021 lists one hundred and twenty-seven (127) vascular plant species as protected. Eighty-six (86) species are listed as Endemic or Endangered or Threatened and forty-one (41) are listed as Cultural or Historical and Economic.

Eighteen (18) species listed on the Forestry Act Declaration of Protected Trees Order 2021 was recorded in the survey areas (see able 2-4). Three (3) species is listed under the subsection "Endemic or Endangered or Threated" and the remaining fifteen (15) species recorded are listed under the subsection "Cultural or Historical and Economic".

6.8.9.1 Method Statement – Protected Tree Survey

Twelve (12) 0.1-acre temporary survey plots were established in the DBEF vegetation (See Figure 2-2 for survey plot locations and table 2-5 for survey results).

The plots were sized using a measuring tape and the area outlined with orange flag tape. Once the plots were established, the amount of each protected species within the area was counted. To avoid double counting or missing a plant, tags were placed on individual plants when counted. The results of the surveys are detailed in the sections that follow.

To estimate the number of protected species that may be impacted in the approximately 170 acres of native DBEF vegetation, the average number of each species recorded in the 0.1-acre plots was multiplied to by 10 to calculate the number for each species that are likely to be in 1-acre. The calculations for 1-acre was multiplied by the total number of acres to be impacted for the overall number of species within the vegetation type.

Figure 6-36 Protected Tree Species Survey Locations

6.8.9.2 Total Number of Protected Trees Identified

A total of 18 protected species were recorded on the site, including endemic or endangered or threatened and cultural or historical and economic.

Table 6-14 Protected Species Recorded on Cotton Bay, Eleuthera, The Bahamas		
Species Recorded		Status
Botanical Name	Common Name	
Avicennia germinans	Black mangrove	CHE
Bursera simaruba	Gum elemi	CHE
Coccothrinax argentata	Silver top palm	CHE
Conocarpus erectus	Buttonwood	CHE
Croton eluteria	Cascarilla	CHE
Guaiacum sanctum	Lignum vitae	CHE
Guapira discolor	Beef wood	CHE
Ipomea pes-caprae	Railroad vine	CHE

Table 6-14 Protected Species Recorded on Cotton Bay, Eleuthera, The Bahamas		
Species Recorded		Status
Botanical Name	Common Name	
Laguncularia racemosa	White mangrove	CHE
Lysiloma latisiliquum	Wild tamarind	CHE
Pseudophoenix sargentii	Buccaneer palm	CHE
Rhizophora mangle	Red mangrove	CHE
Sabal palmetto	Sabal Palm	CHE
Thouinia discolor	Quicksilver	EET
Turnera ulmifolia	Bahamian buttercup	CHE
Uniola paniculata	Sea oats	CHE
Varronia bahamensis	Blood Berry	EET
Wedelia bahamensis	Rong Bush	EET
Key: EET = Endemic or Endangered or Threatened, CHE = Cultural or Historical and Economic		

6.8.9.3 Protected Tree Survey Results

See next page.

Botanical Name	Common Name	Plot #												Total recorded	Average per plot	Estimated per acre	Estimated for 170 acres
		1	2	3	4	5	6	7	8	9	10	11	12				
Bursera simaruba	Gum Elemi	30	34	15	4	21	23	20	24	22	18	23	4	238	10.3	103.5	17,595
Coccothrinax argentata	Silver Palm	2			1			2			5	1	1	12	0.5	5.2	884
Croton eluteria	Cascarilla											3	3	6	0.3	2.6	442
Guaiacum sanctum	Lignum vitae			1	2	1		1		1				6	0.3	2.6	442
Guapira discolor	Blolly		1		1				3		1	3	3	12	0.5	5.2	884
Lysiloma latisiliquum	Wild Tamarind											2		2	0.1	0.9	153
Pseudophoenix sargentii	Buccaneer Palm	14	3	19		3		2		2	32	1	1	77	3.3	33.5	5,695
Thouinia discolor	Silver Leaf					1			10		6	6	2	25	1.1	10.9	1,853
Turnera ulmifolia	Buttercup	1												1	0.0	0.4	68
Estimated Total Protected Species in Dry broadleaf evergreen formation vegetation type																165	28.016

Table 6-15 Number of Protected species recorded in survey for Cotton Bay, Eleuthera, The Bahamas

6.9 Avian Assessment

An avian survey was conducted by Design Elements to identify the presence, abundance, and habitat utilization of avian species within the boundaries of the site.

6.9.1 Avian Methodology

The assessment comprised of fifteen (15) hours of active avian and ecological observation conducted over four (4) days between 27-30 October 2022.

The avifauna of the area was assessed and recorded by walking along shoreline and wetland periphery within existing interior upland trails . Species numbers were recorded in the abundance categories, Single, Few (2-10) and Many (11-100). Species recorded were compiled for final abundance estimates. The taxonomic order and nomenclature follow Howard and Moore 4th edition (incl. corrigenda vol.1-2). Status is based on International Union for Conservation of Nature (IUCN).

6.9.2 Avifauna Observed & Species Diversity

A total of forty-three (43) species were recorded during the investigation.

Common Name	Scientific Name	Range	Status	Observation	Habitat
ANSERIFORMES: Anatidae					
1. Blue-winged Teal	*Spatula discors*	WRN	LC	F	W
2. White-cheeked Pintail	*Anas bahamensis*	PRB	LC	F	W
PHOENICOPTERIFORMES: Podicipedidae					
3. Least Grebe	*Tachybaptus dominicus*	PRB	LC	F	HA/W
COLUMBIFORMES: Columbidae					
4. Eurasian Collared Dove	*Streptopelia decaocto*	PRB	I	F	HA
5. White-crowned Pigeon	*Patagioenas leucocephala*	PRB	NT	M	IU/HA/W
6. Zenaida Dove	*Zenaida aurita*	PRB	LC	F	IU/HA
7. Mourning Dove	*Zenaida macroura*	PRB	LC	F	IU/HA
8. Common Ground Dove	*Columbina passerina*	PRB	LC	M	IU/HA
CAPRIMULGIFORMES: Trochilidae					
9. Bahama Woodstar	*Nesophlox evelynae*	PRB/E	LC	F	IU/HA
CUCULIFORMES: Cuculidae					
10. Smooth-billed Ani	*Crotophaga ani*	PRB	LC	M	HA
11. Yellow-billed Cuckoo	*Coccyzus americanus*	WRN*	LC	F	HA
GRUIFORMES: Rallidae					
12. Common Gallinule	*Gallinula galeata*	PRB	LC	S	W

Common Name	Scientific Name	Range	Status	Observation	Habitat
PELECANIFORMES: Ardeidae					
13. Yellow-crowned Night Heron	*Nyctanassa violacea*	PRB	LC	F	HA/W
14. Green Heron	*Butorides virescens bahamensis*	PRB/e	LC	F	HA/W
CHARADRIIFORMES: Charadriidae					
15. Black-bellied Plover	*Pluvialis squatarola*	WRN	LC	F	CS
16. Wilson's Plover	*Charadrius wilsonia*	WRN**	LC	F	CS
17. Piping Plover	*Charadrius melodus*	WRN	NT	F	CS
CHARADRIIFORMES: Scolopacida					
18. Least Sandpiper	*Calidris minutilla*	WRN	LC	M	CS
19. Spotted Sandpiper	*Actitis macularius*	WRN	LC	S	CS
ACCIPITRIFORMES: Pandionidae					
20. Osprey	*Pandion haliaetus ridgwayi*	PRB/e	LC	F	CS/FO
CORACIIFORMES: Alcedinidae					
21. Belted Kingfisher	*Megaceryle alcyon*	WRN	LC	F	CS
FALCONIFORMES: Falconidae					
22. American Kestrel	*Falco sparverius*	PRB	LC	S	HA
23. Merlin	*Falco columbarius*	WRN	LC	F	HA/FO
PASSERIFORMES: Tyrannidae					
24. Cuban Pewee	*Contopus caribaeus bahamensis*	PRB/e	LC	F	IU/HA
PASSERIFORMES: Vireonidae					
25. Thick-billed Vireo	*Vireo crassirostris crassirostris*	PRB/e	LC	M	IU/HA
PASSERIFORMES: Phaenicophilidae					
26. Western Spindalis	*Spindalis zena zena*	PRB/e	LC	F	IU/HA
PASSERIFORMES: Parulidae					
27. Ovenbird	*Seiurus aurocapilla*	WRN	LC	S	HA
28. Northern Waterthrush	*Parkesia noveboracensis*	WRN	LC	F	W
29. Black-and-white Warbler	*Mniotilta varia*	WRN	LC	F	IU/HA
30. Common Yellowthroat	*Geothlypis trichas*	WRN	LC	F	W
31. American Redstart	*Setophaga ruticilla*	WRN	LC	F	IU/HA
32. Cape May Warbler	*Setophaga tigrina*	WRN	LC	M	IU/HA
33. Northern Parula	*Setophaga americana*	WRN	LC	F	IU/HA
34. Black-throated Blue Warbler	*Setophaga caerulescens*	WRN	LC	F	IU/HA

Common Name	Scientific Name	Range	Status	Observation	Habitat
35. Palm Warbler	*Setophaga palmarum*	WRN	LC	M	IU/HA
36. Prairie Warbler	*Setophaga discolor*	WRN	LC	F	IU/HA
PASSERIFORMES: Cardinalidae					
37. Indigo Bunting	*Passerina cyanea*	WRN	LC	M	IU/HA
PASSERIFORMES: Mimidae					
38. Gray Catbird	*Dumetella carolinensis*	WRN	LC	F	IU/HA
39. Northern Mockingbird	*Mimus polyglottos*	PRB	LC	F	IU/HA
40. Bahama Mockingbird	*Mimus gundlachii*	PRB	LC	F	IU/HA
PASSERIFORMES: Thraupidae					
41. Bananaquit	*Coereba flaveola bahamensis*	PRB/e	LC	F	IU/HA
42. Greater Antillean Bullfinch	*Melopyrrha violacea violacea*	PRB/e	LC	M	IU/HA
43. Black-faced Grassquit	*Melanospiza bicolor bicolor*	PRB/e	LC	M	IU/HA

Table 6-16 Avifauna Observed, Cotton Bay, Eleuthera

*Regional transient/migrant in spring and fall.

**There is a small Permanent Resident Breeding population of Wilson's Plover in The Bahamas.

Key:			
Range	**Status**	**Habitat**	**Observation**
PRB = Permanent Resident Breeding	LC = Least Concern (IUCN)	IU = Interior Upland	S = Single
WRN = Winter Resident Non-Breeding	NT = Near-Threatened (IUCN)	HA = Human Altered	F = Few
	E = Endemic	FO = Fly Over	M = Many
	e = Endemic subspecies	CS = Coastal Shore	
	I = Invasive species	W = Wetland	

6.9.3 Range

The range of a species is the geographic areas where the birds can be consistently found e.g., migrant birds have seasonal ranges while restricted range species remain on the same island or in the same region year-round.

6.9.4 Permanent Resident Breeding

The range of a species is the geographic areas where the birds can be consistently found e.g. migrant birds have seasonal ranges while restricted range species remain on same island or in same region year round. The species observed comprised of a combination of Permanent Resident Breeding (PRB) Species and Winter Resident Non-Breeding (WRNB) Species.

Permanent Resident breeding (PRB) species refers to the resident species that live and breed year-round throughout the Bahama Islands. Twenty-two (22) of the species recorded during the survey (approximately 51%) were PRB species. PRB species included Endemic and endemic subspecies.

Figure 6-37 PRB Smooth-billed Ani Crotophaga ani in human altered area on site

Figure 6-38 PRB Least Grebe Tachybaptus dominicus in Cistern on site

Endemic species are birds that exist within a specific geographic area. The Bahama Woodstar *Nesophlox evelynae* was the only Bahamian endemic species recorded during the survey. Eight (8) endemic subspecies were also recorded. A subspecies refers to one of two or more populations of a species living in different subdivisions of the

species' range and varying from one another by morphological characteristics. In The Bahamas endemic subspecies are subdivided by different island races.

6.9.5 Winter Resident Non-Breeding

Winter Resident Non-breeding (WRN) species refers to the annual non-breeding fall/winter migrants to the Bahama Islands from North America. Twenty-one (21) of the species recorded or 49% were WRN species.

Figure 6-39 Left: WRN Spotted Sandpiper - Actitis mascularius in Golf course wetland, Right: WRN Least Sandpiper - Calidris minutilla along Western Shoreline

Figure 6-40 WRN Piping Plover -Charadrius melodus. along Western Shoreline on site

6.9.6 Conservation Status

The IUCN Red List classifies species at high risk of global extinction. It divides species into nine categories: **Not Evaluated, Data Deficient, Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild** and **Extinct**.

6.9.6.1 Least Concern

IUCN defines Least Concern as "a taxon when it has been evaluated against the Red List criteria and does not qualify for Endangered Near Threatened". Forty (40) of the species observed (93%) are classified as least concern.

