SUPPLEMENTAL ENVIRONMENTAL IMPACT ASSESSMENT

# ROYAL BEACH CLUB AT PARADISE ISLAND
## NASSAU, THE BAHAMAS

CONDUCTED FOR

Royal Caribbean Group

FOR SUBMITTAL TO

# THE MINISTRY OF THE ENVIRONMENT AND NATURAL RESOURCES

## THE DEPARTMENT OF ENVIRONMENTAL PLANNING AND PROTECTION

Prepared by

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NASSAU, THE BAHAMAS

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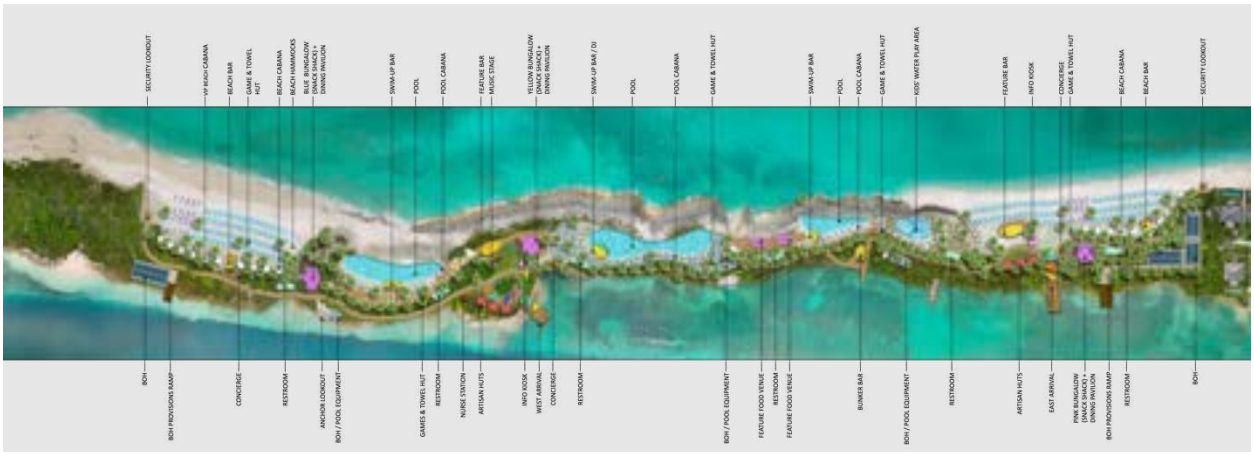
## 1.0 INTRODUCTION

Further to the submittal of the Environmental Impact Assessment submittal of December 2020 supplemental studies have been conducted for the purposes of identification of any changes to both the terrestrial and benthic environments.

## 2.0 UPDATED MASTERPLAN



Large scale and electronic copies have been submitted to DEPP

Our refreshed site plan reflects a vision to create the ultimate beach day, restore Paradise Island and do so as one of the most environmentally progressive tourism developments in The Bahamas. One of our key planning goals is to build the least amount of infrastructure as possible, relying on scaled infrastructure in and around New Providence. The new masterplan reflects a reduction of approximately 9,000 sq ft in Front of House buildings and approximately 15,000 sq ft in Back of House buildings. Another key pillar was the restoration of the beaches to ensure health and stability of the sandy coastline. The new plan includes the removal of nearly 600 sq ft of retaining walls to restore the beach back to its natural state. The new site plan also shows a separation of the pool experience in the center of the site from one long pool to 3 smaller pools. This allows us to work with existing elevations on site in the best way to minimize cut and fill and maintain the integrity of the existing iron shore.

## 3.0 BOTANICAL ASSESSMENTS – 26 May 2023

### 1. Introduction

In October 2019 a botanical assessment was conducted for the western end of paradise island to document the baseline conditions within the proposed project limits and surrounding areas of Royal Beach Club at Paradise Island. In 2023 the size of the development was reduced to 17 acres within the area outlined in figure 1-1. On the 27th of April 2023 a botanical assessment was conducted for the 17 acres encompassing the Royal Beach Club at Paradise Island site. The purpose of the botanical study was to document the baseline conditions within the project limits. More specifically, the focus was to map vegetation types, determine floristic diversity, record protected species abundance, and identify the presence of invasive species.

**Figure 1-1:** Royal Beach Club at Paradise Island Survey area

### 2. Methodology

Vegetation types were mapped by examining aerial photography and March 2023 drone images then verified by walking along the shoreline and within the interior of the vegetation. Vegetation type taxonomy is based on Areces et al. (1999). Vascular plant species occurring in each vegetation type were recorded and used to compile an overall floral list. Plant taxonomy is based on Corell and Corell (1982). The presence, location and abundance of vascular species listed

under the National Invasive Species Strategy for The Bahamas, 2013 were noted when encountered. A protected species survey was conducted to identify the presence and quantify the abundance of plant species listed on the Forestry Act Declaration of Protected Trees Order 2021. A detailed method statement is provided in this section of the report (see section 3.3.3).

# 3. Findings

## 3.1 Habitat Mapping

There are three general vegetation land cover types in The Bahamas – coastal, interior upland and wetland. The site consisted of coastal (Rocky shore, Sandy Shore) and interior upland (Dry broadleaf evergreen formation and Human Altered) land cover types. There were no wetlands within the project limits. Land cover type distribution is outlined in Table 3-1 and illustrated in Figure 3-1.

**Table 3-1:** Land Cover Distribution for Royal Beach Club at Paradise Island

| Land cover distribution | Square Feet | Acres | Percentage of total acres (17) |
|---|---|---|---|
| Sandy shoreline | 95,086 | 2.18 | 12.82% |
| Rocky shore | 92,162 | 2.12 | 12.47% |
| Dry Broadleaf Evergreen Formation | 54,198 | 1.24 | 7.29% |
| Human Altered | 499,198 | 11.46 | 67.41% |
| **Total** | **740,644** | **17** | **100%** |


**Figure 3-1:** Land Cover Map – Royal Beach Cub at Paradise Island

## SECTION 3.0: BOTANICAL ASSESSMENTS

## 3.2 Vegetation Type Descriptions

### 3.2.1 Coastal

Coastal terrestrial ecosystems are those areas that are close to the shoreline which are exposed to wind, salt spray and or periodic inundation. Coastal ecosystems within the project limits include Rocky shore and Sandy shore.

#### 3.2.1.1 Rocky Shore

Rocky Shore is located along the northern and southern coastlines and include iron shore with no vegetation, rock revetments with little to no vegetation and *Rhachicallis americana* (Sandfly Bush) herbland.

An extensive area of iron shore with no vegetation is present along the northern coastline. For the most part, bare iron shore abuts humann altered vegetation in upland sections of the site.

**Photo 3-1:** Northern rocky shoreline profile with no vegetation (view facing East)

In one small section there is a patch of *Rhachicallis americana* (Sandfly Bush) herbland along the interior margin of the bare iron shore, that merges with the dry broadleaf evergreen formation upland vegetation.

**Photo 3-2:** Rocky shore with *Rhachicallis americana* (Sandfly Bush) herbland vegetation on Northern shore (left – view facing South, right – view facing West)

Along the southern shore, the rocky shore profile occurs as a band less than three (3) meters wide between shoreline and the upland vegetation. Iron shore rock with no vegetation is present along wave cut platforms and there is small strip of *Rhachicallis americana* (Sandfly Bush) herbland vegetation along the edge of the upland vegetation in some areas. Invasive species such as *Casuarina equisetifolia* (Australian Pine) are also present.

**Photo 3-3:** Rocky shore with *Rhachicallis americana* (Sandfly Bush) herbland vegetation on Southern shore (view facing North)

Boulder rock revetments are present in the Eastern section of the site on both the Northern and Southern coastlines. These structures are in the heavily human altered areas near existing residential structures.

**Photo 3-4:** Rock revetment along Northern shoreline

**Photo 3-5:** Rock revetment along Southern shoreline

### 3.2.1.2 Sandy Shoreline

Sandy Shoreline is present along the Northern coast interspersed with Rocky shore. These areas are predominantly human impacted. The Western sandy shoreline has large sections of *Scaevola taccada* (White Inkberry) and *Casuarina equisetifolia* (Australian Pine) with a thick leaf litter layer on the ground or zoysia grass as a ground cover.

**Photo 3-6:** Western sandy shoreline profile with *Scaevola taccada* (White Inkberry) and *Casuarina equisetifolia* (Australian Pine) (view facing East)

**Photo 3-7:** Western sandy shoreline profile with *Zoysia* sp. grass as ground cover under *Casuarina equisetifolia* (Australian Pine)

There is a small section that has a patch of vegetation that is typical in native dune systems along the sandy shorelines in The Bahamas. The vegetation present includes *Uniola paniculata* (Sea oats) and *Ipomea pes-caprae* (Railroad vine).

**Photo 3-8:** Western sandy shoreline with pocket of native dune vegetation (left – view facing East, right – view facing West)

The Easternmost sandy shore is predominantly sand with no vegetation and is separated from uplands by a series of concrete retaining walls and rock revetment. The amount of exposed sand below retention structures varies due to periodic tidal and seasonal inundation which at times completely covers this area.

**Photo 3-9:** Eastern sandy shoreline profile with no vegetation and rock revetment (view facing East)

**Photo 3-10:** Eastern sandy shoreline profile with no vegetation and retaining wall (view facing West)

## SECTION 3.0: BOTANICAL ASSESSMENTS

There are sand deposits in some areas above the retaining walls. For the most part these areas are bare sand. Vegetated areas are either invasive or ornamental species. In one area there is a small patch of *Uniola varigata* (Sea Oats) that was planted within a human altered area.

**Photo 3-11:** Patch of *Uniola paniculata* (Sea Oats) planted in sandy area above retaining wall

At one of the narrowest points on the site, there is an area of sand deposit immediately South of the Rocky iron shore on the Northern coast. Vegetation in this area include patches of *Uniola paniculata* (Sea Oats), *Rhachicallis americana* (Sandfly Bush), *Borrichia frutescens* (Bay Marigold) and *Sporobulus virginicus* (Seashore rush grass).

**Photo 3-12:** *Uniola paniculata* (Sea Oats) in sandy area near Northern Rocky Shore

### 3.2.2 Interior Upland

#### 3.2.2.1 Dry Broadleaf Evergreen Formation

Several patches of dry broadleaf evergreen formation (DBEF) are present along the Southern side of the site which is more protected from wind and salt spray. This vegetation type consists of shrubland and forest. Shrubland, at a height of 4-5 feet, is present in one of the narrowest sections of the site. This area is exposed to coastal conditions from both the Northern and Southern shore thus the vegetation is dwarf and wind pruned. Plant species present is predominantly *Coccoloba uvifera* (Sea grape), with *Conocarpus erectus* (Buttonwood) along the Southern shore. Other species present include *Croton linearis* (Granny bush) and *Casasia clusifolia* (Seven-year apple).

**Photos 3-13:** DBEF shrubland 4-5 feet in height (view facing South)

### 3.2.2.2 Human Altered

The Easternmost interior upland areas on site are almost exclusively human altered. The area consists of a series of residences with partial or complete clearing of native vegetation. Existing vegetation is a combination of native vegetation left in place such as large stands of *Coccoloba uvifera* (Sea grape), predominantly invasive species such as *Scaevola taccada* (White Inkberry), Casuarina *equisetifolia* (Australian Pine) and *Thespesia populnea* (Cork Tree); and landscape species including grass, palms and ornamentals such as *Cocos nucifera* (Coconut Palm), *Stenotaphrum secundatum* (St. Augustine grass), *Archontophoenix alexandrae* (Alexander Palm), *Ixora coccinea* (Jungle Flame), *Ficus microcarpa* (Green Island Ficus) and *Plumeria sp.* (Frangipani).