6.9.6.2 Near Threatened

IUCN defines Near Threatened as "a taxon is Near Threatened (NT) when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future". Two (2) NT species were recorded on the site - White-crowned Pigeon *Patagioenas leucocephala and Piping Plover Charadrius melodus*.

6.9.6.3 Invasive Species

Eurasian Collared Dove (*Streptopelia decaocto*) is listed as an invasive species in National Invasive species Strategy for The Bahamas (2013). This document list recommendations for management of this species as Control. It should be noted that invasive species are classified as Permanent Resident Breeding Species given that they live in The Bahamas throughout the year and are breeding populations that do not migrate.

6.9.6.4 Endangered & Protected Species

None of the species recorded are classed as endangered. All species observed are protected under the Wild Birds Protection Act Chapter 249 (Statue Law of The Bahamas).

6.10 Air Quality and Ambient Noises

At present, no significant sources of air emissions or noise sources exist on or within Cotton Bay Development. During construction, the activity of heavy machinery will cause an unavoidable increase in noise. This will result in a short-term deterioration of sound quality. BMPs for noise attenuation will be outlined in the EMP. Worker safety will follow the U.S. Centers for Disease Control and Prevention's National Institute for Occupational Safety and Health (NIOSH) recommended exposure limits (REL). The NIOSH REL for occupation noise exposure is 85 decibels, a-weighted, as an 8-hour time-weighted average (85 dBA as an 8-hr TWA) using a 3-dB exchange rate. Exposures at or above this level are considered hazardous.

7 Socio-Economic Overview

7.1 Population

Eleuthera is a long and thin island that spans 110 miles long and, in its most narrow areas, only 1 mile wide. Within The Bahamas, Eleuthera is located east of New Providence, southeast of Abaco, north of the Exuma island chain, and northwest of Cat Island. The eastern side of the Eleuthera faces the vast Atlantic Ocean and the western side of Eleuthera faces the shallow Bahama Banks. There are more natural wrecks here than any other island in the Bahamas and especially along The Devil's Backbone, which is a shallow and jagged reef extending across the northern edge of Eleuthera[6]. Within The Bahamas, Cotton Bay is located southeast of Greencastle on the island of Eleuthera.

The Bahamas has a population of 399,314 persons, of which 74% reside on New Providence. According to the preliminary Census count for 2022, between 2010 and 2022, the population of The Bahamas increased by 13.6% (or 47,853 person), an annual growth rate of 1.1%. This growth rate is lower than previous intercensal increases which peaked in 1963 at 4.4% average annual growth[7]. Eleuthera accounts for 2.32% (9,247 person) of the total population of The Bahamas; the fourth most populous island. Of this total figure for Eleuthera, 5,324 persons reside in South Eleuthera. Between 2010 and 2022, Eleuthera experienced an influx of 1,045 persons resulting in a 12.74% change in population.

Comparatively, 296,522 persons reside on New Providence, the most populated island of The Bahamas. Collectively, New Providence, Grand Bahama, and Abaco represent 90 percent of the population. New Providence is the most densely populated island, with a population density of 3,707 persons per square mile an increase of 20.4% over 2010 figures versus Eleuthera with 49 persons per square mile.

Table 7-1 Key Demographic and Social Indicators – Eleuthera 2010 versus 2022 Census

Parameter	2010	2022	% Change
Population	8,202	9,247	+12.7%
Male	4,058	4,459	+9.9%
Female	4,144	4,788	+15.5%
% Total Bahamas Population	2.33%	2.32%	0%
Population Density			
Area (Square Miles)	187 sq mi	187 sq mi	
Population Density/Square Mile	44	49	+11%

[6] Department of Statistics, 2010, Census of Population and Housing (Eleuthera)
[7] Bahamas National Statistical Institute. Census Office. Census of Population and Housing: CENSUS 2022. *Preliminary results.* April 2023.

Households		Households	
Total Number of Households	2,718	3,668	+35%
Average Household Size	3.02	2.52	-16.6%

Table 7-2 Socio-Economic Indicators –Bahamas[89]	
Parameter	Value
Population, 2019	381,000
GDP (US $ millions), 2019	13,579
GDP per capita (US$), 2019	35,664
Life Expectancy at Birth, 2019	73.6
Adult Literacy Rate, 15 and up, 2007	96%
Poverty Rate, 2013	12.8%
Unemployment Rate, May 2019	9.5%
Infant Mortality Rate (per 1,000 live births), 2018	8.3
Human Development Index (rank), 2019	60

7.2 Labor Force & Economic Activities

Eleuthera contributed $204 million (1.8%) to The Bahamas' 2021 GDP performance. Unlike most of the family islands in the nation, Eleuthera actually witnessed a decrease in its nominal GDP from 2020 to 2021 ($262 million to $204 million).

In Graph 3 of the Gross Domestic Product by Island, when New Providence and Grand Bahama are excluded, Eleuthera represents 17% of the GDP. The lack of an increase here shows that Eleuthera did not return to pre COVID-19 GDP levels. 2019 saw Eleuthera's highest GDP in quite some time, totaling $316 million. Industrial groups such as Food Services, Accommodation Arts, Household Employment, were combined in this approach, showing that the tourism industry in Eleuthera is still experiencing negative impacts from the COVID-19 pandemic.

Eleuthera has been on a continued trend downwards since a small peak in 2019. Its contribution to the total GDP of The Bahamas fell by 17% in 2020, and again by 22% in 2021. Real estate activities, owner occupied and actual rents in Eleuthera are frighteningly low at a mere $1.1 million in 2021. This number usually tends to reach the $20 to $30 million mark.

8 Adapted from IMF, The Bahamas – *Request for Purchase Under the Rapid Financing Instrument – Press Release; Staff Report; and Statement by the Executive Director for The Bahamas.* Country Report No. 20/191. June 2020 https://www.imf.org/en/Publications/CR/Issues/2020/06/04/The-Bahamas-Request-for-Purchase-under-the-Rapid-Financing-Instrument-Press-Release-Staff-49489

9 Adapted from IMF, The Bahamas – *IMF Executive Board Concludes 2020 Article IV Consultation with The Bahamas. Press Release:* No. 21/23. January 26, 2021

With no major employers on the island, Eleutherans tend to be very resourceful and entrepreneurial. Local residents typically engage in a variety of economic ventures with most activity revolving around farming, small businesses, residential, care-taking, and the hospitality and services industry[10]. The entrepreneurial spirit is alive and well throughout Eleuthera, however, while many locals generate bright ideas and interesting concepts, they may not have access to necessary resources in order to accomplish their goals.

In early 2014, in an effort to support and invigorate economic development, members of One Eleuthera Foundation (OEF) began their journey of creating the Cooperative Credit Union. The Cooperative Credit Union serves to empower and encourage Eleutherans to become owners and operators of their own financial institutions by promoting savings, shareholdings, financial services, and counselling[11]. The One Eleuthera Cooperative Credit Union began services in June of 2016 when they accepted their first deposit. The OECCU is compliant with regulations set by the Central Bank of The Bahamas and works in the same capacity as a regular bank, except it is owned and managed by the members of the credit union.

The number of operating hotels in Eleuthera has slowly been decreasing since 2008, as reported in the 2014 Bahamas Socio-Economic Report. In 2008, Eleuthera had 31 active and operating hotels with total available rooms equaling 337. The figure had dropped to 24 hotels by the year 2011. The follow year experienced the most drastic decrease in operating hotels: only 19 hotels and 202 available rooms in Eleuthera as of 2012[12].

7.3 Poverty

According to the 2001 Bahamas Living Conditions Survey, the poverty rate in Eleuthera was 13.19%[13]. This accounts for 10.41% of the overall population of The Bahamas. The poverty rate in Eleuthera was slightly higher than the national poverty rate of The Bahamas, which is 12.5%[14]. 61% of Eleutherans own their home fully[15]. This is significantly higher when compared to New Providence, where only 31% of the population fully own their home.

One of the most significant ways that poverty can be recognized throughout Eleuthera is by the steady increase of informal settlements, otherwise known as shantytowns. There is a dire need to address the housing challenges and sanitation levels in these communities. It was observed that most (if not all) of these shantytowns are on Government crown land issued to Bahamian families for the purpose of agriculture[16]. The housing structures in these towns are generally informally organized, overcrowded with illegally or poorly erected structures, built with non-durable and/or hazardous material, not having proper sewage disposal systems, limited access to water, and compounded with

[10] (EDAW 2005) One Eleuthera Foundation, 2009.
[11] One Eleuthera Foundation, 2009.
[12] Department of Statistics, 2014, Socio-Economic Report
[13] Department of Statistics, 2001, Bahamas Living Conditions Survey
[14] Department of Statistics, 2013, The Bahamas Household Expenditure Survey
[15] Department of Statistics, 2014, Socio-Economic Report
[16] Department of Environmental Health Services, 2013, Shanty Town Project.

derelict vehicles and garbage accumulation which give rise to the breeding of rodents, mosquitoes, and other disease carrying vectors.[17].

The largest Eleutheran shantytown recognized in the 2013 Shanty Town Project is located in Blackwood, North Eleuthera off the main Eleuthera Highway near to Jean's Bay Dock; the access road through this community leads to Gun Point, which is located at the end of the island[18]. The Blackwood shantytown encompasses 16 wooden structures with a total of 23 adults and 21 children living in the community. Every house has power from BEC and no septic tanks are built to code. There is no municipal water supply; most families have private wells. Other shantytowns in Eleuthera are located at Wemyss' Bight, Green Castle, and Russel Island.

7.4 Climate Change: Environmental Preservation & Sustainability

Due to the geographical location of The Bahamas— with over 80% of land mass within one metre of sea level[19]— climate change is a crucial area of concern for the country. As the ocean temperature, ocean acidity, and sea levels rise, the nation experiences intensified and more frequently occurring extreme weather events. In addition to the low altitude of the country, there exist a great number of settlements and developments situated very close to shorelines, making flooding an extremely tangible threat. The American Meteorological Society suggests there is a strong correlation between climate change and more deadly and destructive storm activity throughout the waters of the Caribbean.

As an island nation, the Bahamas' livelihood is deeply dependent on our surrounding ocean. The National Climate Change Policy highlights several detrimental consequences of climate change that affect Bahamians' uncontaminated supply of food and water. These include: depletion and pollution of potable ground water supplies, loss of agricultural land and reduced agricultural productivity from salinity, introduction of alien pests and diseases and increases in the incidence of pests and diseases of crop plants, introduction of insect vectors of diseases of livestock and humankind, contagious diseases and heat stress-related syndromes[20]. In The Bahamas, the freshwater lenses or aquifers "sit" atop saltwater and rise and fall with the tides. Sea level rise will therefore directly impact the fresh water lenses, raising them progressively nearer the soil surface, more so in those islands with narrow and thinner aquifers than in those islands with larger and thicker aquifers[21]. On Eleuthera and all the major islands south of Eleuthera, evaporation exceeds rainfall and ponds and lakes are hyper-saline[22].

Climate change threatens the everyday lives of Bahamian citizens. Sea level rise threatens 36% of major tourism properties, 38% of airports, 14% of road networks, and 90% of sea ports[23]. These threats place financial constraints

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[17] Department of Environmental Health Services, 2013, Shanty Town Project.

[18] Department of Environmental Health Services, 2013, Shanty Town Project.

[19] The Bahamas Voluntary National Review on the Sustainable Development Goals to the High Level Political Forum of the United Nations Economic and Social Council, 2018.

[20] Department of Statistics, 2017, The National Food & Nutrition Security Policy And Agenda For Action For The Commonwealth of The Bahamas.

[21] Bahamas National Climate Change Committee, 2005, National Policy for The Adaptation to Climate Change.

[22] US Army Corps of Engineers, 2004, Water Resources Assessment of The Bahamas

[23] The Bahamas Voluntary National Review on the Sustainable Development Goals to the High Level Political Forum of the United Nations Economic and Social Council, 2018.

and concerns on Bahamian government officials. As a country, we will see these impacts most evidently on our core industry of tourism, contributing to over 60% of GDP, with expected losses of $869-$946 million in 2050. In addition to threatening The Bahamas' water supply and food security, climate change poses a threat to marine life. Because of the increased levels of carbon dioxide in the atmosphere (due to human activity), there is a greater quantity of CO2 dissolving into the ocean. As the ocean absorbs more CO2, the pH decreases and the ocean becomes increasingly acidic[24]. Rising sea temperatures and increased ocean acidity play major roles in coastal area erosion and coral reef bleaching, placing negative effects on both terrestrial and marine biodiversity. The loss of coral reefs create even greater potential for large incoming waves and storm surges and will severely affect infrastructure and communities at the forefront of these locations.

Extreme wave conditions in The Bahamas may be generated by both hurricanes and waves generated in the Atlantic Ocean. Sites like Glass Window Bridge, Eleuthera are frequently exposed to extreme wave conditions; other sites, such as Rock Sound, Eleuthera, are relatively protected from waves, but are exposed to very large storm surges or increases in water levels during hurricane events. This large increase in water level occurs as a result of the shape of the island and surrounding water depths, and can result in serious flooding[25].

The Cape Eleuthera Island School is a unique campus and research center serving the needs of students, teachers, scientists, and the local community[26]. The mission of The Island School is to understand and preserve the ocean through education; the students and teachers at this school are some of the most active enthusiasts taking action against climate change in Eleuthera. Founded in 1999, The Island School is located 1 mile from Powell Point near the southwestern-most tip of Eleuthera. Other methods of encouraging environmental preservation in Eleuthera are as follows: a recycling operation was set up by OEF in Rock Sound, Eleuthera where individuals are able to recycle glass bottles and jars based on their different colors: green, brown, or clear. The Bahamas National Trust also executes an environmental education camp in Eleuthera. Currently, The Bahamas actively engages in the recycling programme "Cans for Kids," which engages 40 schools across the country in a collection drive and ships roughly 150,000 soda cans annually to Florida[27].

7.5 Education

Recorded in the 2010 Eleuthera Census Report, the total number of persons ages 3-19 attending school full-time was 2,034[28]. There were no children aged 3-14 that were only attending school part-time. However, there were 11 children in the 5-9 age group that were not attending school. In most cases, the distribution of male to female school attendance was relatively the same, but female attendance often ranked slightly higher; this follows suit with school attendance

[24] Smithsonian, 2018, Ocean Acidification.

[25] OAS, 2001, The Bahamas National Report

[26] OAS, 2001, The Bahamas National Report.

[27] The Bahamas Voluntary National Review on the Sustainable Development Goals to the High Level Political Forum of the United Nations Economic and Social Council, 2018.

[28] Department of Statistics, 2010, Census of Population and Housing (Eleuthera).

organized by sex for all the The Bahamas. Out of the 840 persons in the 65+ age group, 52 of them had attended college/university.

The highest qualification/examination achieved by the majority of persons in Eleuthera was the BJC's (912 persons)[29]. Out of the 4,317 persons with access to internet, only 164 of them accessed that internet from an educational institution; the majority (3,192 persons) accessed the internet from home. More persons did not use the internet than the number of persons who used the internet at an educational institution or at work. The percentage of available internet access status gradually decreased as the age group increased: 30-34 year olds at 53.4% access, 45-64 year olds at 49.6% access, and 65 and over reporting 27.3% access.

According to One Eleuthera Foundation, a survey of one particular high school on Eleuthera revealed that 70% of its students did not graduate in 2015[30]. OEF was able to conclude that lack of education, unemployment, poverty, and crime are all linked: under-education and unemployment being the cause and poverty and crime being the effect. In 2015, OEF founded The Centre for Training and Innovation (CTI): an education, training and business enterprise school located in Eleuthera, Bahamas. In Eleuthera, where CTI is based, unemployment is estimated to be as high as 70% in some areas, according to the Eleuthera Master Plan 2005. CTI offers educational opportunities for residents of Eleuthera, north, central and south as well as residents from other islands of The Bahamas. Stated on their website, CTI welcomes students who wish to explore the traditional heritages of Eleuthera, participate in and enhance cultural programs, develop new businesses, envision futuristic possibilities for the island and join forces with other stakeholders to contribute to the island's continued strategic development[31]. Other collaborators on this project are The South Eleuthera Mission and Bahamas Technical and Vocational Institute.

7.6 Health and Wellness

Eleuthera faces a significantly high incidence of breast cancer, as well as other cancers and the challenges of chronic non-communicable diseases such as heart disease, hypertension, and diabetes. Research conducted by Dr Judith Hurley (Medical Director of the Hematology/Oncology Clinics and the Medical Oncology Consultant for the Taylor Breast Center at Jackson Memorial Hospital) indicates that The Bahamas' incidence of inherited breast cancer, recorded to be between 24-27%, is twice as high as the highest rate recorded in high risk groups around the world. Statistics reveal that 43% of Bahamian women diagnosed with breast cancer die before the age of 50 while the average age of death in American women is 65[32].

8,202 persons in Eleuthera responded to the 2010 Census of Population and Housing when surveilling types of health insurance. 1,696 persons had individual health insurance, 1,325 persons had group insurance, and 4,852 persons had no health insurance at all. There are more individuals with no health insurance than those with individual, group,

[29] Department of Statistics, 2010, Census of Population and Housing (Eleuthera).
[30] One Eleuthera Foundation, 2009.
[31] www.oneeleuthera.org/projects/CTI
[32] One Eleuthera Foundation, 2009.

individual & group, and not stated combined[33]. In other words, more than half of the population of Eleuthera does not have health insurance.

Overall, the possibility that a slave settlement or post-emancipation settlement of formerly enslaved individuals survives in the form of subsurface archaeological features cannot be discounted, neither can the possible survival of earlier Loyalist era infrastructure be excluded.

7.7 Historic Aspects

The old Cotton Bay Club in Rock Sound, Eleuthera was originally developed by entrepreneur and Pan American World Airways founder Juan Trippe. The Cotton Bay Club first opened for business in 1959[1] and soon thereafter became one of the top resorts and destinations across the island of Eleuthera. Foreign direct investment in The Bahamas was on the rise in the mid-1900s; Cotton Bay was just one of numerous ongoing multimillion-dollar Bahamian property deals that year[2]. From the outset, Cotton Bay was famously advertised as a private, invite-only resort tucked away on an isolated isle. Roughly 14 miles south of Rock Sound, the exclusivity and beauty of both the land and amenities naturally promoted Cotton Bay as a highly sought-after vacation destination and second home location.

Trippe spared no expense in designing the seaside resort with each luxury cottage costing around $30,000 to construct[3]. Even still, one of the most attractive assets of the Cotton Bay Club was its world-class, 18-hole golf course designed by British-American golf course architect Robert Trent Jones (Sr.). Jones was a highly sought-after architect, designing and re-designing over 500 golf courses in 35 different countries over the course of his lifetime[4]. In November of 1959, The Daily Oklahoman reported of Trippe's paradise: "Cottages for itinerant golfers are strung out along the sandy shores of Cotton Bay and more are abuilding".

[33] Department of Statistics, 2010, Census of Population and Housing (Eleuthera).

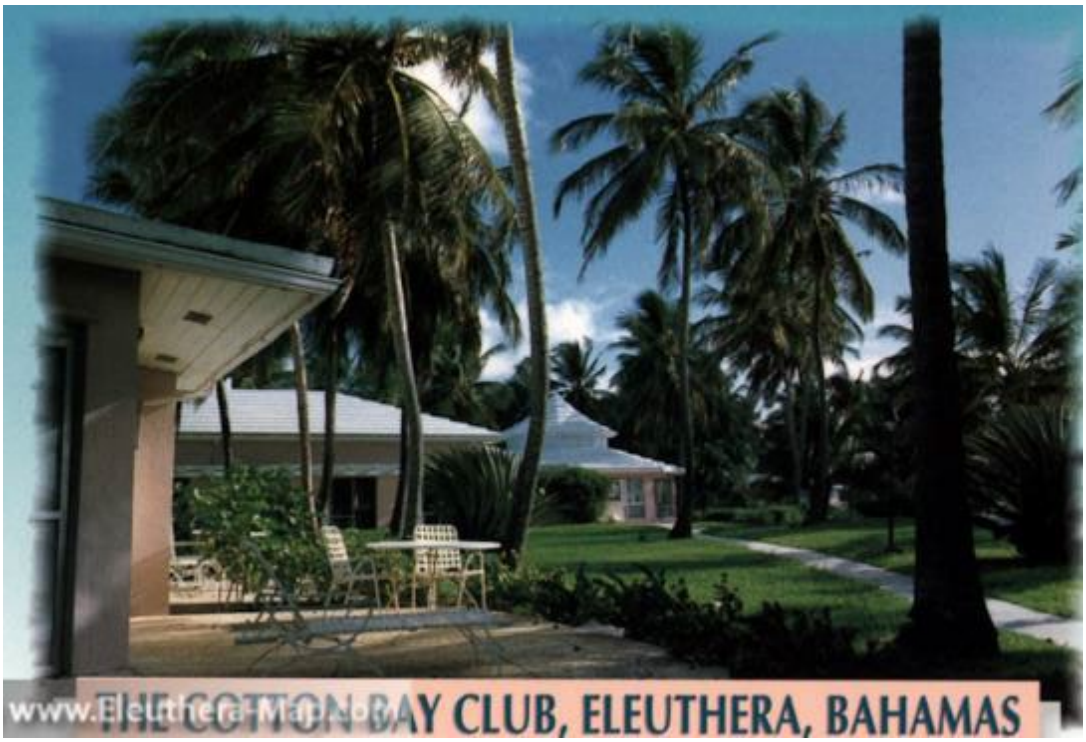
Cotton Bay Club golf course overlooking Cotton Bay[5]

Cotton Bay Club golf course on the 18th hole[6]

1 bahamianology.com, “The Men Who Built Rock Sound, Eleuthera In A Pre-Independent Bahamas” [2018]
2 bahamianology.com/, “Cotton Bay … and more massive property developments by foreign investors” [2018]
3 bahamianology.com/, The Miami Herald [1957]
4 https://www.theguardian.com/, Ron Sirak, “Obituary Robert Trent Jones Sr” [2000]
5 eleuthera-map.com/, Perry Joseph Photography
6 eleuthera-map.com/, Perry Joseph Photography

7.7.1 Juan Trippe

Juan Terry Trippe was born in New Jersey, USA at the turn of the twentieth century. Trippe is often credited as one of the three famous tycoons, alongside New England cloth-maker Austin T. Levy and Alcoa Aluminium chairman Arthur Vining Davis, who developed Rock Sound and "triple-handedly created Eleuthera's 20th century economy[7]". Trippe's vision for Cotton Bay was that of a 'cottage colony' for he and his wealthy friends. A commercial aviation trailblazer, Juan Trippe also spearheaded the expansion of the Rock Sound airport, which is where his elitist guests would arrive before making the short journey to Cotton Bay. With the expansion, Trippe's goal was to enable his Pan Am jets to fly directly into Eleuthera on a daily basis from hubs located in New York, Miami, and Nassau. Before entrepreneurs like Trippe arrived in Eleuthera in the early to mid-1900s, the island had mainly profited from local fishing and agriculture industries. However, through these advancements, Juan Trippe seemingly ignited and controlled the tourism scene in Rock Sound, Eleuthera. Late Bahamian journalist Larry Smith dubbed the development of the Rock Sound airport "the most notable achievement in airlift to an out island in Bahamian History[8]". Thriving at the time, Pan American Airways even held a 45% interest in Bahamas Airways in 1943[9].



Rooms and Dining Hall at Cotton Bay Club[10]

Swimming pool area of the Cotton Bay Club Resort[11]

Although Juan Trippe was the developer and ultimate mastermind behind Cotton Bay, the history of the project (and the history of Eleuthera as a whole) would be incomplete without mention of American industrialist and philanthropist Arthur Vining Davis. Davis set about his investments in The Bahamas in the 1940s[12]. Over the remainder of his lifetime, he grew to be one of the largest landowners in South Eleuthera and was listed in The Miami Herald as one of twenty "Big Spenders in the Bahamas[13]," of which Trippe was also included. Davis' holdings in Rock Sound grew from 6,000 acres to some 15,000 acres by 1954, and by the time of his death in 1962, Davis had owned more than 30,000 acres in Eleuthera alone[14]. Arthur Vining Davis had big dreams for Cotton Bay, but concealed much of the particulars in the preliminary planning stages. In the early 1950s, Davis sought governmental approval for a 300-room resort and hotel. However, the project was rejected by the Bahamian government: a clear turning point in the ownership of Cotton Bay. After this rejection, Davis sold much of his stock in Eleuthera to Trippe. Juan Trippe did exactly what Arthur Vining Davis did nearly two decades before, except he was actually able to bring his vision of Cotton Bay to fruition.

When Trippe opened the Cotton Bay Club in 1959, although other luxury developments existed in South Eleuthera, it topped the charts as the only resort with a championship styled golf course. This was a huge attraction to the wealthy American holidaymaker. The original Cotton Bay Club set the standard for future resorts in Eleuthera, with the exclusive nature or the club heavily contributing to its charm. The Daily Oklahoman reported on Cotton Bay shortly after its opening: "The whole project is being developed by Juan Trippe and his company of adventures as a club and rooms at Cotton Bay are limited to those who can get their cotton pickin' hands on an invitation[15]". Later, when building his own development in 1970, a foreign investor told the Fort Lauderdale News: "We envision a development which maintains a quality and style comparable to the Cotton Bay Club area pioneered by Juan Trippe."