**Photos 3-14:** Human altered area with abandon structures

## SECTION 3.0: BOTANICAL ASSESSMENTS

**Photos 3-15:** Human altered area with concentration of Coconut Palms

## 3.3 Vascular Plant Diversity

### 3.3.1 Species abundance

A total of ninety-six (96) vascular plant species were observed during the investigation (See Table 3-2).

***Table 3-2:*** *List of vascular plant species recorded at Royal Beach Club at Paradise Island*

**Table Key: RS** = Rocky Shore, S**S** = Sandy Shore, **DBEF** = Dry Broadleaf Evergreen Formation, **HA** = Human Altered.

| Botanical Name | Common Name | Vegetation Type | | | |
|---|---|---|---|---|---|
| | | SS | RS | DBEF | HA |
| 1. *Acalypha wilkesiana* | Match me if you can | | | | ✓ |
| 2. *Adenium obesum* | Desert Rose | | | | ✓ |
| 3. *Aechmea blanchetiana* | Bromeliad | | | | ✓ |
| 4. *Agave sp.* | Agave (variegated) | | | | ✓ |
| 5. *Allamanda cathartica* | Allamanda | | | | ✓ |
| 6. *Aloe vera* | Aloe | | | | ✓ |
| 7. *Aralia sp.* | Aralia | | | | ✓ |
| 8. *Araucaria heterophylla* | Norfolk Island pine | | | | ✓ |
| 9. *Archontophoenix alexandrae* | Alexander palm | | | | ✓ |
| 10. *Asparagus densiflorus* | Asparagus fern | | | | ✓ |
| 11. *Borrichia arborescens* | Bay marigold | | ✓ | | |
| 12. *Borrichia frutescens* | Bay marigold | | ✓ | | ✓ |

| Botanical Name | Common Name | Vegetation Type | | | |
|---|---|---|---|---|---|
| | | SS | RS | DBEF | HA |
| *13. Bougainvillea glabra* | Bougainvillea | | | | ✓ |
| *14. Brassaia actinophylla* | Umbrella tree | | | | ✓ |
| *15. Breynia distichia* | Snow bush | | | | ✓ |
| *16. Bumelia americana* | Milkberry | | | ✓ | |
| *17. Bursera simarouba* | Gum elemi | | | ✓ | |
| *18. Caesalpinia sp.* | Knicker Bean | | | ✓ | |
| *19. Cakile lanceolata* | Sea Rocket | ✓ | | | ✓ |
| *20. Capraria biflora* | Goat weed | | | | ✓ |
| *21. Carissa macrocarpa* | Natal plum | | | | ✓ |
| *22. Casasia clusifolia* | Seven-year apple | | | ✓ | |
| *23. Casaurina equisetifolia* | Casuarina | ✓ | ✓ | | |
| *24. Catharanthus roseus* | White periwinkle | | | | ✓ |
| *25. Chrysobalanus icaco* | Cocoplum | | | ✓ | |
| *26. Coccoloba diversifolia* | Pigeon plum | | | ✓ | |
| *27. Cocolobba uvifera* | Seagrape | | ✓ | ✓ | ✓ |
| *28. Cocos nucifera* | Coconut | ✓ | | | ✓ |
| *29. Conocarpus erectus* | Buttonwood | | ✓ | ✓ | |
| *30. Conocarpus erectus L. var. sericeus* | Silver Buttonwood | | ✓ | | ✓ |
| *31. Cordia sebestena* | Geiger tree | | | ✓ | ✓ |

| Botanical Name | Common Name | Vegetation Type | | | |
|---|---|---|---|---|---|
| | | SS | RS | DBEF | HA |
| *32. Crinum asiaticum* | Crinum lily | | | | ✓ |
| *33. Croton linearis* | Granny bush | | | ✓ | |
| *34. Cyperus planifolus* | Flatleaf sedge | | | | ✓ |
| *35. Desmodium canum* | Begger's weed | | | | ✓ |
| *36. Echites umbelatta* | Devil's potato | | | ✓ | ✓ |
| *37. Eleusine indica* | Fowl foot grass | | | | |
| *38. Emilia fosbergii* | Tasselflower | | | | ✓ |
| *39. Epipremnum aureum* | Pothos vine | | | | ✓ |
| *40. Erithalis fruticosa* | Black torch | | | ✓ | |
| *41. Eugenia axillaris* | White stopper | | | ✓ | |
| *42. Euphorbia cyathophora* | Wild poinsettia | | | | ✓ |
| *43. Euphoria mesembrianthemifolia* | Coast spurge | ✓ | | | |
| *44. Ficus aurea* | Golden Wild Fig | | | ✓ | |
| *45. Ficus bejamina* | Ficus tree | | | | ✓ |
| *46. Ficus citrifolia* | Short-leaved Fig | | | ✓ | |
| *47. Ficus elastica* | Rubber tree | | | | ✓ |
| *48. Ficus microcarpa* | Green Island Ficus | | | | ✓ |
| *49. Galactia rudolphioide* | Red Milk Pea | | | | ✓ |
| *50. Hibiscus sp.* | Hibiscus | | | | ✓ |

| Botanical Name | Common Name | Vegetation Type | | | |
|---|---|---|---|---|---|
| | | SS | RS | DBEF | HA |
| *51. Hippomane mancinella* | Manchineel | | | ✓ | |
| *52. Hymenocallis arenicola* | Spider lily | | | | ✓ |
| *53. Ipomea pes-caprae* | Railroad vine | ✓ | | | ✓ |
| *54. Ixora coccinea* | Jungle flame | | | | ✓ |
| *55. Jacquemontia havanensis* | Havana Cluster vine | | | ✓ | |
| *56. Jacquinia keyensis* | Joewood | | | ✓ | ✓ |
| *57. Jasminum fluminense* | Jasmine vine | | | ✓ | |
| *58. Jatropha intergerrima* | Jatropha | | | | ✓ |
| *59. Laguncularia racemosa* | White Mangrove | | ✓ | | |
| *60. Lantana camara* | Wild Sage | | | | ✓ |
| *61. Leucaena leucocephala* | Jumbay | | | ✓ | ✓ |
| *62. Manilkara jaimiqui subsp. emarginata* | Wild dilly | | | ✓ | |
| *63. Melanthera aspera* | Melanthera | | | | ✓ |
| *64. Myriopus volubilis* | Soilder vine | | | ✓ | |
| *65. Pandanus sp.* | Pandana (variegated) | | | | ✓ |
| *66. Parthenium hysterophorus* | Pound cake bush | | | | ✓ |
| *67. Passiflora cupraea* | Devil's Pumpkin | | | ✓ | ✓ |
| *68. Philodendron sp.* | Philondendron | | | | ✓ |
| *69. Phyllanthus epiphyllanthus* | Rock bush | | | ✓ | |

| Botanical Name | Common Name | Vegetation Type | | | |
|---|---|---|---|---|---|
| | | SS | RS | DBEF | HA |
| *70. Pithecellobium keyense* | Ram's horn | | | ✓ | |
| *71. Plumeria obtusa* | Wild frangipani | | | ✓ | |
| *72. Plumeria sp.* | Frangipani | | | | ✓ |
| *73. Reynosia septentrionalis* | Darling plum | | | ✓ | |
| *74. Rhabdadenia biflora* | Mangrove rubber vine | | | | ✓ |
| *75. Rhachicallis americana* | Sandfly bush | | ✓ | | |
| *76. Rivina humilis* | Rogue Plant | | | | ✓ |
| *77. Ruellia brittoniana* | Mexican Petunia | | | | ✓ |
| *78. Sabal palmetto* | Sabal Palm | | | ✓ | ✓ |
| *79. Sansevieria trifasciata* | Snake plant | | | | ✓ |
| *80. Scaevola taccada* | White Inkberry | ✓ | | | ✓ |
| *81. Schefflera arboricola* | Dwarf Umbrella tree | | | | ✓ |
| *82. Sesuvium portulacastrum* | Sea Purslane | | | | ✓ |
| *83. Simarouba glauca* | Paradise tree | | | | ✓ |
| *84. Smilax havanensis* | China brier | | | ✓ | |
| *85. Solandra maxima* | Cup of Gold Vine | | | | ✓ |
| *86. Sporobulus virginicus* | Seashore rush grass | | ✓ | | |
| *87. Stachytarpheta jamaicensis* | Blue flower | | | | ✓ |
| *88. Stenotaphrum secundatum* | St. Augustine Grass | | | | ✓ |
| *89. Strumpfia maritima* | Mosquito Bush | | ✓ | | |

| Botanical Name | Common Name | Vegetation Type | | | |
|---|---|---|---|---|---|
| | | SS | RS | DBEF | HA |
| *90. Suriana maritima* | Bay cedar | | ✓ | | |
| *91. Tabebuia sp.* | Poui | | | | ✓ |
| *92. Talinum triangulare* | Water leaf | | | | ✓ |
| *93. Thespesia populnea* | Cork tree | | | | ✓ |
| *94. Uniola paniculata* | Sea Oats | ✓ | | | |
| *95. Washingtonia robusta* | Washingtonian palm | | | | ✓ |
| *96. Zamia furfuracea* | Cardboard palm | | | | ✓ |

### 3.2.2 Invasive Species

The 2013 Bahamas National Invasive Species Strategy (NISS) lists forty-eight (48) plant species as known invasive alien species in The Bahamas. Eight (8) NISS-designated species were observed on Royal Beach Club site (Table 3-3). The NISS identifies mechanisms to manage and control invasive species and make recommendations for species that should be eradicated or controlled. Table 3-3 also provides management recommendation as outlined in the NISS.

***Table 3-3:*** *List of Invasive plant species recorded at Royal Beach Club at Paradise Island*

| Botanical Name | Common Name | Presence on site | NISS Recommendations for control |
|---|---|---|---|
| 1. *Asparagus densiflorus* | Asparagus fern | Rare occurrence, only a few individuals in human altered residential areas in Eastern section of the site. | None listed |

| Botanical Name | Common Name | Presence on site | NISS Recommendations for control |
|---|---|---|---|
| 2. *Brassaia arboricola* | *Umbrella Tree* | Rare occurrence only a few individuals in human altered residential areas. | Control |
| 3. *Casuarina equisetifolia* | Australian Pine | A common species along the coast forming large stands at several locations. Common in human altered areas in Eastern section of the site. | Control |
| 4. *Jasminum fluminense* | Jasmine vine | Common species in human altered areas in Eastern section of the site. | Control |
| 5. *Lantana camara* | Wild Sage | A few individuals in around residences in human altered areas in Eastern section of the site. | None listed |
| 6. *Leucaena leucocephala* | *Jumbay* | Occasional species in human altered areas. | Control |
| 7. *Scaevola taccada* | White Inkberry | A common species along the coast forming large stands at several locations. Large stands present | Eradication |

| Botanical Name | Common Name | Presence on site | NISS Recommendations for control |
|---|---|---|---|
| | | in human altered areas in Eastern section of the site. | |
| 8. *Thespesia populnea* | Cork tree | Large trees in human altered areas in Eastern section of the site. | None listed |

**Photo 3-16:** Large stands of *Scaevola taccada* (White Inkberry) in human altered area in Eastern section of site

### 3.3.3 Protected Species

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.