7 bahamapundit.com/, Larry Smith, "Lighthouse Point and the History of South Eleuthera" [2013]
8 The Tribune, Larry Smith, "Tough Call: A tale of South Eleuthera" [2013]
9 https://en.wikipedia.org/wiki/Juan_Trippe [2022]
10 eleuthera-map.com/, Perry Joseph Photography
11 eleuthera-map.com/, Perry Joseph Photography

7.7.2 Cotton Bay: Present

Reflecting on the original Cotton Bay Club in a 1991 article through the lens of an Eleutheran native, Los Angeles Times reporter Ian Glass paints Cotton Bay as the "once private club owned by Pan Am founder Juan Trippe, who would fly in his well-heeled friends by 727 Yankee Clipper for a weekend of golf[16]". A 2019 Google Earth aerial shot of the historic location shows that the landscape has remained largely in keeping with the original layout. A number of original members of the old Cotton Bay Club still own homes in the Rock Sound area.

Aerial shot of Cotton Bay circa 1959

12 windingbayeleuthera.com/about/ [2016]
13 The Miami Herald, Sunday 8 March [1959]
14 The Tribune, Larry Smith, "Tough Call: A tale of South Eleuthera" [2013]
15 The Daily Oklahoman, Sunday 8 November [1959]
16 Los Angeles Times, Ian Glass, "Alone on Eleuthera Island with Mrs. Wright" [1991]

7.7.3 Historic Aerial Imagery

Historic aerials offer a visual glimpse of historic land use before the availability of satellite imagery. Land use in South Eleuthera during this period is marked by small plots of cleared land for agricultural use and settlements. Even prior to the Cotton Bay Club, this area was influenced by human activities. Notably, the lagoon area referred to as the "yacht harbour' on later land resource maps is an isolated pond with no connection to sea seen below. There are no indications that historic resources exist on the site; should construction activities make a discovery of antiquity, protocols outlined in the Environmental Management Plan will guide the workforce.

Figure 7-1 Historic Aerial ~1942

By 1958, construction of the Cotton Bay Club was well underway with the Cotton Bay Club opening for business in 1959. The pond was excavated and connected to the sea for the future but never fully completed 'yacht harbour'. The golf course is under construction with irrigation ponds interspersed throughout the course.

Figure 7-2 Historic Aerial 1958, Cotton Bay Club, South Eleuthera

By 1974, homes had been constructed along the narrow ridge between the golf course and the Atlantic Ocean. The water catchment basin for west of Cotton Bay Drive is clearly visible.

Figure 7-3 Historic Aerial 1974, Cotton Bay Club, South Eleuthera

8 Environmental Laws, National Environmental Policies and International Conventions

Cotton Bay is located within the constituency of Central and South Eleuthera represented by the Hon. Clay Glennford Sweeting, Minister of Agriculture, Marine Resources, and Family Island Affairs; and Member of Parliament.

8.1 Environmental Laws of The Bahamas

Environmental Law, Regulation, Policy	Subject	Summary
Antiquities, Monuments, and Museum Corporation Act 1998, Chapter 51	To protect antiquities	An Act to provide for the preservation, conservation, restoration, documentation, study and presentation of sites and objects of historical, anthropological, archaeological and paleontological interest, to establish a National Museum, and for matters ancillary thereto or connected therewith.
Antiquities, Monuments, and Museum Regulations, 1999	To establish the National Register of Historic Places and provide application for permits and licences	Regulations to establish the National Register of Historic Places, and provide procedures for application for a permit, application for a licence, fees for permits and renewal application.
Bahamas National Trust Act, 1959 Bahamas National Trust Amendment, 2013 Bahamas National Trust Amendment, 2019	Designation and management responsibility for National Parks	This Act and Amendment founded The Bahamas National Trust and grant it authority for the provision and oversight of National Parks in The Bahamas. The 2019 Amendment expands the duties of The Bahamas National Trust; to revise the constitution of the council; and to expand its authorized capital investments; and for connected purposes.
The Bahamas Protected Areas	A Notice of MPA Maps	A notice by the Ministry of Environment and Housing to the public advising the following maps depict Marine Protected Areas within The Bahamas under the Global Environment Facility (GEF) Full Size Project (FSP).
Biological Resources and Traditional Knowledge Act, 2021	To provide for the regulation and access to biological resources and associated traditional knowledge	An Act to provide for the regulation and access to biological resources, and associated traditional knowledge, sustainable use of its components, prohibiting unlawful genetic and bio-prospecting and gathering and for search for The Bahamas and its people fair and equitable sharing of the benefits arising out of the use of biological resources, traditional knowledge, and to establish the necessary administrative structures and processes for the implementation and enforcement of such principles and for matters connected therewith or incidental thereto.
Conservation and Protection of the Physical Landscape of The Bahamas, 1997 Chapter 260	Excavation, Landfill, Quarrying, Mining,	This Act makes provisions for the regulation of activities including excavation, landfill, quarrying, and mining in The Bahamas for the purpose of conservation of maintenance of the environment.
Environmental Health Services (Collection and Disposal of Wastes) Regulations 2004	To administer and outline waste collection and management facilities	Environmental Health Services (Collection and Disposal of Wastes) Regulations 2004 establish the collection and control of waste including waste facilities and other matters relating to wastes.
Environmental Health Services (Fees and Services) Regulations 2000	To establish fees and services performed by the Department of	The Fees and Services regulations outline services and associated fee rates performed by the Department of Environmental Health Services. The Department may provide testing for air quality, water quality, and radioactive materials.

Environmental Law, Regulation, Policy	Subject	Summary
	Environmental Health Services	
Environmental Health Services Act 1987	To promote and protect the public health and to provide for the conservation and maintenance of the environment	An Act to promote the conservation and maintenance of the environment in the interest of health for proper sanitation in matters of food and drinks, and generally for the provision and control of services, activities, and other matters connected therewith or incidental thereto.
Environmental Planning and Protection Act 2019	To establish the Department of Environmental Planning and Protection	An Act to establish the Department of Environmental Planning and Protection; and to provide for the prevention or control of pollution, the regulation of activities, and the administration, conservation and sustainable use of the environment and for connected purposes. The Act defines procedures for environmental impact assessments and environmental reporting requirements for protection of natural resources.
Environmental Impact Assessment Regulations, 2020	To provide procedures for a Certificate of Environmental Clearance (CEC).	The Regulations provide procedures for the review proposed projects inclusive of monitoring and compliance requirements. The Regulations dictate the requirements for a Certificate of Environmental Clearance (CEC).
Forestry Act of 2010	To protect the forests and make declarations to use	The Act provides for utilization of forest products and non-timber forest products from the forest estate. It sets forth the management and conservation of the forest estate and associated industries.
Forestry (Declaration of Protected Trees) Order, 2021	To declare protected trees	A declaration of protected trees under the Forestry Act for Part I endemic or endangered or threaten protected trees, and Part II cultural or historical and economic protected trees.
Health and Safety at Work Act 2002 Health and Safety at Work Amendment, 2015	To protect human health and safety at work	The purpose of the Act is to secure the health, safety and welfare of persons at work- protect persons other than persons at work against risks to health or safety arising out of or in connection with the activities of persons at work- control the storage and use of explosive or highly flammable or otherwise dangerous substances, and generally preventing the unlawful acquisition, possession and use of such substances.
Planning and Subdivision Act, 2010 Planning and Subdivision Regulations (Application Requirements), 2011	To regulate the built environment	This Act regulates the development of the built environment though physical planning protocols across the archipelago of The Bahamas. The Act stipulates the process for subdivision approval subject to specific conditions with respect to the features of the proposed development or project including the preparation of an Environmental Impact Assessment/Statement.
Plant Protection Act 2016	To protect and promote plant health	An Act to protect and promote plant health; to prevent the introduction and spread of plant diseases and pests and to provide for appropriate phytosanitary measures for their control; to facilitate trade in plants and plant products; and to regulate other matters connected thereto.
Public Works Act 1963	To provide for the physical development of The Bahamas	An Act to provide for the construction, management and development of public works, buildings, and road.
Water and Sewerage Act 1976	To establish the Water and Sewerage Corporation and to	An Act to establish a Water and Sewerage Corporation for the grant and control of water rights, the protection of water resources, regulating the

Environmental Law, Regulation, Policy	Subject	Summary
	control water resources	extraction, use and supply of water, the disposal of sewage and for connected purposes.
Wild Animals Protection Act 1968	To protect wild animals of The Bahamas	The Act provides a listing of protected animal species in The Bahamas
Wild Birds Protection Act 1987 Wild Bird Protection Act (Reserves)	To protect wild birds of The Bahamas	The Act protects the wild birds of The Bahamas and makes provision for the dedication of time periods for the hunting of specific species.

8.2 National Environmental Policies & Recommendations

Relevant National Policies	Subject	Summary
National Policy for the Adaptation to Climate Change 2005	Climate change assessment for the immediate and project adaptation techniques for The Bahamas	The National Policy for the Adaptation to Climate Change outlines a national framework to meet the goals and objectives of the United Nations Framework Convention on Climate Change (UNFCC). The Bahamas is committed to reduce greenhouse gases and address climate change impacts.
National Invasive Species Strategy for The Bahamas, 2013	Identifies and recommends a management framework for the control and eradication of invasive species.	The National Invasive Species Strategy for The Bahamas originally published in 2003, was updated in 2013 as part of the Global Environment Facility funded project, Mitigating the Threats of Invasive Alien Species in the Insular Caribbean (MITIASIC). It sets forth a management framework for the control and eradication of invasive species.
National Biodiversity Strategy and Action Plan, 1999	A plan to maintain biodiversity through sustainable development for a small island developing nation.	The Bahamas Government is committed to conserve biodiversity and to pursue sustainable development. This document highlights the role of biodiversity in the Bahamian social and environmental context and recommends measures to ensure its compatibility with future development.
The Bahamas National Wetland Policy	The goal of the National Wetlands policy is to conserve, manage, and restore wetland wisely in conjunction with sustainable development practices.	The Bahamas National Wetland Policy outlines a national framework to meet the goals and objectives of the Ramsar Convention which The Bahamas signed on June 7, 1997. This policy paper provides direction to the Government for the management of wetlands and to identify wetlands of national importance.

8.3 International Conventions of Relevance

International Convention/Organization	Subject	Summary
Cartagena Convention Ratified: June 24, 2010	An agreement for the protection and development of the marine environment in the wider Caribbean region	The Convention provides a legal framework for cooperation in the wider Caribbean region. Three technical agreements support the Convention which include: - Protocol for Co-Operation in Combating Oil Spills - Protocol for Specially Protected Areas and Wildlife (SPAW) - Protocol Concerning Pollution from Land-based Sources and Activities (LBS)

International Convention/Organization	Subject	Summary
Convention on Biological Diversity Signed: June 12, 1992	To preserve species diversity	The Bahamas is a signatory to the Convention on Biological Diversity which came into force December 1993. It has three main goals: a) The conservation of biological diversityb) The sustainable use of components of biological diversityc) The fair and equitable sharing of the benefits arising out of the utilization of genetic resources
Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention) Signed: June 7, 1997	This convention provides a framework for the international protection of wetlands as contributors for human resources and moreover, for avifauna which do not adhere to international boundaries.	The Bahamas is a signatory to the Convention on Wetlands of International Importance, also known as the Ramsar Convention. This convention provides a framework for the international protection of wetlands as contributors for human resources and moreover, for avifauna which do not adhere to international boundaries. Ramsar defines wetlands as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters."
Convention to Combat Desertification & Drought Signed: Nov. 10, 2000	To combat desertification and to mitigate the effects of drought	The Convention is a proponent for sustainable development by addressing social and economic issues that directly impact land degradation.
United Nations Framework on Climate Change Signed: June 1992 Kyoto Protocol Signed: April 9, 1999 Paris Agreement Ratified: August 22, 2016; Entered into Force: November 4, 2016	To stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with climate systems	The Bahamas is a signatory to UNFCC which entered into force in March 1994. The UNFCC was the culmination of climate negotiation at the Rio Earth Summit in 1992. This summit established a framework with an aim to stabilize atmospheric greenhouse gas. The Kyoto Protocol was developed under the UNFCC to provide emissions targets and timetables for developed countries. The Paris Agreement as put forth at the Conference of the Parties (COP21) in December 2015. The agreement has not yet come into force as it requires at least 55 parties to have ratified the agreement.

8.4 Government Departments and Local Non-Governmental Organizations

- Ministry of Works and Utilities
- Ministry of the Environment and Natural Resources
- Forestry Unit
- Department of Environmental Planning and Protection
- Department of Physical Planning
- Department of Environmental Health Services
- Water and Sewerage Corporation
- Bahamas Power & Light
- Antiquities Monuments, and Museums Corporation
- Civil Aviation Department

9 Environmental Impact Analysis

9.1 Methodology

Environmental impacts were assessed through a combination of background desktop study, scientific literature, and onsite field assessments.

Terrestrial surveys, including botanical and wildlife, and marine surveys were performed to document existing site conditions. The terrestrial survey recorded observed flora and fauna to identify present vegetation communities. Terrestrial surveys, including botanical and wildlife, and marine surveys were performed to document existing site conditions. The terrestrial survey records observed flora and fauna to identify present vegetation communities. Botanical and wildlife assessments were performed October 27-30, 2022 by Design Elements. Marine benthic surveys were performed by JSS Consulting Ltd. from November 23-24, 2022 and January 17, 2023.

9.2 Land Use Impact

The Cotton Bay Resort to be developed on 220 acres of a 400-acre privately owned parcel maintains its prior land use as a luxury resort complete with golf course and residences. Operated as the Cotton Bay Club from 1959 to the mid-1980s, the long period of discontinued operations allowed for recolonization of cleared areas by weedy and invasive species, particularly on the golf course as evident by the high number of invasive species identified at 10. Historic aerial imagery supports prolonged human disturbance by agricultural use and clearing even prior to the installation of the golf course observed in the 1958 aerial.

To support the addition of residences (branded and unbranded) west of the golf, Cotton Bay Road will be relocated to the property's western periphery. These residences will be constructed in an area consisting of disturbed and undisturbed upland vegetation. BOH facilities will develop accordingly to accommodate the increase in localized population support project components.

Impacts related to the change in land use pertain primarily to those impacts associated with increased anthropogenic uses including residential and hotel units, increased transportation use, energy uses, and potable water demands. There are no coastal modifications proposed.

Vegetation Cover	Area (Acres)	% Survey Area
Interior Upland		
Dry Broadleaf Evergreen Formation	**169.80**	**40.72**
Wetlands		
Coastal lagoon	2.36	0.57
Cisterns	0.3	0.07
Golf Course Ponds	17.94	4.30

Vegetation Cover	Area (Acres)	% Survey Area
	20.6	**4.94**
Human Altered Areas		
Existing Asphalt Road	5.20	1.25
Invasive Species dominated (including Sandy Shore & Rocky Shore)	217.94	52.26
	223.14	**53.51**
	413.54	**99.17**

Table 9-1 Vegetation Cover Areas

9.3 Aesthetic Impact

Overall, aesthetic impacts are anticipated to be neutral, if not slightly negative. The extent of aesthetic impacts may be subject to individual preferences, particularly as it relates to the beauty of coppice formation. Coppice vegetation dominates the site where the branded and unbranded residences are located; coppice may be considered aesthetically pleasing with its native trees and dense foliage. Loss of coppice vegetation for infrastructure and buildings can be mitigated by limiting the construction footprint and maintaining a natural buffer where feasible. Features such as karst formations should be integrated to the overall design and left intact to showcase natural phenomena where safety and infrastructure allow. Additionally, the architectural design and layout of the proposed development will influence individual perceptions of positive or negative impacts.

The developer intends to save medium to large tree specimens though avoidance or relocation where feasible. A nursery is envisioned to be established during construction to support transplanted trees saved for future use. Additional mitigation efforts may include the preservation of the epiphytes on site as well as the use of native trees in landscaping. Loss of upland vegetation can be mitigated through the use of landscape ecology principals to soften installation of hardscape and buildings.

9.4 Impacts to the Physical Environment

Impacts to the physical environment are unavoidable in the construction footprint, however, impacts can be managed and mitigated by employing BMPs during construction and operation. Physical impacts pertain primarily to land clearing and grading to accommodate buildings and associated facilities including the hotel, resort, and supporting utility infrastructure.

9.4.1 Erosion and Sediment Impacts

Erosion and sediment impacts associated with the overall development are largely dependent on adherence to BMPs. Construction activities will require management of excavated and graded areas and land-based pollutants which fall under an EMP.

Development introduces impervious surfaces, which exacerbate the volume and speed of runoff flow, particularly during storm events with periods of heavy downpours. Runoff is a vehicle for the introduction of land-based

pollutants into the natural environment. When practical, drainage will be captured and reused for irrigation purposes; retention ponds may also capture stormwater in certain areas.

9.4.2 Impacts to Shoreline/Nearshore and Coastal Processes

With no proposed coastal modifications, no significant short- or long-term impacts to natural coastal processes are anticipated. Of note, the homes situated on the ridgeline to the east of the yacht harbour along the coast are outside the scope of this development; this EIA does not capture coastal and/or marine impacts associated with the actions of an individual homeowner.

9.4.3 Hydrologic Impacts

With the installation of a water and wastewater treatment plant built to Water and Sewerage Corporation standards, no long-term impacts are anticipated. The golf course irrigation system may include lakes or other storage facilities, a pumping station, controlling valves, control lines, sprinkler heads and fertigation system. At present, water resources located on the property include 10 ponds within the golf course.

9.5 Biological Impacts

9.5.1 Upland

Coppice habitat, the DBEF, is the most biodiverse vegetation community in The Bahamas. DBEF accounts for 40% of the total land area with human altered areas comprising over 50%. Built over three (3) phases, the resort and branded residences will built within a predominantly disturbed area. An unavoidable loss of vegetation will result from clearing needed for building footprints, golf course, residences, and ancillary features.

Eighteen (18) protected tree species were identified during the baseline biological assessments. Subject to permit criteria, any mature protected tree species identified and within the limit of works for clearing will require a permit for removal under the Forestry Act, as listed under the Protect Tree Order 2021. Permits for the harvesting of a mature protected tree species will be obtained through the Forestry Unit prior to construction start.

Mitigation for the loss of upland vegetation may include planting with native vegetation, limiting construction footprints, and removal/control of invasive species.

9.5.2 Impacts to Biodiversity

Biodiversity refers to the irreplaceability and vulnerability of a habitat or community within a specific geographic context. The Bahamas is party to the Convention on Biological Diversity, which recognizes the interconnectedness of climate change and biodiversity. Cotton Bay's vascular diversity of 148 species is considered high though not unexpected given the variety of habitat types including coastal, wetland, and upland. Of the 148 species, 10 were identified as invasive and observed predominately in the golf course.

Threats to biodiversity including the introduction of invasive species, changes in micro-climates, habitat loss and fragmentation, and changes in air and water quality from emissions, effluents, and sedimentation.[34] Small island nations are uniquely vulnerable to the introduction of invasive species. The importation of landscaping material presents opportunity for the introduction of non-native and invasive species, such as the cane toad and green iguana, notably on New Providence. Invasive species are a nuisance and may be difficult to manage without adequate vigilance and quick eradication efforts.

Neglect to golf course maintenance allowed the recolonization of previously manicured fairways and course greens by invasive species. Removal of invasive species in areas slated for development and replacement by native species will improve and secure the biodiversity while eliminating the compounding threat of thriving invasive species populations across a small island. Invasive species outside the development footprint will be managed, where feasible.

Table 9-2 Invasive Species Recorded on Cotton Bay, Eleuthera, The Bahamas

Botanical Name	Common Name	Management
Casuarina equisetifolia	Australian pine	Control
Casuarain glauca	Suckering Australian Pine	Eradication
Delonix regia	Royal poinciana	Control
Haematoxylum campechianum	Logwood	Control
Ipomoea purpurea	Morning Glory	Control
Jasminum fluminense	Jasmine vine	None listed
Leucaena leucocephala	Jumbay	Control
Scaevola taccada	Hawaiian seagrape	Eradication
Thespesia populnea	Cork Tree	None listed
Schinus terebinthifolia	Brazilian Pepper	Eradication

Vascular plant diversity also included 18 species listed on the Protected Tree Order 2021. Prior to construction, a permit to Harvest a Protected Tree Species will be filed with the Forestry Unit for mature protected species meeting permit criteria.

Cotton Bay can support biodiversity through the use of native landscaping, a biosecurity and invasive species management plan, limited construction footprints, and natural areas accessed by pedestrian pathways. Installation of renewable energy technologies, utility management, and master planning based on the natural setting support climate change initiatives to lessen anthropogenic impacts on the climate.

34 Graham, Watkins et al. Guidance for Assessing and Managing Biodiversity Impacts and Risks in Inter-American Development Bank Supported Operations. IDB-TN-932. November 2015.

9.5.2.1 Habitat Fragmentation & Degradation

Habitat fragmentation is a recognized threat to biodiversity that generally results in reduced ecosystem function and species richness. The extent of fragmentation can be limited by natural corridors, green spaces, and reduced construction clearing footprints.

Cotton Bay has experienced periods of deforestation and recolonization associated with resort development, operation, closure and periods of manicured landscape. To counter this cyclical deforestation, a native landscaping palette will increase biodiversity through the control, removal, and eradication of invasive species presently abundant. Invasive species outside the development footprint will be managed, where feasible.

As is typical in the Bahamian terrestrial environment, the DBEF exhibited the greatest species diversification amongst all vegetation cover types. It is expected that some habitat degradation will occur due to the unavoidable loss of habitat associated with building and infrastructure development. A phased approach will limit the extent of degradation impacts occurring at one time. It is recommended that the site be left in its natural state until necessary for construction, with a limited building envelope. With implementation of BMPs, particularly sewerage for wastewater treatment, no impacts are anticipated that would contribute or accelerate the upland or marine habitat degradation.

9.5.3 Golf Course Irrigation & Management

To manage potential impacts to the marine environment related to the upland management of the golf course, the following sections describe the practices that will be in place.

9.5.3.1 Fertilizer

A fertigation system will control the application of fertilizer to the golf course. Technology, xeriscaping, and course reconfiguration will seek to minimize fertilizer needs and reduce water demand. Leachate impacts will be controlled via the use of minimal applications of fertilizers and herbicides with an updated irrigation system. The fertigation system will manage leachate reducing potential impacts to the marine environment.

9.5.4 Wildlife Impacts and Avifauna & Bats

Forty-three (43) avifauna species were recorded during the investigation. Interestingly, avifauna use of irrigation ponds supported a wide variety of waterfowl. Such observation supports the positive influence of wetland rehabilitation/creation and habitat creation. Of note, one Piping Plover, an IUCN Red listed species was observed along the beach.

Elsewhere, biological surveys identified frequent karst formations in upland areas designated for the residences. Where unavoidable, it is recommended that construction practices follow Ministry of Works guidelines. There is no intention to remove protected fauna. Fauna including snakes, crabs, etc., encountered during construction will be caught and moved to similar habitat. The developer will, where feasible, avoid the removal of a protected tree.

9.6 Fire and Hurricane Risks

The Bahamas lies in the Atlantic hurricane zone and is subject to indirect or direct hurricane landfall from time to time. Moreover, The Bahamas is affected by storm impacts including storm surge and elevated tides due to nearby low-pressure storm systems. The developer will adhere to the Bahamas Building Code and, where possible, use hurricane resistant materials to withstand winds of 150 miles per hour and a first floor elevation of +12ft.

Fire-fighting equipment such as fire extinguishers must be available onsite at all times. The inventory of materials shall identify any substances requiring additional specialty fire-fighting equipment. A list emergency numbers should be available onsite at all times.

9.7 Socio-Economic Impacts

Situated in the constituency of South Eleuthera, the Cotton Bay Club will provide employment opportunities for the residents of Eleuthera and the greater Bahamas. Approximately 300 jobs will be generated during construction and 200 jobs are anticipated during operation. Employees will arrive to the hotel and residences via the Queen's Highway. Relating to antiquity, no structures or ruins have been discovered on the site to date. It is anticipated the USD$200 million development will contribute over $2 million per annum in Government taxes and fees.

9.7.1 Impacts to Neighbouring Communities

Direct and indirect impacts to neighbouring communities pertain primarily to the influence of the project on Eleuthera. The influx of visitors and workers may place increased demand on available social resources, such as medical facilities, food stores, road network, and schools.

To support the project Master Plan, Cotton Bay Road and Cocoplum Drive will be relocated and improved. It is anticipated that traffic will increase along the Queen's Highway during working hours, with additional vehicles traveling during the rush hours periods (7 a.m. to 9 a.m.) and (3 p.m. to 5 p.m.). The influx of vehicles during construction and operation may present a safety hazard in narrow areas where large trucks may have difficulty passing in opposite directions. BMPs for dust, noise, and air quality control including traffic management will be outlined in the EMP in addition to a grievance redress protocol.

9.7.2 Cultural Resources

Relating to antiquity, to date no structures or ruins have been discovered onsite. During clearing exercises, protocols will be in place for the discovery of antiquities, with immediate notification made to the AMMC. Any artefact or structure will be left in place until otherwise indicated by AMMC.

10 Environmental Management

Environmental management is a systematic approach that integrates environmental policy and planning with continuous monitoring of implementation techniques to improve environmental compliance to achieve the goals of sustainable development. Hazards to human health and safety and the environment can be managed through careful planning, vigilance and strong communication during works and continual improvement to the overall environmental management program.

The preferred management approach is to avoid, minimize, and control adverse impacts to human health, safety, and the environment. Where adverse impacts cannot be avoided, BMPs should be employed to mitigate human and environmental harm.

The EMP is a dynamic document with revisions anticipated throughout the various stages of the project. A copy of the EMP will be kept onsite at all times.

10.1 Good Housekeeping Practices

Good housekeeping practices help maintain a safe and healthy workplace by eliminating hazards. While seemingly simple, a well-kept site improves productivity and worker health, thereby aiding in accident and fire prevention. A tidy work site, organized and free of clutter, allows for more effective use of the site.