Six (6) species listed on the Forestry Act Declaration of Protected Trees Order 2021 were recorded on the site (see Table 3-4). All species recorded are listed under the subsection "Cultural or Historical and Economic".

**Table 3-4:** Protected species recorded on Royal Beach Club at Paradise Island

| Botanical Name | Common Name |
|---|---|
| 1. *Bursera simaruba* | Gum elemi |
| 2. *Conocarpus erectus* | Buttonwood |
| 3. *Ipomoea pes-caprae* | Railroad vine |
| 4. *Jacquinia keyensis* | Joewood |
| 5. *Sabal palmetto* | Sabal Palm |
| 6. *Uniola paniculata* | Sea Oats |

To assess the relative abundance of protected species on the site, the Forestry Unit, Ministry of Environment and Natural Resources requires that one (1) 0.1-acre survey plot is established for every 10 acres of vegetation to be impacted. As the human altered areas of the site was dominated by invasive species the protected species survey was focused on the DBEF vegetation that have native species.

Native DBEF vegetation on the site totalled 1.24 acres thus one (1) temporary survey plot was established within DBEF to assess protected species (See Figure 3-2 for survey plot location).

The plot was sized (66 feet X 66 feet) 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.

Of the six (6) protected species on the site, two (2) species were recorded in the survey plots. The results of the plot surveys are detailed in Table 3-4 below.

To estimate the number of protected species that may be impacted in the approximately 1.24 acres of native DBEF vegetation, the number of each species recorded in the 0.1-acre plot was multiplied by 10 to calculate the number for each species that are likely to be in 1-acre. The calculations for 1-acre were multiplied by the total number of acres to be impacted (1.24) for the overall number of species within the vegetation type.

**Table 3-4:** Protected species recorded in survey plots for Royal Beach Club at Paradise Island

| Botanical Name | Common Name | # recorded in 0.1-acre Plot | Estimated number # per | Estimated # in DBEF Vegetation on site (1.24 acres) |
|---|---|---|---|---|
| ***1.*** *Bursera simaruba* | Gum elemi | 12 | 120 | 148.8 |
| ***2.*** *Sabal palmetto* | Sabal palm | 2 | 20 | 24.8 |
| | **Total** | **14** | **140** | **173.6** |


**Figure 3-2:** Location of Protected Species survey plot

## 4. Conclusion

The findings of this survey speak to the observations within the 17 acres outlined in figure 1-1. These findings are similar to the 2019. Variations noted are due to the reduced scope of the report.

# 4.0 BENTHIC ASSESSMENTS – April 2023

## 1.0 INTRODUCTION

### 1.1 Project Description

Royal Beach Club at Paradise Island (RBCPI) is a privately owned property located on the western end on Paradise Island, The Bahamas (See Figure 1). RBCPI is approximately 17 acres and is located just off the northern shore of the city of Nassau, New Providence.


**Figure 1:** Location map of the Royal Beach Club.

The RBCPI project seeks to develop Paradise Beach and Colonial Beach to create an arrivals area, family zone, water sports centre, food and beverage services, swimming pool and back of house area to support beach experience. The construction of the water taxi dock may include seawalls, wave attenuators, docks and fixtures.

### 1.2 Purpose and Scope

JSS Consulting Ltd. was contracted to conduct an assessment of the marine environment of Royal Beach Club at Paradise Island, Paradise Island, the Bahamas. Previously an Environmental Impact Assessment (EIA) was completed for the project site in 2020 and a Benthic Mapping and Coral Assessment was completed in 2021. The purpose of the study was to record the existing conditions of the site and the

diversity of benthic flora and fauna and compare it to previous baseline data recorded in the respective EIA and the data collected in the Benthic Mapping and Coral Assessment.

The Scope of works includes assessment of the:

- Existing and proposed dock areas,
- The coastline on the property,
- Corals for Bleaching, Stony Coral Tissue Loss Disease (SCTLD), and other diseases,
- Flora and fauna abundance and diversity,
- Benthic habitat description.

## 2.0 METHODOLOGY

On March 29-30th, 2023, field studies were conducted on the RBCPI site within the surveyed areas below (See Figure 2). A five (5) person team consisting of four (4) JSS Consulting team members and a boat captain conducted the assessments. The area encompasses shallow water between one and fifteen feet (1ft-15ft) on the Northern side of the project site and one to ten feet (1-10 ft) on the southern side of the project site.

On April 14th, 2023 a second attempt was made to survey the rocky shoreline of Caves Beach (Area B) on the northern side of the property; however, due to swells and poor visibility, assessment of the area was not possible. A final attempt was made on April 22nd and 23rd ,2023, where the team was able to successfully assess the area.


**Figure 2:** Map of the assessed areas.

**Map Key:** Area A= Offshore, Area B, Area C, Area D, Area E, Area F, Area G

## 2.1 Coastal Benthic Assessment

The marine ecosystem at RBCPI was assessed using the transect method. Digital photographs of the representative and/or notable conditions were taken using two (2) Olympus TG-6 cameras, Chasing F1 Surface Drone and Power Dolphin by Power Vision Surface Drone. Shoreline transects were completed by snorkelers who used previous EIA and Benthic Mapping and Coral Assessment to outlined areas of high concern to assess.

Surface water quality sampling was conducted to document baseline water quality conditions in the project area. The following parameters was analysed using the Horiba U-50 Multiparameter Water Quality Meter:

- Salinity
- Turbidity
- Temperature
- Ph
- Dissolved oxygen
- Total dissolved solid

Drones were used to assess the benthic habitat of the project site. Drones were navigated perpendicular to the shoreline and photos and GPS data points were taken. Special attention was placed on areas noted in the respective EIA and the Benthic Map and Coral Assessment (see Figure 3).


**Figure 3**: Key assessment areas in 2021.

Divers also swam along the shoreline to assess the changes in habitat structure along the coastline. Spot Checks were also completed around the assessed areas to confirm benthic habitat type and GPS point was taken at the surface.

Areas with coral colonies and seagrass beds in the assessed area were noted. Coral heath was visually observed during the assessment for the presence of diseases such as Stony Coral Tissue Loss Disease (SCTLD), and coral bleaching. Representation photos were taken.

Benthic habitats were classified as hardbottom, sandy bottom, and seagrass. A list of the dominant stony corals, octocorals, seagrass, fish and other marine life observed within the surveyed areas are included in the Species List in Section 3.4. Species abundance was recorded as Single (1), Few (2-10), Many (11 -100), and Abundant (100+).

## 3.0 RESULTS

## 3.1 General Observations

The weather conditions during this assessment were clear and sunny. High tide was observed, as the assessment began at 10:00 am. Water depth was measured to be one to fifteen feet (1ft- 15ft) on the Northern side of the assessed area. During the assessment ground swells were observed to be 2-3ft. 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 northern area was 8 and visibility in the southern area was 9.

## 3.2 Water Quality Analysis

Water quality samples were taken in the surveyed areas during the assessment. A total of four (4) samples were taken and recorded during the assessment.

**Table 1: In-field readings of water quality parameters.**

| Royal Beach Club at Paradise Island Project Water Quality Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Water Sample** | **Latitude** | **Longitude** | **Temperature (°C)** | **PH** | **Salinity (ppt)** | **Turbidity (NTU)** | **Dissolved Oxygen (mg/L)** | **Total Dissolved Solids (g/L)** |
| 1 | 25°05’10"N | 77°19'48"W | 26.2 | 7.8 | 33 | 0.0 | 0.00 | 30.1 |
| 2 | 25°05’07"N | 77°20’23"W | 26 | 8 | 34 | 22.4 | 0.00 | 31.2 |
| 3 | 25°05.128"N | 77°20.326"W | 26 | 8 | 34 | 6.9 | 0.00 | 31.2 |
| 4 | 25°05.057"N | 77°20.345"W | 27 | 8 | 33 | 6.7 | 0.00 | 30.3 |

## 3.3 Benthic Description

### 3.3.1 Northern Side

The following section below provides descriptions of the benthic habitat observed on the northern side of RBCPI.

Due to the similarity in benthic habitat along transects, the habitats encountered are separated into three (3) generalized categories:

- Algal dominated hard bottom
- Seagrass bottom
- Algal dominated sandy bottom

Overall, the benthic habitats appear to be healthy and consist of typical flora and fauna populations for the area. There was some human-related debris (such pipes and tires) observed during the assessment.

**Photo 1:** Algal dominated hardbottom with debris

**Photo 2:** Algal dominated hardbottom with debris

#### 3.3.1.1 Algal dominated hard bottom

The benthic habitat observed just beyond the shoreline and offshore consisted of hard bottom dominated by algae and sargassum and intermixed with patches of sand and seagrass beds. This benthic habitat made up approximately 80% of project site on the northern site of the project site. This area had low rugosity and loose rubble was observed in the pockets between the ridges. This was to be expected as the area has high energy waves.

**Photo 3:** Cavity in the algal dominated hardbottom

**Photo 4:** Algal dominated hardbottom with loose rubble

Dominant stony corals observed in this area included Blade Fire Coral (*Millepora complanata*), *Branching* Fire Coral (*Millepora alcicornis*), Lesser Starlet Coral (*Siderastrea radians*), Mountainous Star Coral (*Orbicella faveolata*), Knobby Brain Coral (*Pseudodiploria civosa*) and Mustard Hill Coral (*Porites astreoides*). Soft corals observed along the hardbottom included Slit-pore Sea Rods (*Plexaurella spp.*), Angular Sea Whips (*Pterogorgia anceps*) and Common Sea Fans (*Gorgonia ventalina*). A complete list of corals observed can be seen in the Species List in Section 3.6.1.2. Corals in the area appear to be in good health. No Stony Coral Tissue Loss Disease (SCTLD) or bleaching was observed on the corals.

**Photo 5:** Algal dominated hardbottom Branching Fire Coral (*Millepora alcicornis)*

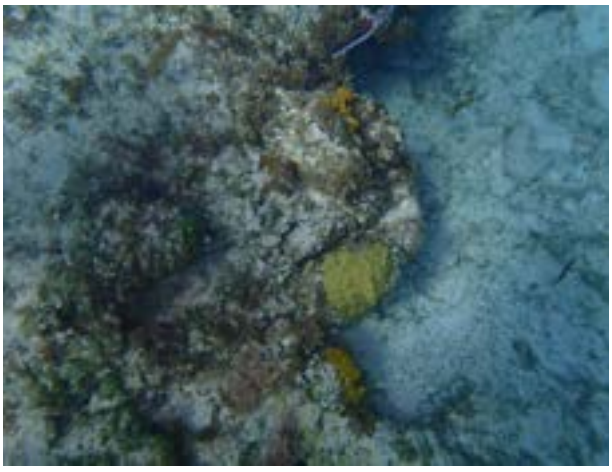


**Photo 6:** Algal dominated hardbottom with Mustard Hill (*Porites astreoides)*

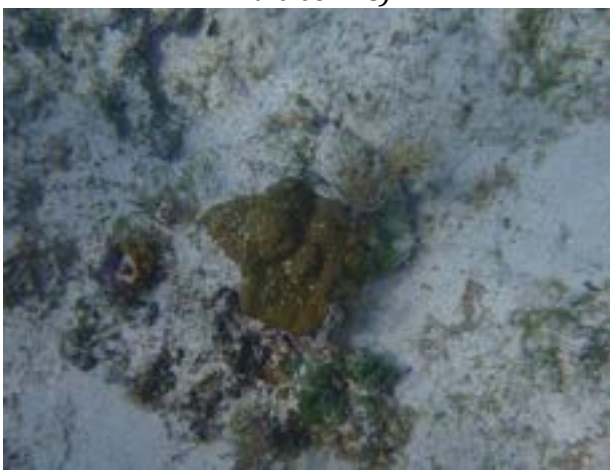


**Photo 7:** Algal dominated hardbottom with Sargassum (*Sargassum fluitan*) and Knobby Brain Coral (*Pseudodiploria civosa*)

**Photo 8:** Algal dominated hardbottom with Mountainous Star Coral (*Orbicella faveolate*), and sponges

Most common algae observed were Sargassum (*Sargassum fluitan*), *Dictyota spp*. and Fuzzy Finger Algae (*Dasycladus vermicularis*).