General guidelines for good housekeeping practices include but are not limited to the following:

- Identification and marking of physical hazards, such as open trenches
- A designated materials storage area with adequate space and organization for supplies
- Preventive maintenance on tools and machinery to reduce the threat of spills and accidents
- A waste management program that provides and frequently empties bins for litter, dumpsters, and a designated area for construction debris
- Daily street cleaning to prevent elevation of dust particles and mud during rainfall events

10.2 Site Safety and Health

Personnel onsite will have access to sanitary conveniences, potable water, and when deemed necessary for the task, appropriate personal protective equipment (PPE). PPE protects the body from safety and health risks at work. Additional PPE will be available for work sites near water or open trenches with standing water and will include ladders, safety harnesses, and training.

PPE may include but is not necessarily limited to the following:

- Steel-toed boots
- Safety vests
- Hard hats
- Gloves
- Eye protection
- Hearing protection

All personnel will undergo an initial site safety and health training, followed by periodic refresher training. Employees should be trained on how to use PPE properly and effectively. PPE shall be inspected and maintained in good condition and if it becomes worn or broken, new PPE shall be distributed and used.

Potable drinking water will be available onsite at all times. Sanitary conveniences will be available for use onsite and regularly emptied.

Adequate lighting will be provided for work that continues during nighttime hours.

A first-aid kit and emergency contact list will be available at all times. Hazards such as open trenches and utilities will be marked by caution tape. Security and signage will identify hazards to public safety.

10.3 Materials Storage

Materials stored according to BMPs prevent spills through hazard avoidance. Materials shall be stored in a designated and secured area. Every material requires specific handling procedures because materials differ by composition, size, and weight. Materials shall be handled and stored according to specifications found in the Material Safety Data Sheet (MSDS). MSDSs shall be kept onsite at all times.

Flammable materials will be stored away from ignition sources to prevent fire. The contractor shall have fire extinguishing equipment onsite at all times.

10.4 Waste Management

Waste management identifies a project's waste streams, makes provision for timely and effective removal, and allocates responsibility for waste disposal. General housekeeping should keep the work areas free of litter and construction debris.

All solid waste materials will be placed in a designated dumpster or bin to be emptied on a fixed schedule and disposed of at a facility as directed by DEHS. Sanitary conveniences will be emptied at regular intervals by an approved sewage disposal company. Hazardous materials, if any, will be identified, appropriately stored, and disposed of in coordination with DEHS.

10.5 Protection and Preservation of Natural Resources/Sensitive Environmental Features

Employment of BMPs will minimize adverse impacts to natural resources and ensure viability of sensitive environmental features such as wetlands and nearshore habitats.

- A walkover survey is performed to identify affected protected tree species and subject to permit criteria, to apply for a permit to harvest a protected tree under the purview of the Forestry Unit under the Protected Tree Order 2021, Forestry Act 2010.
- Erosion and sediment control measures will minimize sedimentation impacts and constitute a form of pollution control.
- Spill prevention practices include designated refuelling and fuel storage areas with adequate containment measures, preventive heavy vehicle and machinery maintenance, and onsite spill clean-up kits, and waste management.

10.6 Stormwater

Removal of vegetation and development construction increases the amount of impervious surface areas, which increases the rate of surface water runoff. These high stormwater flow rates can lead to erosion and flooding. Stormwater may be contaminated with oil and grease, metals, particulate matter, and other pollutants released by vehicles. Stormwater may also contain nutrients and herbicides used for the management of vegetation in the right-of-way.

Stormwater management practices slow peak runoff flow, reduce sediment load, and increase infiltration. Infiltration is increased via vegetated swales, filter strips, terracing, detention ponds or basins, infiltration trenches/basins, and constructed wetlands.

General stormwater management practices include the following:

- Methods to reduce/slow peak runoff flow
- Installation of energy dissipation measures
- Regular maintenance of erosion and runoff control measures

10.7 Erosion and Sediment Control

Sediment impacts may occur during heavy storm events where flash flooding may erode surfaces and transfer suspended sediments to another location. Turbid conditions may adversely affect light penetration through the water column, impairing photosynthesis for marine species.

BMPs for erosion and sediment control include but are not limited to the following:

- Dewatering hoses, if any, will be placed away from sensitive environmental features and allow time for suspended sediment to fall out.
- Installation and ongoing maintenance for sediment and erosion control devices such as silt fencing, check dams, and/or mulch berms
- Revegetation and/or otherwise stabilizing of a cleared area

10.8 Prevention of Pollution of Groundwater Resources

Employment of BMPs will minimize adverse impacts to natural resources and ensure viability of sensitive environmental features such as wetlands and nearshore habitats. Erosion and sediment control measures will minimize sedimentation impacts and constitute a form of pollution control.

Spill prevention practices include the following:

- Designated refuelling and fuel storage area; with adequate containment measures (110 percent of capacity)
- Preventive heavy vehicle and machinery maintenance
- A designated wash-down area away from surface waters and sensitive environmental features
- A waste management program
- Onsite spill clean-up kits

10.9 Air Quality and Noise Attenuation

10.9.1 Air

The contractor shall implement measures to maintain ambient air quality. Fine sediment may become airborne during the dry season, which typically begins in November and ends in late May. Dust mitigation strategies during construction may include:

- Vehicle speed restrictions
- Site watering, as necessary, during the dry season

It should be noted that due to the isolated nature of the site and there being no adjacent neighbours, air, noise, and dust mitigation will require less mitigative measures than if situated in a densely populated area.

10.9.2 Noise

Noise prevention and mitigation begins at the source of noise. Noise reduction at the source prevents extraneous noise output. Noise reduction options may include but are not limited to the following:

- Selecting equipment with lower sound power levels
- Installing suitable mufflers on engine exhaust and compressor components
- Installing acoustic enclosures for equipment casing radiating noise
- Installing vibration isolation for mechanical equipment
- Limiting hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas

10.10 Fire and Hurricane Risks

The North Atlantic tropical cyclone season begins June 1 and ends November 30. However, tropical disturbances may form prior to the start and after the close of this time period. The Bahamas lies within the hurricane zone, so it is expected that tropical disturbances, tropical depressions through Category 5 hurricanes, may periodically make landfall. Risks associated with tropical cyclones include storm surge, high winds, and heavy rainfall. All construction will adhere to the Bahamas Building Code.

In terms of fire-fighting capabilities, the potable water systems will include a high-service pumping station for fire and potable water. The distribution system will include fire hydrants and fire suppression. The well water will be polished through a WTP prior to entering a common fire/water storage tank. From the tank, water is distributed to the site via a piping network that is maintained pressurized via a booster pump station(s). In the event of a fire alarm and a demand for water, adequate safeguards and automated valving will isolate available supply to fire suppression only. Fire-fighting equipment such as fire extinguishers must be available onsite at all times. The inventory of materials shall dictate any substances requiring additional specialty fire-fighting equipment. A list emergency numbers should be available onsite at all times.

10.11 Environmental Monitoring

Environmental compliance is achieved through frequent and consistent site inspection and strong communication with the contractor. Construction monitoring documents the contractor compliance to the EMP with respect to but not limited to site safety and health, protection of ground water, general housekeeping, hazardous waste disposal, noise and air quality control, and protection of natural resources. The monitoring checklist is the mechanism within the environmental management system to document onsite practices, provide recommendations, and note when corrective action is required.

10.12 Grievance Redress

Grievance redress for employees, neighbours, and adjacent property owners is a management tool to identify, assess, and provide resolution of complaints during a project cycle. Implementing a system of grievance redress early in a project's cycle allows for resolution of minor issues before escalation. Grievance redress mechanisms (GRMs) are a core component of managing project operational risk.

10.13 Draft EMP TOR – Cotton Bay

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11 Public Consultation

Public consultation will occur in coordination with the Department of Environmental Planning and Protection in accordance with the Environmental Impact Regulations 2020.

12 Mitigation

Mitigation is achieved through avoidance, minimization, rehabilitation, compensation, or offsetting. Where feasible, avoidance of impacts is pursued as a priority mitigation strategy. Where avoidance is not an option, strategies are presented to mitigate known and unknown impacts.

12.1 Climate Change Mitigation and Adaptation Plan

Climate change will contribute to greater climate variability, where changes may occur to precipitation patterns, increase in frequency and intensity of storm events, extreme heat, global sea level rise, and alteration of wave patterns, leading to shoreline erosion. Given this climate variability, engineering and building designs should plan for a scenario for future high anthropogenic greenhouse gas emissions. The Bahamas' low-lying topography makes it highly susceptible to sea level rise, with 80 percent of The Bahamas' landmass within 1.5 m of sea level. Freshwater resources are even more vulnerable, with 90 percent within 1.5 m. Cotton Bay benefits from ample elevations in excess of 15ft, with most project features situated at elevations above 15 ft.

The Sixth Assessment Report by Working Group II for the IPCC identifies climate change impacts and risks specific to small islands. Key points include ecosystem degradation, severe coral bleaching, infrastructure susceptibility to climate risks, pressures on freshwater resources and drought risk, extreme precipitation and wave impacts, and the vulnerability of communities on small islands to exceed adaptation limits[35].

Sustainable land management can reduce negative impacts of climate change on ecosystems and societies.[36] To mitigate forecasted climate vulnerabilities, Cotton Bay proposes the following adaptation techniques as outlined in the following sections.

12.1.1 Renewable Energy and Energy Consumption

Currently, it is anticipated that the development will derive energy from three sources, the existing BPL infrastructure, a solar farm and diesel generators. Per the National Energy Policy of The Bahamas, the developer anticipates 30% of electricity needs will be generated by renewable energy sources.

12.1.2 Deforestation Mitigation & Prevention of Desertification

Land degradation is defined by the International Plant Protection Convention (IPPC) as a "negative trend in land condition, caused by direct or indirect human induced processes, including anthropogenic climate change, expressed as a long-term reduction and as loss of at least one of the following: biological productivity, ecological integrity, or value to humans."[37] Land degradation contributes to the effects of desertification, where vegetation cover is decreased, and carbon dioxide is released to the atmosphere. Vegetation removal and replacement with impervious surfaces and black asphalt may result in a heat island effect, where urban temperatures are higher, most notably at night, than compared to surrounding areas that are more vegetated.

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[35] IPPC. Sixth Assessment Report. Working Group II. Fact Sheet – Small Islands. 2022

36 IPPC. Climate Change and Land. Summary for Policymakers. 2020

37 IPPC. Climate Change and Land. Summary for Policymakers. 2020

Environmental due diligence performed early in the master planning guided the overall land use design, complimenting scenic vistas and seascapes. Cotton Bay has experienced prior clearing and recolonization by weedy and invasive species particularly along the coast and golf course.

Additionally, a native landscaping palette will increase biodiversity through the control, removal, and eradication of jumbay and logwood, invasive species that are presently abundant. Trees grown in the nursery will be evaluated for replanting potential and overall integration to the design aesthetics and architecture.

12.1.2.1 Rainfall & Freshwater Resources

Based on the IPCC 5th Assessment Report and the CMIP5, climate change will alter existing rainfall patterns in The Bahamas. Climatology data suggest that The Bahamas region will incur a 3 percent decrease in monthly rainfall averages, with an increased intensity of rainfall events between October and February.

Overall, total rainfall is expected to decrease, placing additional pressure on freshwater resources. Freshwater resources in The Bahamas originate from rainfall only and accumulate in Ghyben-Hertzberg lenses. On average, the freshwater lens occurs at a depth of 2 ft to 5 ft below the surface. Ninety percent of freshwater lens resources in The Bahamas are within 5 ft of the surface. Given the proximity of fresh water to the surface and the high porosity of limestone, over-extraction and pollution may lead to depletion, saltwater intrusion, and/or contamination, impairing the fragile layer of freshwater over salt. Saltwater intrusion to limited freshwater resources is a threat.

At Cotton Bay, the potable water system components consist of a WTP,

Recommendations for Golf Course Water Management at Cotton Bay:

1) To landscape greenspace areas in a xeriscape manner which uses natural vegetation along with minimal water trees and plants that rely on the natural, available rainfall.
2) The golf course reconfiguration can incorporate more natural vegetation between fairways and around greens. Such a reconfiguration could be directly related to reducing the required irrigated area.
3) Turf grasses that are either more salt resist or require less water or both.
4) On concern of irrigating with a saline source is getting increasingly more saline water because of the over-pumping and thus creating an environment that could eventually damage the turf grasses and underlying soil.

12.2 Vegetation Management

12.2.1 Clearing & Grubbing

There will be an unavoidable loss of vegetation in areas slated for development. The developer shall take care to ensure that vegetation removal is kept at the minimum required.

Clearing and grubbing prepares the site for construction. Clearing removes the above-surface foliage and trees, whereas grubbing removes the roots that remain in the soil. This process requires heavy machinery and adherence to BMPs for sediment and erosion control, prevention of pollution to groundwater resources, and protection of sensitive environmental features.