The presence of vertebrate herbivores (reef grazers) such as parrotfish and sea urchins were minimal in this area. Juvenile parrotfish and Rock-boring Urchins (*Echinometra lucunter*) were observed in the crevices of the hardbottom.

Fish abundance and diversity was overall low on the northern side of the property; however, the majority of fish species in the area were observed in this benthic habitat. Species include, Bar Jacks (*Carangoides*

*ruber*), Slippery Dicks (*Halichoeres bivittatus*), Banded Butterflyfish (*Chaetodon striatus*), and Blue Tangs (*Acanthurus coeruleus*).

**Photo 9:** Algal dominated hardbottom with Banded Butterflyfish (*Chaetodon striatus*).

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### 3.3.1.2 Seagrass

Patches of sandy bottom dominated with seagrass was observed amongst the hardbottom. Turtle grass (*Thalassia testudinum*) was the dominant species, covering areas of sandy bottom in moderate density. Patches of sparse algae were observed throughout the Turtle grass (*Thalassia testudinum*) beds. The benthic habitat made up approximately 1% of the northern side of the property.

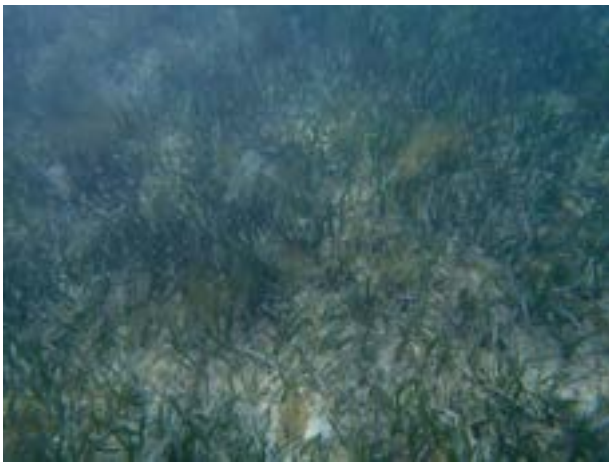

**Photo 10:** Turtle Grass (*Thalassia testudinum*) with algae

**Photo 11:** Cavity filled with rubble within the seagrass beds

### 3.3.1.3 Algae dominated Sandy bottom

Algal sandy bottom with low to medium density of seagrass was observed in patches amongst the hardbottom. The dominant algae observed in this benthic habitat was Sargassum (*Sargassum fluitans*). No epifauna was observed in this benthic habitat.

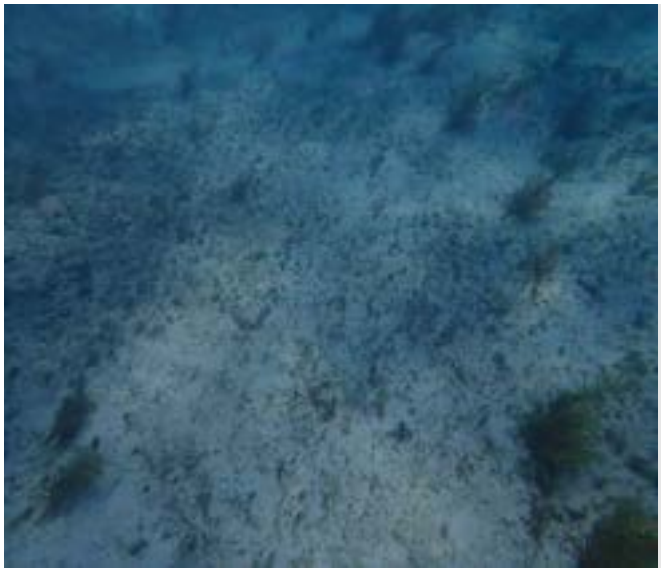

**Photo 12:** Algal dominated sandy bottom

Bare sand was observed along the beaches and just offshore of the rocky shoreline. No flora or fauna was observed in these areas.

Sandy bottom areas made up approximately 18% of the northern side of the property.

### 3.3.2 Southern Side

The following section below provides descriptions of the benthic habitat observed on the southern side of RBCPI.

Due to the similarity in benthic habitat along transects, the habitats encountered are separated into Four (4)) generalized categories:

- Algal and coral dominated hardbottom
- Seagrass Beds
- Sandy bottom
- Other

There was some human-related debris (glass bottles) observed during the assessment.

**Photo 13:** Debris (glass bottle) along the benthic environment on the southern side of shore

**Photo 14:** Debris along the benthic environment on the southern side of site.

#### 3.3.2.1 Seagrass beds

Approximately 64 % of the southern side of the project site is dominated by seagrass beds. The areas are mainly dense Turtle grass (*Thalassia testudinum*), with sparse Manatee grass (*Syringodium filiforme*) and moderate algae. The seagrass beds still appear to be healthy and consist of flora and fauna populations that depict a healthy seagrass ecosystem. The seagrass ranged from sparse to dense across the site.

Small colonies of stony corals such as Mustard Hill (*Porites astreoides*), Lesser Starlet Coral (*Siderastrea radians*) and Finger Coral (*Porites porites*) were commonly seen in the seagrass.

**Photo 15:** Dense Turtle Grass (*Thalassia testudinum)*

**Photo 16:** Mustard Hill (*Porites astreoides*) in Turtle Grass (*Thalassia testudinum*)

### 3.3.2.2 Algal and Coral Dominated Hardbottom

The hard bottom observed was an extension of the shoreline and rock revetment. The area extends to the sandy bottoms and seagrass beds. The area made up approximately 4% of the southern side benthic habitat and had low rugosity and small amounts of loose rubble. Several algae species were observed within this area such as Fuzzy Finger Algae (*Dasycladus vermicularis*), Mermaid's Shaving Brush (*Penicillus sp*.), and Three Finger Leaf Algae (*Halimeda incrassata*).

Dominate stony corals found in this area included Lesser Starlet Coral (*Siderastrea radians*), Finger Coral (*Porities porities*), Mustard Hill Coral (*Porities astreoides*), Grooved Brain Coral (*Diploria labyrinthiformis*), Rose Coral (*Manicina areolata*), and Fire Coral (*Millepora alcicornis*). Soft corals observed along the hardbottom included Slit-Pore Sea Rods (*Plexaurella spp*.), Angular Sea Whips (*Pterogorgia anceps*) and Common Sea Fans (*Gorgonia ventalina*). A complete list of corals observed can be seen in the Species List in Section 3.6.1.2. Corals in the area appear to be in good health. No Stony Coral Tissue Loss Disease (SCTLD) and signs of bleaching were observed during the assessment.

**Photo 17:** Rock Revetment

**Photo 18:** Rock revetment consisting of an algal and coral dominated hardbottom substrate

**Photo 19:** Mustard Hill Coral (*Porites astreoides*), Fire Coral (*Millepora alcicornis*), and Slit-Pore Sea Rods (*Plexaurella spp.*) on the rock revetment

### 3.3.2.3 Sandy Bottom

Sandy bottom was present amidst the seagrass beds and extended from the hardbottom shoreline. This benthic habitat made up approximately 31% of the southern side of the property. The sandy shore in some areas also had very sparse Turtle grass (T*halassia testudinum*) and Manatee grass (*Syringodium filiforme*) and algae, usually Fuzzy Finger Algae (Dasycladus vermicularis), pinecone algae (Rhipocephalus phoenix) and various *Penicillus spp*.

Bare sand was observed on the western side of the assessed area.

**Photo 20:** Sandybottom substrate

### 3.3.2.4 Other

Several existing dock structures were observed on the southern side of the property. Some of these docks have collapsed and are acting as artificial reefs. The highest density and abundance of fish species on this side of the property were observed near and around these collapse structures.

**Photo 21:** Collapsed dock on the southern side of the property

**Photo 22:** Fish diversity around collapsed dock

Conch Shell substrate was seen on the western end of the property. There was a significant amount of conch shells discarded after conch harvest that extended from shore into the marine environment.

**Photo 23:** Conch shells on the coastline on the western end of the property boundary (Area D)

**Photo 24:** Conch shell substrate on the western end of the property boundary (Area D)

These areas made up approximately 1% of the southern side benthic composition.

## 3.4 Benthic Habitat Map

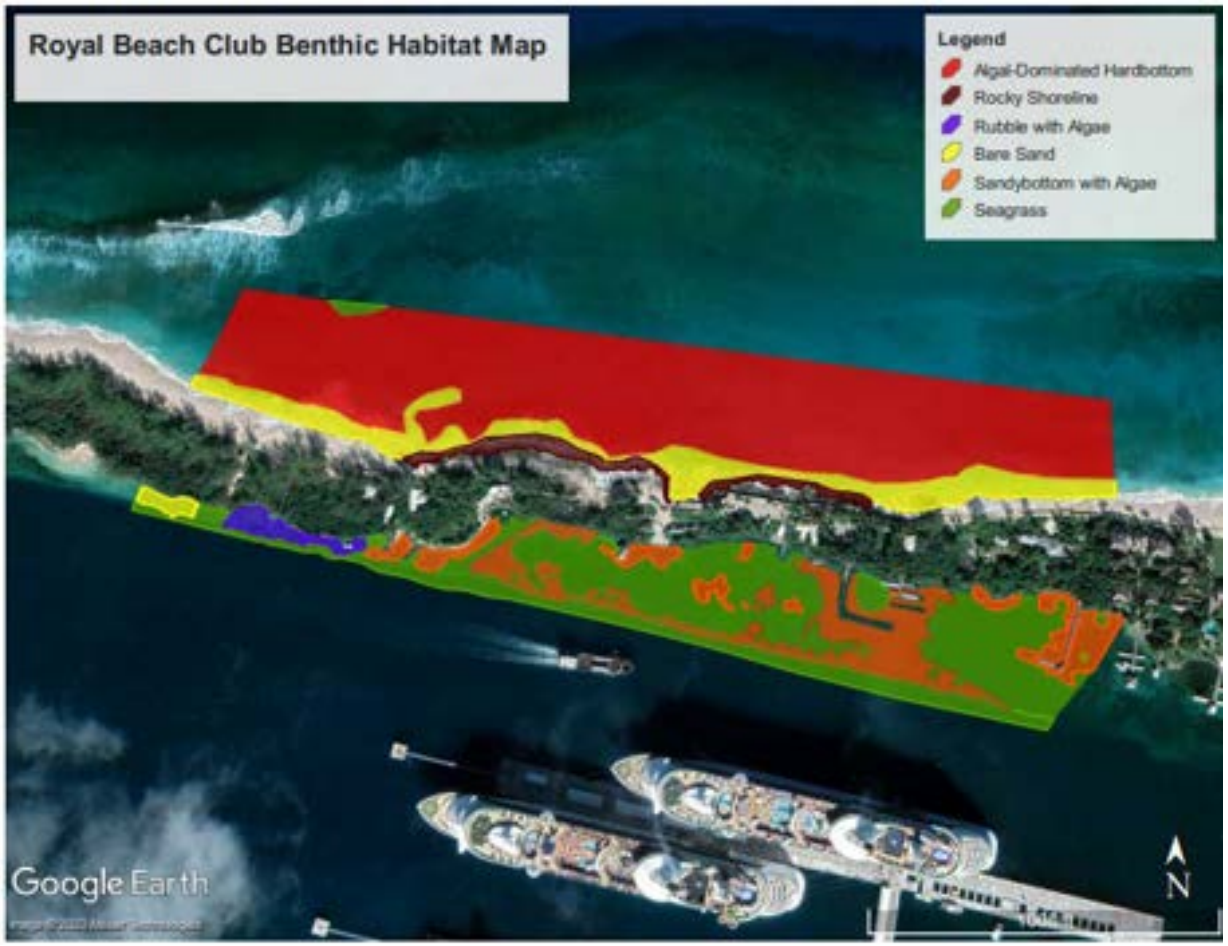


**Figure 4:** Royal Beach Club Benthic Habitat Map

## 3.5 Coral Map


**Figure 5:** Royal Beach Club Coral Map.

## 3.6 Species List

### 3.6.1 Fauna

Roving diver visual fish surveys were conducted using a modified Atlantic and Gulf Rapid Reef Assessment (AGRRA) Protocol to form the species list. Fish observed were identified and given a frequency rating (based on occurrence) of Single (1 individual), Few (2-10 individuals), Many (11-100 individuals), or Abundant (More than 100 individuals).

#### 3.6.1.1 Fish Species

Twelve (12) fish species were seen existing in artificial reefs (collapsed docks) and hard bottom areas and offshore from the coastline of the proposed site.

**Table 2: Fish Species observed during the assessment.**

| Scientific Name | Common Name | Abundance | Comments |
|---|---|---|---|
| *Acanthurus coeruleus* | Blue Tang | Many | |
| *Haemulon flavolineatum* | French Grunt | Many | |
| *Sphyraena barracuda* | Great Barracuda | Few | Observed on the northern side of property |
| *Lutjanus griseus* | Gray Snapper | Few | |
| *Stegastes leucostictus* | Beaugregory | Many | |
| *Abudefduf saxatilis* | Sergeant Major | Many | |
| *Thalassoma bifasciatum* | Bluehead Wrasse | Few | |
| *Aparisoma viride* | Stoplight Parrotfish | Few | Juvenile and Intermediate phase |
| *Scarus taeniopterus* | Princess Parrotfish | Few | |
| *Gerres cinereus* | Yellowfin Mojarras | Few | |
| *Atheriniformes* | Silversides | Many | |
| *Pomacanthus arcuatus* | Gray Angelfish | Few | Observed around artificial reef |

**Photo 25:** Blue Tang (*Acanthurus coeruleus*)

### 3.6.1.2 Coral Species

Nineteen (19) coral species were observed on dock piles and hard bottoms areas during the assessment.

**Table 3: Coral Species observed during the assessment**

| Scientific Name | Common Name | Abundance |
|---|---|---|
| *Millepora alcicornis* | Fire Coral | Many |
| *Gorgonia ventalina* | Common Sea Fan | Many |
| *Plexaurella spp.* | Slit-pore Sea Rod | Many |
| *Plexaurella spp.* | Sea rods | Few |
| *Pterogorgia anceps* | Angular Sea Whips | Few |
| *Pseudopterogorgia spp.* | Sea plume | Many |
| *Porites porites* | Finger Coral | Many |
| *Orbicella faveolata* | Mountainous Star Coral | Few |
| *Porites astreoides* | Mustard Hill | Many |
| *Siderastrea radians* | Lesser Starlet Coral | Few |

| | | |
|---|---|---|
| *Pseudodiploria strigosa* | Symmetrical Brain Coral | Few |
| *Pseudodiploria clivosa* | Knobby Brain Coral | Many |
| *Diploria labyrinthiformis* | Grooved Brain Coral | Few |
| *Montastraea cavernosa* | Great Star Coral | Single |
| *Agaricia humilis* | Lettuce Coral | Few |
| *Siderastrea siderea* | Massive Starlet Coral | Few |
| *Colpophyllia natans* | Boulder Brain Coral | Single |
| *Eusmilia fastiginia* | Smooth Flower Coral | Single |
| *Manicina areolata* | Rose Coral | Few |

**Photo 26:** Split-pore Sea Rod (*Plexaurella spp.)*

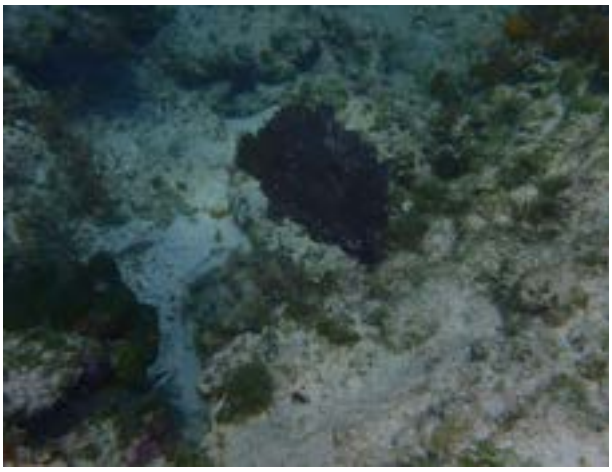

**Photo 27:** Common Sea Fan (*Gorgonia ventalina*)

**Photo 28:** Smooth Flower Coral (*Eusmilia fastiginia)*

**Photo 29:** Lettuce Coral (*Agaricia humilis*)

### 3.6.1.3 Other Fauna and Epifauna

Majority of the epifauna species were found either on the sea floor, in crevices of on rocks that sat on the seafloor or in cavities of the rocky coastline during this assessment and fauna species were found in the surrounding area. Fourteen (14) Epifauna species and two (2) fauna species were observed during the survey.

**Table 4: Other Fauna and Epifauna observed during the assessment**

| Scientific Name | Common Name | Abundance | Comments |
|---|---|---|---|
| *Dasyatis americana* | Southern Stingray | Few | |

| | | | |
|---|---|---|---|
| *Chelonia mydas* | Green Turtle | Single | |
| *Condylactis gigantea* | Giant Anemone | Few | Only observed on the southern side |
| *Echinometra lucunter* | Rock- boring Urchin | Many | Only on Northern Side |
| *Diadema antillarum* | Long-spined Sea Urchin | Few | Only observed on the southern side |
| *Bispira brunnea* | Social Feather Duster | Single | |
| *Spirobranchus giganteus* | Christmas Tree Worm | Single | |
| *Holothuria mexicana* | Donkey Dung Sea Cucumber | Few | |
| *Cliona zooxanthellate* | CZOO sponge | Many | |
| *Palythoa caribaeorum* | PCAR invertebrate | Few | |
| *Anamobaea oerstedii* | Split-Crown Feather Duster | Few | |
| *Aplysina insularis* | Branchlet Sponge | Many | |
| *Cliona varians* | Brown Variable Sponge | Many | |
| *Cliona delitrix* | Red Boring Sponge | Few | |
| *Svenzea zeai* | Dark Volcano Sponge | Many | |
| *Aplysina sp.* | Rope Sponge | Many | |

**Photo 30:** Long-spined Sea Urchin (*Diadema antillarum*)

**Photo 31:** Social Feather Duster (*Bispira brunnea*)

**Photo 32:** Giant Sea Anemone (*Condylactis gigantea*)

### 3.4.2 Flora – Algae, Seagrass, and Seaweed Species

Seventeen (17) flora species were observed throughout the survey site.

**Table 5: Flora Species observed during assessment**

| Scientific Name | Common Name | Abundance |
|---|---|---|
| *Thalassia testudinum* | Turtle Grass | Abundant |
| *Syringodium filiforme* | Manatee Grass | Abundant |
| *Turf Algae* | Algae | Abundant |

| | | |
|---|---|---|
| *Penicillus capitatus* | Mermaid Shaving Brush Algae | Abundant |
| *Sargassum fluitans* | Sargassum | Abundant |
| *Dasycladus vermicularis* | Fuzzy Finger Algae | Abundant |
| *Dicotya spp.* | Dicotya | Abundant |
| *Udotea sp.* | Mermaid's Fan | Abundant |
| *Penicillus dumetosus* | Bristle Ball Brush | Abundant |
| *Cladophora spp.* | Weed Algae | Abundant |
| *Halimeda incrassate* | Three Finger Leaf Algae | Abundant |
| *Halimeda copiosa* | Large Long-leaf hanging vine | Few |
| *Galaxaura sp.* | Thicket Algae | Abundant |
| *Penicillus pyriformis* | Flat-top Bristle Brush | Abundant |
| *Halimeda spp.* | Green Algae | Abundant |
| *Acanthophora spicifera* | Spiny Seaweed | Abundant |
| *Padina sanctae crucis* | White Scroll Algae | Abundant |

## 4.0 COMMERCIALLY IMPORTANT, ENDANGERED, AND PROTECTED SPECIES

There were four (4) marine species observed during this assessment that are listed on the Convention on International Trade of Endangered Species (CITES) list or the International Union for Conservation of Nature (IUCN) Red List (see table 6).

The CITES listing group species in appendices I, II and III. There were three (3) species observed during the assessment that are listed within CITES Appendix II. CITES Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.

**Table 6: Species listed with CITES and IUCN**

| Scientific Name | Common Name | CITES Listing | IUCN Listing |
|---|---|---|---|

| | | | |
|---|---|---|---|
| *Scleractinia spp.* | Stony Corals | Appendix II | Not Listed |
| *Dasyatis americana* | Southern Stingray | Not Listed | Near Threatened |
| *Siderastrea siderea* | Massive Starlet Coral | Appendix II | Critically Endangered |
| *Orbicella faveolata* | Mountainous Star Corals | Appendix II | Endangered |

There are some species of fauna and flora observed during the assessment that are important to the economy of The Bahamas and are important key stone species for the marine ecosystems. Other species are protected under The Bahamas Fisheries Resources (Jurisdiction and Conservation) Act 1977 (highlighting amendments 2006, 2010, 2011) and Fisheries Act 2020. Table 7 below outlines these key species.

**Table 7: Species observed that are Commercially and Ecologically Important**

**Table key: CI** = Commercially Important, **ES** = Endangered Species, **PS** = Protected Species, **EI** = Ecologically Important

| Scientific Name | Common Name | Status |
|---|---|---|
| *Family: Scaridae* | Parrotfish | EI |
| *Scleractinia spp.* | All Coral Species | PS/EI |
| *Family: Zosteraceae* | All Seagrass Species | EI |
| *Dasyatis americana* | Southern Stingray | EI |

## 5.0 DISCUSSION

The assessed area consisted of a 17 acre, partially developed portion of land on the western end of Paradise Island. There are plans to develop the portion of the island into a family friendly economic and social hub for local and cruise ship guests to enjoy a wide range of water and land activities. The proposed development will include the repair of existing docks as well as construction of new docks to allow for docking of water taxis transporting guests to and from the RBCPI.

The findings show that the assessed area had a medium diversity and abundance of fauna and medium diversity and high abundance of flora. The denser flora area was observed on the southern side of the project area in the form of seagrass.