Construction BMPs:

- Protection of Sensitive Environmental Features.
  - Environmental controls shall be placed along sensitive environmental features such as wetlands and barriers shall be installed around fully mature protected trees, to protect from encroachment, and damage from machinery.
  - The workforce will receive training on protected tree species and the importance of wetland habitat and mangroves.
  - A walkover survey shall be performed prior to the commencement of works. Mature protected trees, if any, in the area of the work site shall be removed only upon receipt of a Permit to Harvest a Protect Tree as permitted by the Forestry Unit, subject to permit criteria.
  - Heavy machinery will undergo routine maintenance to prevent leaks, spills, and/or other mechanical failure that may cause environmental harm.

- Cleared Vegetation.
  - Vegetation that is cleared may be mulched and used for other beneficial purposes. Invasive species should be separated from any mulching operation and disposed of separately.

- Landscaping & Planting
  - All areas cleared for construction should be temporarily stabilized (environmental controls, temporary seeding, etc) until such time that they are ready for final stabilization in order to mitigate sediment and erosion impacts.

12.2.2 Invasive Species Management

The Bahamas National Invasive Species Strategy 2013 (NISS) updated policies to mitigate the threat of invasive species via the prevention of introduction as well as the management and eradication of listed species[38]. Invasive species management protects the natural environment, genetic diversity of flora and fauna, ecosystem services, and quality of life. This National Policy is further strengthened in the Environmental Planning and Protection Act, 2019, which defines invasive alien species as "a species that is non-native or alien to the ecosystem under consideration, and its introduction causes or is likely to cause harm to the economy, environment, or human health".

Small Island Developing States (SIDS) like The Bahamas have high native species diversity and endemism counts due mainly to physical isolation from the mainland. This isolation is both a vulnerability and an advantage for invasive species management.[39]

As an archipelagic nation, The Bahamas is uniquely vulnerable to invasive alien species due to multiple invasion border pathways, requiring a complex management approach and the distribution of islands each harboring a site-specific habitat matrix with limited defences to aggressive and opportunistic invaders. Climate change exacerbates this threat, with intensifying storm events resulting in significant habitat degradation and loss, facilitating rapid colonization by alien invaders. Moreover, climatic changes may be conducive for the spread of tropical disease.

38 Moultrie, S. (2013). *The Bahamas National Invasive Species Strategy 2013*. Nassau: Department of Marine Resources.

39 Bullard, JM. (2013). Critical Situation Analysis of Invasive Alien Species Status and Management, The Bahamas. Nassau. Department of Marine Resources.

Public educational campaigns and media have highlighted several alien species including lionfish, cane toad, Australian pine, and white inkberry. These widely recognizable species threaten native populations through competition of resources, predation, and displacement. Other environmental threats associated with invasive species include the following:

- Loss of genetic diversity
- Introduction of disease
- Change in the physical properties of the environment
- Changes to ecosystem functions
- Changes in nutrient cycles

Invasive species not only threaten the natural environment but also the underlying economy and culture. Competition for subsistence harvesting and degradation of culturally important habitats and resources may also be affected[40]. Economic impacts from invasive species include:

- Loss of biodiversity, rare and endemic species
- Interference with fisheries, agriculture, and silviculture
- Disruption to tourism products
- Damage to infrastructure
- Decreased property value
- Costs of clean up and control
- Costs of treatment or quarantine
- Health costs and loss of productivity.

12.2.3 Invasive Species Identified at Cotton Bay

Ten (10) invasive species were observed on the site. These species are listed below along with recommendations for management as outlined in the National Invasive Species Strategy for the Bahamas, 2013.

Table 12-1 Invasive Species Recorded on Cotton Bay, Eleuthera, The Bahamas

Botanical Name	Common Name	Management
Casuarina equisetifolia	Australian pine	Control
Casuarain glauca	Suckering Australian Pine	Eradication
Delonix regia	Royal poinciana	Control
Haematoxylum campechianum	Logwood	Control
Ipomoea purpurea	Morning Glory	Control
Jasminum fluminense	Jasmine vine	None listed
Leucaena leucocephala	Jumbay	Control
Scaevola taccada	Hawaiian seagrape	Eradication
Thespesia populnea	Cork Tree	None listed

40 Moultrie, S. (2013). *The Bahamas National Invasive Species Strategy 2013*. Nassau: Department of Marine Resources.

Table 12-1 Invasive Species Recorded on Cotton Bay, Eleuthera, The Bahamas		
Botanical Name	Common Name	Management
Schinus terebinthifolia	Brazilian Pepper	Eradication

12.2.4 Management Protocols

Invasive species management protocols for Cotton Bay pertain to the following:

- The introduction pathway
- Eradication and control of existing invasive species in the development footprint
- Routine preventive maintenance for future establishment

Continued vigilance following construction buildout is key to long-term preservation of biodiversity.

12.2.4.1 Introduction Pathway

Preventing the introduction of an invasive alien species through invasion pathway management is the most effective practice to avoid unwanted species establishment. Most vectors arrive via human-assisted transport such as planes and ships. These transport mechanisms move organisms outside their natural environs. As an island nation, The Bahamas imports myriad goods, including food, ships, tires, pallets, construction materials, and landscaping. Intentional introductions are often motivated by economic, environmental, and social means, for example agricultural, landscaping, and even environmental control measures.[41] In the absence of national policies to avoid the import of invasive alien species, the following BMPs are recommended.

Introduction Pathway Management BMPs

- **Landscaping – Native Palette.** The landscaping palette should promote a predominantly native species array, with ornamental species reviewed for inclusion on the National Invasive Species Strategy 2013 lists.
- **Landscaping – Purchase Local.** Where feasible, landscaping should be purchased via a local supplier, where trees and shrubs are grown locally, avoiding the human-assisted transport invasion pathway.
- **Materials Review.** Upon arrival, construction materials should be reviewed for unwanted vectors. All earth-moving equipment should be washed down prior to site arrival to prevent transport of invasive seeds, i.e., *Casuarina*, and/or material. Disturbed areas are ideal habitats for invasive seedlings to establish.
- **Vector Control.** Vector control onsite should consist of approved methods and agents. Biological control of vectors such as rats shall not include the introduction of a non-native species.

12.2.4.2 Eradication and Control

The Bahamas National Invasive Species Strategy 2013 (NISS) lists invasive species and also provides a recommendation for control: eradication, control, or none listed. Eradication is the preferred approach to restore and maintain biodiversity; however, it is also the most costly and difficult to implement. Established populations of

41 Bullard, JM. (2013). Critical Situation Analysis of Invasive Alien Species Status and Management, The Bahamas. Nassau. Department of Marine Resources.

invasive species, such as the Australian pine, would take significant resources and years of committed action to accomplish eradication.

Of critical importance is the disposal mechanism for the removed invasive species. Felling of botanical species without removal may result in unintentional seed dispersion.

Control techniques include:

- Physical Control – removal by hand, mechanical harvesting, or the creation of physical barriers.
- Chemical Control – chemical dosing, use of toxic baits, and application of herbicides and pesticides.
- Biological Control – the introduction of natural enemies, such as pests and pathogens, from the invader's origin.

It is recommended that Cotton Bay pursue physical control via the removal and/or mechanical harvesting of invasive species onsite where feasible. It is anticipated that individuals will be removed to accommodate built infrastructure. Where invasive alien species exist outside the built infrastructure, it is recommended that the developer continue to undertake physical control to eradicate the prevalence of NISS 2013 listed species onsite.

12.2.4.3 Monitoring

Routine maintenance and monitoring for the establishment of invasive alien species, particularly those on the NISS list for eradication, should be ongoing. The most cost-effective approach is preventing the establishment of NISS-listed species.

- **Removal of Invasive Alien Species (IAS) saplings.** *Casuarina* seedlings quickly become established in disturbed areas such as cleared roadways and paths. These areas should be routinely monitoring for the sprouting of IAS saplings. These saplings should be removed immediately.
- **Ongoing Monitoring of Introduction Pathways BMPs.** Policies related to the choice of landscaping palettes and vendors should be continually reviewed for adherence to the Invasive Species Management Plan.
- **Education.** Residents and businesses should be educated on NISS species. Community efforts to identify unknown plants, birds, and invertebrates/mammals should be encouraged. All unknown species should be photographed for identification by informed personnel.
- **Outreach.** Upon identification of an IAS, the developer should inform and work with the relevant authorities to devise an appropriate plan to manage, control, and eradicate the intruder.

12.3 Wetlands

Wetlands exist in a transition zone between the aquatic and terrestrial environments. Neither terrestrial nor aquatic, wetlands have unique characteristics that allow for a distinct classification. The Bahamas is a signatory to the Convention on Wetlands of International Importance for Waterfowl Habitat, also known as the Ramsar Convention. Ramsar defines wetlands as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of

which at low tide does not exceed six meters." Wetlands of The Bahamas are categorized as either coastal or inland wetlands[42].

The man-made irrigation pond that function as wetlands on the golf course will be considered for form, function and aesthetics with respect to management. Where wetlands necessitate modifications, the overall goal is to increase ecosystem function and secure the island's overall biodiversity. Wetland enhancement and alternate habitat creation goals are listed below:

- Invasive species removal
- Habitat restoration on perimeter
- Increase avifaunal use during the entire year (create levels)
- Aesthetic improvements (invasive species removal and habitat restoration)

12.3.1 Wetland Enhancement & Ecological Engineering

Wetland creation, restoration, enhancement and ecological engineering (including alternate habitats) are techniques to mitigate ecological loss. Each technique is unique and its application, and appropriateness, is site-specific, based on existing conditions.

Definitions for the techniques are provided as follows:

- **Wetland restoration.** The return of a wetland from a disturbed or altered condition caused by human activity to a previously existing condition.
- **Wetland creation.** The conversion of a persistent upland or shallow water area into a wetland by human activity
- **Wetland enhancement.** A human activity that increases one or more functions of an existing wetland.
- **Ecological Engineering.** The design of sustainable ecosystems/habitats that integrate human society with its natural environmental for the benefit of both.

13 Contributors

Melissa Alexiou, Environmental Specialist, Waypoint Consulting

Janeen Bullard, Marine Biologist, JSS Consulting

Tanya Ferguson, Botanist, JSS Consulting

Predensa Moore, Avian Expert, JSS Consulting

42 Bahamas National Trust. Field Guide to the Wetland Plants of The Bahamas.

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15 CVs

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NATIONALITY & LANGUAGE

Citizenship: United States of America
Residency: Spousal Permit with Right to Work – Bahamas
Languages: English

EDUCATION

Master of Science, Environmental Science and Policy, The Johns Hopkins University
Bachelor of Arts, Environmental Studies, Rollins College
Certificate, Geographic Information Systems (GIS), The Johns Hopkins University

PROFESSIONAL CERTIFICATION & TRAINING

Project Management Professional (PMP), Project Management Institute
National Association of Environmental Professionals (NAEP)
ASTM E1527 Phase I & II Environmental Site Assessments for Commercial Real Estate
OSHA 10-Hour Certification

EXPERIENCE

2012 – Present
Waypoint Consulting Ltd., Environmental and Project Management Consulting, Director, Nassau, Bahamas

- Environmental Impact Assessments, Environmental Management/Mitigation Plans
- Climate Change, Vulnerability, Risk & Adaptation
- Project management and administration services for permitting
- Construction Monitoring for Environmental Management
- Research analyst, advisory consulting services, and technical writing

Selected Projects

Environmental Impact Assessment & Environmental Management Plan, Disney Cruise Line, Lighthouse Point, Eleuthera, The Bahamas

Waypoint Consulting was the lead local environmental consultant for Disney's Cruise Destination and Entertainment Facility at Lighthouse Point, Eleuthera. This $250+ million project features a cruise ship pier, marina, and associated facilities for cruise passengers. The project completed the environmental permitting process under the Environmental Planning and Protection Act 2019 and Environmental Impact Assessment Regulations 2020 including public consultation.

Environmental Legislative Review for Offshore Petroleum Industry

Waypoint reviewed existing and proposed legislation for relevance to the offshore petroleum industry. International Conventions and National Environmental Policies were also included in the assessment.

Env. & Social Analysis – Climate-Resilient Coastal Mgmt. & Infrastructure Program – IDB BH-L1043
The purpose of the ESA was to identify environmental and social aspects including risks, evaluate site-specific aspects, and provide recommendations for measures to mitigate identified impacts for projects proposed on Long Island, Grand Bahama, Andros, and New Providence. Stakeholder consultation was a critical element for site specific project evaluation.

Environmental Site Assessment, Philautia, Eleuthera, The Bahamas
Waypoint prepared an Environmental Site Assessment to document existing site conditions at the former U.S. Naval Facility, Eleuthera. Decommissioned in 1980, quarters and general infrastructure including larger generators and catchment basin exist in deteriorated conditions.

Environmental Impact Assessment: Cruise Line, Private Island Development, The Bahamas
Waypoint provided local environmental consulting expertise to assist a major cruise line with identifying a suitable location for a new cruise ship destination facility. In association with ATM, Waypoint prepared an EIA and liaised with government officials.