**Benthic Composition**

The benthic composition of the southern side of the property remains virtually unchanged from data and information discussed in the Benthic mapping and Coral Assessment completed in 2021.

**Existing and Proposed Docks**

The project proposes the repair of some of the existing docks and construction of new docks on the southern side of the property (Areas D, E and F). These areas transition from algal and coral dominated hard bottom to either moderate to dense seagrass beds or sandy bottom with sparse algae and seagrass. The area had low wave energy and low rugosity. Mustard Hill Coral (*Porites astreoides)*, Lesser Starlet Coral (*Siderastrea radians*) and Finger Coral (*Porites porites)* were observed on the hard bottom.

The highest abundance of fish and coral species was observed in these areas. This was also observed and noted in the previous Benthic and Coral Assessment. A few Long Spined Sea Urchin (*Diadema antillarum*) was observed in this area. Long-spined Sea urchin and coral health in the area appear to be normal. Coral were also diverse in these areas, there were no signs of bleaching or Stony Coral Tissue Loss Disease (SCTLD).

High levels of domestic waste were observed, which was to be expected as the area is highly trafficked.

**Offshore Area**

The Offshore area (Area A) is predominantly hardbottom with sargassum (70-80%). Dominant stony corals observed in this area included blade fire coral (*Millepora complanata*), Lesser Starlet Coral (S*iderastrea radians*), Mountainous Star Coral (*Orbicella faveolata*) and Mustard Hill Coral (*Porites astreoides*). Patches of sandy bottom and seagrass bed were observed amongst the hard bottom. The sandy bottom contains sparse algae and seagrass, mainly Turtle grass (*Thalassia testudinum*). The seagrass beds appeared healthy and contained flora and fauna typically found in the seagrass beds.

**Terrace and Events Area**

The Terrace and Event Space (Area C), transitions from bare sand inshore to algal dominated hardbottom offshore. This area had a low diversity and abundance of flora and fauna.

**Seagrass Beds**

Seagrass beds were observed on both the northern and southern side of the property. There were small patches of dense seagrass (predominantly Turtle Grass (T*halassia testudinum*)) with sparse algae offshore on the northern side of the property. Cavities of bare sand and reef rubble were observed within the seagrass.

**Photo 33:** Turtle Grass (*Thalassia testudinum*)

The seagrass beds on the southern end of the property remain virtually unchanged from what was noted in the Benthic Mapping and Coral Assessment. The Seagrass beds are dominated by turtle grass with sparse amounts of manatee grass. The density of the seagrass ranged from sparse to dense in certain areas. The Benthic Mapping and Coral Assessment noted dense seagrass beds in Area F which remain unchanged.

Both Turtle grass (*Thalassia testudinum*) and Manatee grass (*Syringodium filiforme*) are now listed on the updated 2021 Bahamas Protected Tree Order. The seagrass beds appear to still be healthy and contain flora and fauna typically seen in seagrass beds.

**Corals**

Coral abundance and diversity were determined to be the same as the 2021 Benthic Mapping and Coral Assessment. Coral species were observed on the northern and southern side of the property; however, the majority of the coral species were found on the southern side of the property in hardbottom areas of Area D.

Most of the stony coral species observed during this assessment were observed to be in good health, however, signs of disease and mortality were evident amongst certain species. Signs and mortality were particularly seen amongst a patch of Mountainous Star Coral (*Orbicella faveolata)* located in Area D. Mountainous Star Coral (*Orbicella faveolata*) is listed as endangered by the International Union for Conservation of Nature (IUCN). In the 2021 assessment, it was reported that about 50% of the coral colonies had died and the remaining corals were observed to be affected by diseases or dead material.

Corals on site are showing signs of old dead tissue lose but not Stony Coral Tissue Loss Disease. There were no signs of bleaching or Stony Coral Tissue Loss Disease (SCTLD) observed during this assessment.

However, level 1 bleaching was reported to be observed in a few coral species during the 2021 assessment.

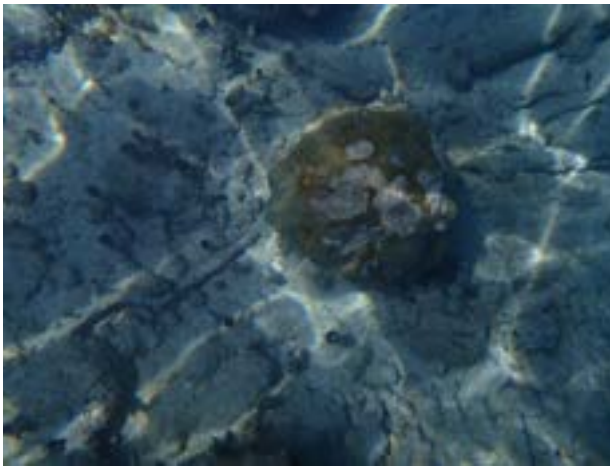

**Photo 34:** Diseased Mountainous Star Coral (*Orbicella faveolata*)

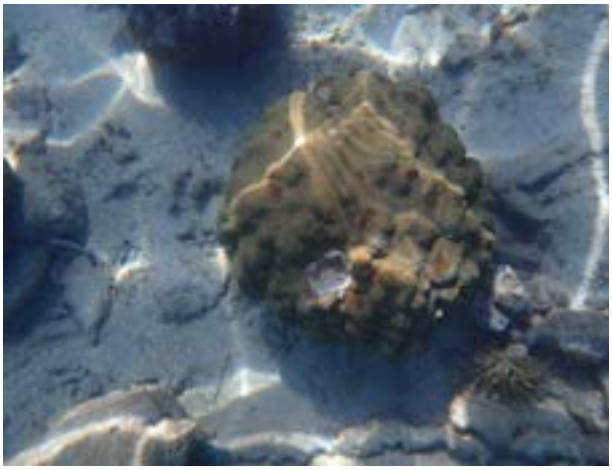

**Photo 35:** Diseased Mountainous Star Coral (*Orbicella faveolata*)

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**Long Spined Sea Urchin (*Diadema antillarum*)**

*D.antillarum* population has decreased since the 2021 Benthic Mapping and Coral Assessment. Only a few adults were observed in rock crevices on the southern side of the site. According to researchers *D.antillarum* has the highest rate for consuming algae among reef herbivores thus, acting as the most important participant in the fight against algae dominated reefs..

**Photo 40:** Long Spined Sea Urchin (*Diadema antillarum*)

**Fish Species**

Fish abundance and diversity remain virtually the same as the 2021 Benthic Mapping and Coral Assessment. Majority of the fish species were observed near collapsed docks on the southern side of property and in the hardbottom habitat on the Northern side of the property. This was to be expected as the crevices and cavities provide a shelter for these species. There were no fish during this assessment or the 2021 assessment that are considered commercially important or endangered.

**Table 8: Comparative view of fish species observed during this assessment and previous assessments**

| Scientific Name | Common Name | Abundances 2019 | Abundances 2021 | Abundances 2023 |
|---|---|---|---|---|
| *Abudefduf saxatilis* | Sergeant Major | Few | Many | Many |
| *Acanthurus chirurgus* | Doctor Fish | Single | Few | Few |
| *Acanthurus coeruleus* | Blue Tang | Single | Not observed | Many |

| | | | | |
|---|---|---|---|---|
| *Caranx ruber* | Bar Jack | Single | Not observed | Many |
| *Chaetodon ocellatus* | Spotfin Butterflyfish | Few | Not observed | Few |
| *Chromis multilineata* | Brown Chromis | Few | Not observed | Not Observed |
| *Epinephelus guttatus* | Red Hind | Single | Not observed | Not Observed |
| *Ginglymostoma cirratum* | Nurse Shark | Not observed | Single | Not Observed |
| *Gramma loreto* | Fairy Basslet | Few | Not observed | Not Observed |
| *Haemulon flavolineatum* | French Grunt | Many | Many | Many |
| *Haemulon sciurus* | Blue Striped Grunt | Few | Not observed | Not Observed |
| *Halichoeres bivittatus* | Slippery Dick | Many | Few | Many |
| *Holocentrus sp.* | Squirrelfish | Few | Few | Not Observed |
| *Lutjanus analis* | Mutton Snapper | Single | Not observed | Not Observed |
| *Lutjanus apodus* | Schoolmaster Snapper | Few | Not observed | Not Observed |
| *Pomacanthus paru* | French Angelfish | Single | Not observed | Few |

| | | | | |
|---|---|---|---|---|
| *Sparisoma viride* | Stoplight Parrotfish | Single | Single | Single |
| *Sphyraena barracuda* | Great Barracuda | Not observed | Single | Few |
| *Stegastes leucostictus* | Beaugregory | Few | Few | Few |
| *Thalassoma bifasciatum* | Blue headed wrasse | Few | Few | Few |
| *Gerres cinereus* | Yellowfin Mojarra | Not Observed | Not Observed | Few |

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## APPENDICES

### Appendix A: GPS Coordinates

| GPS Point | Latitude | Longitude | Benthic Description | Location |
|---|---|---|---|---|
| **1** | 25°05.128"N | 077°20.319"W | Sandybottom | Terrance and Event Area (Area C) |
| **2** | 25°05.150"N | 77°20.459"W | Hardbottom | Offshore (Area A) |
| **3** | 25°05.163"N | 77°20.573"W | Sandybottom | Offshore (Area A) |
| **4** | 25°0.5.202"N | 77°20.653"W | Hardbottom with Sargassum | Offshore (Area A) |
| **5** | 25°0.5.211"N | 77°20.613"W | Hardbottom with Seagrass | Offshore (Area A) |
| **6** | 25°0.5.215"N | 77°20.600"W | Hardbottom with patches of Seagrass | Offshore (Area A) |
| **7** | 25°0.5.205"N | 77°20.545"W | Hardbottom with patches of Sargassum | Offshore (Area A) |
| **8** | 25° 5.145'N | 77° 20.198'W | seagrass | Offshore (Area A) |
| **9** | 25° 5.236'N | 77° 20.290'W | Hardbottom with sargassum | Offshore (Area A) |
| **10** | 25° 5.174'N | 77° 20.299'W | Algal dominated Sandybottom | Offshore (Area A) |
| **11** | 25° 5.224'N | 77° 20.419'W | Hardbottom with sargassum | Offshore (Area A) |
| **12** | 25° 5.084'N | 77° 20.537'W | Area with lots of debris and Conch Shells | Area D |
| **13** | 25° 5.080'N | 77° 20.508'W | Seagrass bed. Silt covered the seagrass | Area D Within Seabed Lease 1 |
| **14** | 25° 5.087'N | 77° 20.502'W | Patches of *Orbicella faveolata* | Area D within Seabed Lease 1 |
| **15** | 25° 5.058'N | 77° 20.487'W | Seagrass and Algae | Area D |
| **16** | 25° 5.057'N | 77° 20.480'W | Sandy bottom with patches of Algae and Seagrass | Area D |
| **17** | 25° 5.055'N | 77° 20.447'W | Sand with algae | Area D |
| **18** | 25° 5.095'N | 77° 20.527'W | Collapsed dock that acts as a artificial reef | Area D |
| **19** | 25° 5.052'N | 77° 20.468'W | Algae and sand with scattered coral | Area D |
| **20** | 25° 5.038'N | 77° 20.450'W | Seagrass | Area D |

| | | | | |
|---|---|---|---|---|
| **21** | 25° 5.055'N | 77° 20.422'W | Sandybottom with seagrass | Area D |
| **22** | 25° 5.035'N | 77° 20.413'W | Seagrass | Area D |
| **23** | 25° 5.071'N | 77° 20.381'W | Seagrass | Area E within Seabed Lease 3 |
| **24** | 25° 5.062'N | 77° 20.350'W | Sandybottom with algae and sparse seagrass | Area E |
| **25** | 25° 5.053'N | 77° 20.393'W | Sand with Algae and seagrass | Area E |
| **26** | 25° 5.042'N | 77° 20.383'W | Seagrass | Area E |
| **27** | 25° 5.033'N | 77° 20.378'W | Sandybottom with seagrass | Area E |
| **28** | 25° 5.042'N | 77° 20.365'W | Sandybottom, no algae | Area E |
| **29** | 25° 5.045'N | 77° 20.367'W | Finger Coral (*Porites porites)* | Area E |
| **30** | 25° 5.076'N | 77° 20.371'W | Coral growing under dock | Area E |
| **31** | 25° 5.027'N | 77° 20.340'W | Sand With Algae | Area E |
| **32** | 25° 5.063'N | 77° 20.339'W | hardbottom that transition into Sandybottom. High coral diversity and abundance on boulders | Area E |
| **33** | 25° 5.047'N | 77° 20.312'W | Sandybottom with algae | Area E |
| **34** | 25° 5.026'N | 77° 20.311'W | sandybottom with algae | Area E |
| **35** | 25° 5.058'N | 77° 20.282'W | Seagrass | Area F |
| **36** | 25° 5.045'N | 77° 20.286'W | Seagrass | |
| **37** | 25° 5.051'N | 77° 20.257'W | Coarse Sand w/ Algae | Area F within Seabed Lease 4 |
| **38** | 25° 5.035'N | 77° 20.237'W | Coral patch with seagrass bed | Area F within Seabed Lease 4 |
| **39** | 25° 5.050'N | 77° 20.218'W | Sandybottom with seagrass | Area F within Seabed Lease 4 |
| **40** | 25° 5.033'N | 77° 20.230'W | Dense Seagrass | Area F within Seabed Lease 4 |
| **41** | 25° 5.025'N | 77° 20.223'W | Coral Patches | Area F within Seabed Lease 4 |
| **42** | 25° 5.022'N | 77° 20.215'W | Knobby Brain Coral and Seagrass | Area F within Seabed Lease 4 |

| | | | | |
|---|---|---|---|---|
| **43** | 25° 5.015'N | 77° 20.289'W | Sandybottom with seagrass and algae | Area F |
| **44** | 25° 5.016'N | 77° 20.251'W | Seagrass beds | Area F |
| **45** | 25° 5.015'N | 77° 20.227'W | Sandybottom with seagrass and algae | Area F |
| **46** | 25° 5.047'N | 77° 20.200'W | Single Coral Heads | Area F within Seabed Lease 4 |
| **47** | 25° 4.997'N | 77° 20.231'W | Sandybottom with seagrass | Area F |

# 5.0 AVIAN ASSESSMENTS – October 2019 and April 2023

## 1 Introduction

Forest Consultants was contracted by Islands by Design to conduct terrestrial biological baseline studies for The Royal Beach Club, Paradise Island, The Bahamas. Avian surveys were undertaken to identify the presence, abundance, and habitat utilization of avifauna on the site. A previous avian survey was conducted by the team on 7 October 2019 as a part of the biological baseline assessment for the Royal Beach Club Environmental Impact Assessment, 2019. In 2023, a second series of avian surveys were conducted on 06 and 27 April 2023, which provided additional data. This report outlines the combined findings of the 2019 and 2023 surveys.

## 2 Methodology

The avifauna of the area was assessed and recorded by walking along the shorelines and within the interior of the vegetation. 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) Red List.

## 3 Findings

### 3.1 Species Diversity

A combined total of thirty-five (35) avian species were recorded in the 2019 and 2023 surveys (See Table 3-1). Twenty-three (23) species were recorded in 2019 and twenty-two (22) species were recorded in 2023.

**Table 3-1:** Avifauna observed on Royal Beach Club, Paradise Island, The Bahamas

| **TABLE KEY:** | | | |
|---|---|---|---|
| **RANGE** | **STATUS** (Conservation - IUCN) | **Abundance Category** | **Habitat Utilization** |
| **PRB** = Permanent Resident Breeding<br>**WRN =** Winter Resident Non-Breeding<br>**e =** Endemic subspecies | **LC =** Least Concern<br>**NT** = Near Threatened | **S** = Single<br>**F** = Few<br>**M** = Many<br>**A** = Abundant | **FO** = **Fly over**<br>**HA** = Human Altered<br>**IU** = Interior Upland<br>**CS** = Coastal Shore |

| Common Name | Scientific Name | Range | Status | 2023 | | 2019 |
|---|---|---|---|---|---|---|
| | | | | Observation | Habitat Utilization | Observation |
| **COLUMBIFORMES: Columbidae** | | | | | | |
| 1. White-crowned Pigeon | *Patagioenas leucocephala* | PRB | NT | M | IU/HA/ FO | M |
| 2. Mourning Dove | *Zenaida macroura* | PRB | LC | - | - | F |
| 3. Common Ground Dove | *Columbina passerina* | PRB | LC | F | IU/HA | F |
| **CUCULIFORMES: Cuculidae** | | | | | | |
| 4. Mangrove Cuckoo | *Coccyzus minor* | PRB | LC | S | IU | - |
| **PELECANIFORMES: Ardeidae** | | | | | | |
| 5. Black-crowned Night-Heron | *Nycticorax nycticorax* | PRB | LC | - | - | S |
| 6. Yellow-crowned Night Heron | *Nyctanassa violacea* | PRB | LC | F | IU/HA | PE |
| 7. Green Heron | *Butorides virescens virescens* | PRB/e | LC | F | IU/HA | - |
| 8. Great Blue Heron | *Ardea herodias* | WRN | LC | S | FO | - |
| **CHARADRIIFORMES: Haematopodidae** | | | | | | |
| 9. American Oystercatcher | *Haematopus palliatus* | PRB | LC | F | CS | F |
| **CHARADRIIFORMES: Charadriidae** | | | | | | |
| 10. Wilson's Plover | *Charadrius wilsonia* | PRB | LC | F | CS | - |
| 11. Killdeer | *Charadrius vociferus* | PRB | LC | - | - | F |
| 12. Piping Plover | *Charadrius melodus* | WRN | NT | - | - | F |
| **CHARADRIIFORMES: Scolopacidae** | | | | | | |
| 13. Ruddy Turnstone | *Arenaria interpres* | WRN | LC | - | - | S |
| 14. Sanderling | *Calidris alba* | WRN | LC | - | - | F |
| 15. Spotted Sandpiper | *Actitis macularius* | WRN | LC | F | CS | S |
| **CHARADRIIFORMES: Laridae** | | | | | | |
| 16. Laughing Gull | *Leucophaeus atricilla* | PRB | LC | F | FO | F |
| 17. Least Tern | *Sternula antillarum* | WRN | LC | F | FO | - |
| **ACCIPITRIFORMES: Pandionidae** | | | | | | |
| 18. Osprey | *Pandion haliaetus* | PRB | LC | - | - | F |
| **CORACIIFORMES: Alcedinidae** | | | | | | |
| 19. Belted Kingfisher | *Megaceryle alcyon* | WRN | LC | S | FO | - |

| Common Name | Scientific Name | Range | Status | 2023 | | 2019 |
|---|---|---|---|---|---|---|
| | | | | Observation | Habitat Utilization | Observation |
| **FALCONIFORMES: Falconidae** | | | | | | |
| 20. American Kestrel | *Falco sparverius* | WRN | LC | F | HA | S |
| 21. Peregrine Falcon | *Falco peregrinus* | WRN | LC | | | S |
| **PASSERIFORMES: Tyrannidae** | | | | | | |
| 22. Gray Kingbird | *Tyrannus dominicensis* | SRB | LC | - | - | F |
| 23. La Sagra's Flycatcher | *Myiarchus sagrae lucaysiensis* | PRB/e | LC | S | IU | - |
| **PASSERIFORMES: Parulidae** | | | | | | |
| 24. Ovenbird | *Seiurus aurocapilla* | WRN | LC | - | - | S |
| 25. Black-and-white Warbler | *Mniotilta varia* | WRN | LC | F | IU | - |
| 26. American Redstart | *Setophaga ruticilla* | WRN | LC | F | IU | F |
| 27. Northern Parula | *Setophaga americana* | WRN | LC | F | IU | - |
| 28. Palm Warbler | *Setophaga palmarum* | WRN | LC | F | HA | - |
| 29. Pine Warbler | *Setophaga pinus* | WRN | LC | - | - | F |
| 30. Yellow-throated Warbler | *Setophaga dominica* | WRN | LC | - | - | F |
| **PASSERIFORMES: Icteridae** | | | | | | |
| 31. Boat-tailed Grackle | *Quiscalus major* | PRB | LC | - | - | F |
| **PASSERIFORMES: Thraupidae** | | | | | | |
| 32. Bananaquit | *Coereba flaveola bahamensis* | PRB/e | LC | F | IU/HA | - |
| **PASSERIFORMES: Mimidae** | | | | | | |
| 33. Gray Catbird | *Dumetella carolinensis* | WRN | LC | S | IU | - |
| 34. Northern Mockingbird | *Mimus polyglottos* | PRB | LC | F | IU/HA | F |
| **PASSERIFORMES: Turdidae** | | | | | | |
| 35. Red-legged Thrush | *Turdus plumbeus plumbeus* | PRB/e | LC | F | HA | - |

## 3.2 Species 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 same island or in same region year round.

The species observed comprised of a combination of Permanent Resident Breeding Species, Winter Resident Non-Breeding Species, and Summer Resident Breeding Species.

### 3.2.1 Permanent Resident Breeding Species

Permanent Resident Breeding (PRB) species refers to the resident species that live and breed year-round throughout the Bahama Islands. Seventeen (17) of the species recorded during the survey (approximately 49%) were PRB species.

**Photo 3-1:** PRB American Oystercatcher *Haematopus palliatus* on rocky shore on site April 2023

**Photo 3-2:** PRB Wilson's Plover *Charadrius wilsonia* on rocky shore on site April 2023

**Photo 3-3:** PRB Yellow-crowned Night Heron *Nyctanassa violacea* in human altered area on site April 2023

**Photo 3-4:** PRB Northern Mockingbird. *Mimus polyglottos* in human altered area on site April 2023

**Photo 3-5: Juvenile Black-crowned Night-Heron Nycticorax nycticorax on site October 2019**

**Photo 3-6: Osprey Pandion haliaetus eating a Stoplight Parrotfish on site October 2019**

There were no endemic species recorded on the site during the survey however four (4) endemic subspecies were among the PRB species recorded. *Endemic species* are birds that are found only in a particular area e.g. The Bahamas. An endemic subspecies, designated by a Latin trinomial, are a taxonomic category that ranks immediately below species and designates a population of a particular geographic region genetically distinguishable from other such populations of the same species.

### 3.2.2 Winter Resident Non-Breeding Species

Winter Resident Non-breeding (WRN) species refers to the annual non-breeding fall/winter migrants to the Bahama Islands from North America. Seventeen (17) of the species recorded were WRN species.

### 3.2.3 Summer Resident Breeding Species

Summer Resident Breeding species refers to migrants that breed in The Bahamas during summer months from April to October and spend the rest of the year in other regions. Gray kingbird *Tyrannus dominicensis* is the only species in this category that was recorded within the site. This species was recorded during the 2019 survey.