A Comprehensive Strategy for the Optimization of Family Island Airports - IDB BH-L1027, Bahamas
Waypoint was subcontracted to provide support in the review and application of existing environmental regulations and guidelines for The Bahamas Civil Aviation Department (BCAD). Review of BCAD schedules combined with a review of national parks and important bird areas was part of a gap analysis to strengthen environmental understanding and commitment by the aviation authority.

Environmental Manager. North Abaco Port Project, Great Abaco, The Bahamas
Waypoint was the designated Environmental Manager for the completion of the North Abaco Port Project which included opening the port basin to the Sea of Abaco. Waypoint provided oversight of the Environmental Monitor and submitted weekly environmental reporting to the BEST Commission.

Environmental Management Plan: Commercial Forestry Project, The Bahamas
Waypoint was subcontracted to provide research, and technical writing and editing for an Environmental Management Plan (EMP) related to a potential commercial forestry project in The Bahamas. EMP best management practices highlighted fire management, wildlife management, and management protocols for sensitive environmental features, preservation of water quality and soil quality.

Environmental Impact Assessment: Children's Bay Cay, Exuma, The Bahamas
Waypoint in coordination with Applied Technology Management (ATM) provided technical writing services, environmental analysis, and consultation for local project permitting. Waypoint is the local environmental consultant of record and liaises directly with government.

Phase 1 Big Pond Landfill Remediation/Restoration IDB Mitigation for Roadworks, New Providence,
Melissa provided environmental monitoring services to the Contractor through Islands By Design Ltd. for remediation efforts at Big Pond, a former landfill and important urban mangrove ecosystem. Remediation of the former landfill served as the mitigation component for the New Providence Road Improvement Project. Mitigation included the demolition of two buildings, removal of contaminated soils, removal of surface waste, and the implementation of a boardwalk, trails, and basketball courts.

2010 – 2012
Islands By Design, Environmental Scientist, Nassau, Bahamas

Selected Projects
BEC Abaco 69kV Transmission Line, Abaco, EIA
As a high priority project, environmental and socio-economic analysis was performed under a tight-schedule with significant implications for residents of the Greater Abacos.

South Beach Township Project, Nassau
The South Beach Township Project was an initiative to rehabilitate a low income area through planning for an area of southeastern New Providence. A key component of the plan was to identify existing environmental issues, namely flooding and limited beach access, and to rectify these issues to create a mixed-use sustainable community.

Sports Centre Redevelopment Project, Nassau- Environmental Monitor
As the Environmental Monitor, I performed twice weekly site visits to document contractor compliance to the EMP and monthly reports to evaluate overall contractor compliance and provide recommendations for improvement.

2007 – 2008
Farkas Berkowitz & Company, Associate, Washington, DC
A Strategic Management Consulting Firm where Melissa performed market research and analysis for top Engineering News Record, Fortune 500 firms

2005 – 2007
Protection Strategies Incorporated, Environmental Scientist, Arlington, VA
Government Contractor to U.S. Environmental Protection Agency (EPA) for the Water Contaminant Information Tool (WCIT)

CONTINUING EDUCATION AND CONFERENCES

- Results-Based Project Management, Professional Certificate, IADB, December 2021
- Climate Change: Financial Risks and Opportunities. Imperial College Business School (Imperial X) March 2021
- National Association of Environmental Professionals (NAEP) Virtual Conference, Aug 2020/May 2021
- Management for Environmental Results with Performance Based Measurement, Johns Hopkins U., 2019
- Coastal and Marine Spatial Planning Advancement Training, Duke University and Battelle, Spring 2015
- Creation and Restoration of Wetlands, Everglades Wetland Research Park, October 2014
- Sponsor, Bahamas Natural History Conference, March 2014 & 2016 & 2018

SKILLS

- Geographic Information Systems (GIS)
- MS Word, MS Excel, MS PowerPoint, MS Publisher, MS Visio, MS Project

COMMUNITY INVOLVEMENT

- Bahamas Society of Engineers, Associate Member
- Bahamas Engineers, Architects, and Allied Professionals, Board Member, 2016-2021
- Bahamas Chamber of Commerce, Energy and Environment Committee, 2015-2016

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EDUCATION:

2008	UNIVERSITY OF LONDON **PG Certificate in Environmental Management** **Environmental Impact Assessment Course**
2008	UNIVERSITY OF LONDON **PG Certificate in Environmental Management** **Environmental Auditing Course**
2003 – 2006	COLLEGE OF THE BAHAMAS **Bachelor of Education, Biology with Combined Science**
1991 – 1995	COLLEGE OF THE BAHAMAS **Associates of Arts, Biology**

TRAINING:

- Biodiversity Data Management Workshop; Mar. 2005; Nassau, Bahamas
- Workshop on Bahamas becoming signatory to The Rotterdam Convention; Feb. 2005; Nassau, Bahamas
- Workshop on Bahamas becoming signatory to International Treaty on Plant Genetic Resources for Food and Agriculture; Feb. 2005; Nassau, Bahamas
- Geo Bahamas Workshop; June 2004; Nassau, Bahamas
- Fire Management Workshop; May 2002; Belize
- Eco-lodge Design Workshop; May 2001; Nassau, Bahamas
- Terrestrial Ecology Workshop; April 2001; Nassau, Bahamas
- Hibiscus Mealy bug Workshop; January 2001; Nassau, Bahamas
- Pest Risk Analysis Workshop; January 2001; Nassau, Bahamas
- Ozone Depletion Workshop; March 1998; Nassau, Bahamas
- Agriculture Conference & Tradeshow; September 1998; Orlando, Florida
- Green Management Seminar; October 1997; Nassau, Bahamas
- Ecotourism Planning Seminar; September 1997; Nassau, Bahamas

EMPLOYMENT:

2008 – Present DESIGN ELEMENTS

Principal
- Organize and coordinate staff and sub-contractors
- Prepare proposal and final reports
- Oversee Environmental Management of project

Field Scientist
- Conduct Botanical Assessments for EIA
- Conduct site inspections for environmental compliance

2014 – 2015 BAHAMAS GOVERNMENT,
MINISTRY OF WORKS & URBAN DEVELOPMENT,
PROJECT EXECUTION UNIT, BIG POND PARK PROJECT

Environmental Specialist
- Conduct site environmental inspections
- Monitor civil works and park construction activities to ensure environmental compliance
- Provide advice on selection of appropriate plants for landscaping
- Provide on-site biological and botanical evaluation

2005 – 2007 BAHAMAS NATIONAL TRUST
Curator, Retreat Gardens
- Design and implement restoration plan
- Develop maintenance program
- Management of rare collection of palms
- Contributions to interpretive signage and brochures

1997 – 2007 BAHAMAS GOVERNMENT, DEPARTMENT OF AGRICULTURE
Bahamas National Herbarium, Curator
- Identify and Curate plant specimens

National Entomology Collection, Curator
- General maintenance of insect collection

Conservation Unit
- Vegetation survey and analysis
- Review of scientific research permits
- Review of Environmental Impact Assessments
- Public education publications and training

CORE STRENGTHS:

- Project Management
- Strong Science Background
- Leadership Skills
- Strategic Development Planning
- Development of Educational Programs
- Good written & verbal communication skills

CAREER HIGHLIGHTS:

- **Worked on over 100 projects on 33 Islands and Cays throughout The Bahamas. Notable projects include:**

  - Big Pond Park Project; New Providence, The Bahamas; Environmental Specialist (IDB Project)
  - Water & Sewerage Corporation, Water Supply Improvement Project, Environmental Specialist (CDB Project)
  - Ocean Cay Marine Reserve, Bimini, The Bahamas, Environmental Management (MSC Cruises)
  - Barbuda Airport, Antigua and Barbuda, Biological Assessments for EIA

- **Worked on a variety of project in the environmental and design fields including:**

  - Environmental Impact Assessments
  - Environmental Management Plans
  - Environmental Management
  - Biological Baseline Data Collection
  - Habitat Restoration
  - Coral Relocation
  - Coral Relocation Monitoring
  - Land Classification System
  - Post Hurricane Assessment
  - Strategic Development Plan
  - Oil Impact Pre-Assessment
  - Invasive Species Removal
  - Native Landscape Palette, Design, Installation and Interpretation
  - Public Education Program
  - Rat Eradication

AWARDS:

- Bahamas Women in Science &Technology Careers Seminar, Honoree, 2002

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SUMMARY OF QUALIFICATIONS

With over 10 years of experience in the scientific and environmental field I am able to bring forth a plethora of skill sets that arrange from multi-tasking, planning and coordination, management of personnel and time as well as confidential handling of sensitive information and resources. I am dedicated and hardworking, with a passion for excellence. I possess skills in project management, educational & public outreach and research & development.

EXPERIENCE

2011 – Present

Environmental Specialist

- Botanical, Avian and Marine Assessments for Environmental Impact Assessments, Proposal preparations and final reports **– Design Elements Ltd., Blue Engineering and Islands by Design**
- Native Plant Landscaping **– Design Elements Ltd.**
- Environmental Field and Management Services such as The Airport Gateway Project (**Design Elements Ltd**), The Big Pond Park Project, Big Pond Park Project Phase I & II (**IDB projects**) and Paradise Island Bridge Renovation Project (**Island Site Development**)
- Author of the "Andros Sustainable Development Masterplan" (I
- Author of the "Critical Situation Analysis of Invasive Alien Species for The Bahamas"
- Project Coordinator for Lyford Cay Cane Toad Eradication
- Planning Officer for the Public Forum on the UNESCO global Small Island Development States Conference on Climate Change
- Various Environmental Committees including National Forestry Week and Bahamas National Coastal Awareness Committee

2006-2011 **Bahamas National Trust** Nassau, Bahamas

Parks Planner and Community Liaison Officer

- Develop proposals to government for the establishment of new National Parks.
- Grant writing
- Develop General Management Plans for existing National Parks.
- Work with surrounding communities to gain support for the importance of establishing new National Parks.
- Project Management for the establishment of the Leon Levy Native Plant Preserve, Eleuthera, The Bahamas.
- Work with Governmental, private sector and non-governmental organizations on conservation and environmental issues throughout The Bahamas.
- Organized and implemented successful clean-up campaigns throughout The Bahamas

- Manage all daily details and education of staff for educational programs.
- Organize all special events for the Education Department.
- Liaise with corporate sponsors in order to further fund educational programs.
- Develop marine education lesson plans and activities (on and off site) for grade levels K-12 and college students.
- Attendance and professional presentations at events both locally and abroad.
- Development of the National High School Marine Science Curriculum.

2001-2004 **Tuskegee University** Tuskegee, AL

Research Assistant

- Developed and maintained research projects in conjunction with Tuskegee University and NASA.
- Aided in the daily maintenance and running of a greenhouse.
- Organized and taught Environmental and General Biology courses.

1999-2001 **Dolphin Encounters** Blue Lagoon, Bahamas

Marine Mammal Trainer

- Trained Atlantic Bottlenose Dolphins in educational and interactive programs.
- Assisted in developing marine conservation and educational programs.

EDUCATION

2001-2004 **Tuskegee University** Tuskegee, AL

M.S. Biology (Concentration in Plant and soil Science).

Thesis Topic: The Effects of Superoptimal CO_2 on the Growth, Yield, Gas Exchange, Stomatal Conductance and Starch of Sweet Potato and Peanut.

1995-1999 **Tuskegee University** Tuskegee, AL

B.S**.** Marine Biology

AWARDS &CERTIFICATIONS

2015 IICA, Efficient use of Rainwater and Runoff in Agricultural Activities, Chitre, Panama

2015 IICA, Agro-Eco Tourism Training Workshop

2014 Commercial Training Center of Department of Commerce, Hainan Province, China Climate Change on Tropical Island and Economic Development for Developing Countries

2013 The Nature Conservancy, Coral Reef Restoration

2013 The Nature Conservancy, AGRRA Coral Surveys

2010 The Bahamas National Trust, Business Writing

2010 The Bahamas National Trust, Public Presentation

2010 The Bahamas National Trust, Project Management

2010 The Bahamas National Trust, Public Participation and Informed Consent

2010 The Bahamas National Trust, Planning Nuts and Bolts

2009 The Nature Conservancy, Bush Fire Management
2009 The Nature Conservancy, Invasive Species Management
2009 College of The Bahamas, Mangrove Forest Ecology, Management and Restoration
2008 International Fund for Animal Welfare, Certificate of Completion for Whale Watch Guide Training
2006 National Association of Interpretation, Certified Interpretive Guide
2006 Tuskegee University, 1st Place Graduate Oral Presentation Sigma Xi
2005 Tuskegee University, Certificate of Effective Leadership
1995 Auburn University, NAUI Scuba Certified

PROFESSIONAL MEMBERSHIPS

SEEDS-Ecological Society of America, Sigma Xi Scientific Research Society, Beta Kappa Chi Honor Society, National Association for Interpretation, National Marine Educators Association