**Photo 3-7: Gray Kingbird Tyrannus dominicensis on site October 2019**

## 3.3 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.**

Most of the species observed are classified as Least Concern by IUCN which defines Least Concern as "a taxon when it has been evaluated against the Red List criteria and does not qualify for Endangered or Near Threatened". It is not considered a species of conservation because it is still plentiful in the wild.

Two (2) species observed - White-crowned Pigeon *Patagioenas leucocephala, and Piping Plover Charadrius melodus are* classified as Near Threatened by IUCN. 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".

All species observed are protected under the Wild Birds Protection Act Chapter 249 (Statue Law of The Bahamas).

**Photo 3-8:** PRB White-crowned Pigeon *Patagioenas leucocephala* on site April 2023

## 3.4 Habitat Utilization

**2019 Survey**

The majority of birds were detected within the coastal and interior dry broadleaf evergreen vegetation. The three (3) falcons were found in the rocky coastal area and used Casuarina trees as perches. The Gray Kingbird use tall dry branches as perches to look-out for flying insects; their primary food source. The majority of White-crowned pigeons were detected in the residential areas. Piping Plovers were only found in the sandy area.

**2023 Survey**

Several species of shorebirds were observed along the coastal shoreline including a pair of Wilson's Plovers *Charadrius wilsonia* recorded along the north-western rocky shore and pairs of American Oystercatchers *Haematopus 6asserine* and Spotted Sandpipers *Actitis macularius* along the South-western rocky shore. A Green Heron *Butorides virescens virescens* was also observed along the South-western rocky shore. There was little activity noted along the sandy shore. One Yellow-crowned Night Heron *Nyctanassa violacea* was recorded on the north-western sandy shore.

The most avian activity was recorded in the interior upland sections of the site including broadleaf vegetation and human altered areas. Species in the human altered areas included permanent resident breeding species that are adapted to urban settings such as Red-legged Thrush *Turdus plumbeus plumbeus,* Northern Mockingbird *Mimus polyglottos*, and the Common Ground Dove *Columbina 7asserine*. An American Kestrel *Falco sparverius* was perched in branches of Australian pine trees overlooking the northern sandy shore and broadleaf vegetation. Resident and migrant passerine species such as Bananaquit *Coereba flaveola bahamensis* and Palm Warbler *Setophaga palmarum* were also observed in this area. Activity in the broadleaf interior upland was predominantly winter resident non-breeding passerines.

A noteworthy habitat utilization observation is the abundance of White-crowned Pigeon *Patagioenas leucocephala* in the interior upland sections of the site. The constant movement in and out of the Coconut Palms (*Cocos nucifera*) suggest that there is breeding activity on the site. The White-crowned Pigeon breeding season in The Bahamas is March to August.

## 4 Discussion

The surveys were conducted outside of the Summer Resident Breeding (SRB) season. SRB species fall into two main categories – Landbirds and Seabirds. The site is not suitable for larger seabird nesting which prefer isolated cays and rocks. Smaller seabird such as terns were recorded flying over the site, but it is unlikely that this species will utilize the site for nesting.

There are three (3) species of migrant land birds that breed in The Bahamas – Black-whiskered Vireo *Vireo altiloquus, Chordeiles gundlachii*, and Gray Kingbird *Tyrannus dominicensis.* The Gray Kingbird was recoded on the site during the 2019 survey and it is likely that the Antillean Nighthawk might utilize the site. However, the Black-whiskered Vireo which prefers taller broadleaf forest vegetation is unlikely to be found on the site during a summer assessment due to this limiting factor.

## 5 Recommendations

To minimize the impact on habitat loss due to the development, where possible, consideration should be given to focusing areas for proposed construction in section of the site that is already heavily human impacted, as opposed to clearing native vegetation from new areas. The eastern section of the site including areas dominated by invasive species meets this criterion.

## 6 Conclusion

The findings of this report are based on a small sample size of two data points and do not represent the total expected diversity at the site as data collection does not cover a full year of sampling. However, the avifauna observed are a fair representation of species typically found in the vegetation types present.

## 7 References

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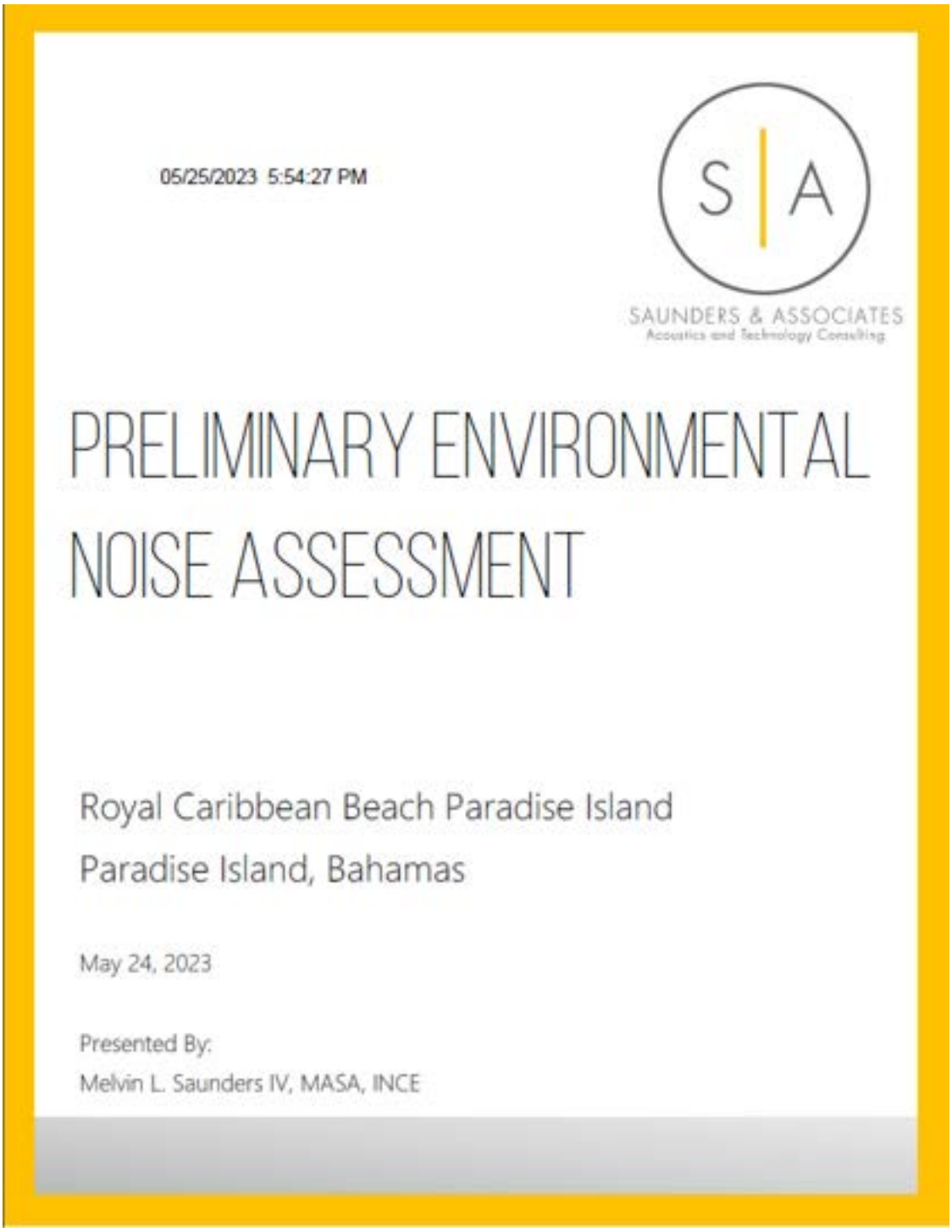
SCHEDULE (Sections 2, 4, 6, 8 and 11).

## 6.0 NOISE ASSESSMENT – May 2023

New Providence & Paradise Island, The Bahamas - Noise Assessment



## Introduction

The selected Royal Caribbean Beach Club is situated along Paradise Island in the Bahamas. It is a 17 acre site which sits north of the main cruise ship terminal along the stretch of beach leading to the Nassau Harbour Lighthouse. The site is designated to host Royal Caribbean ship patrons for day uses activities on site including shopping, pool party, dining, drinking, and entertainment. Day-to-day use and coverage of the outdoor areas will be achieved with use of a distributed loudspeaker system which allows the musical source to be closer to the listener. Performance areas for bands and DJ's will be covered with large format loudspeakers. Primary back of house activities will occur on the easternmost portion of the Royal Caribbean property including the use of engine generators and pump rooms. Other mechanical pump rooms will be located throughout the property.

## Existing Conditions

Measurements were conducted on March 8-9, 2022 to collect data for the waterway traffic and environmental conditions. As part of our assessment, environmental noise measurements were conducted over a 24 hour period along the existing uninhabited island to record the existing conditions. The date of the site visit was selected with favorable weather conditions in mind. Sound level meters were installed at locations 1,2, and 3 as noted on the map below. Additionally, we collected several third octave band spectrum measurements over the course of the 24-hour period.

The site consists of a significant amount of vegetation, including trees, thick brush at locations 1 and 2. Location 3 provided the clearest line of sight to the waterway with consideration of present noise sources. Comparison of general noise level between the locations were fairly consistent however, we found that the noise as a result of palm tree movement is more significant in locations 1 and 2.

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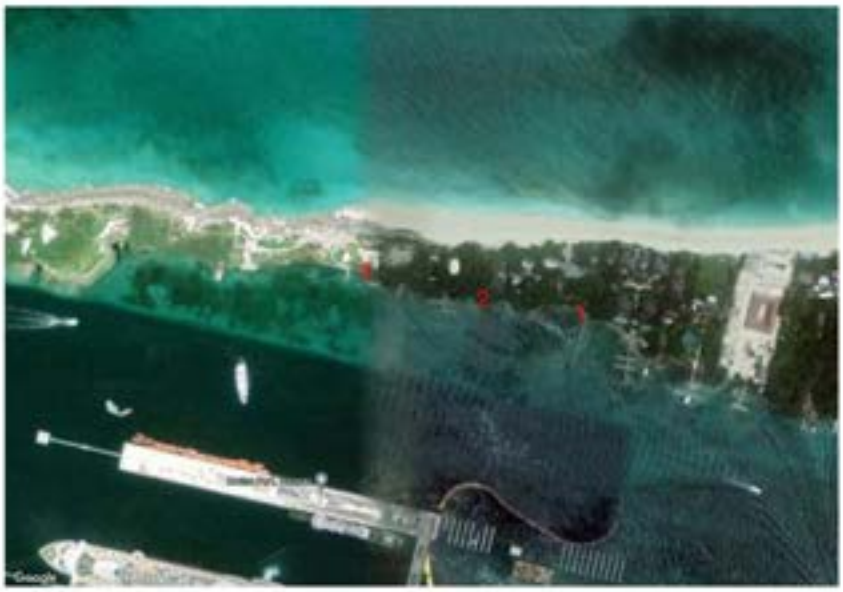

Figure 1. Satellite image indicating project site, measurement locations and notable noise sources.

Figure 2. Photo of measurement set up at Locations.

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General daytime noise levels range from 55-60 dBA with peaks exceeding 80 dBA in some cases with cruise ship departures and associated ship horns. We have included a list of common sounds below to help gauge the measurement results.

Detailed measurement results are shown in the charts below. For each measurement location, the chart includes both the maximum noise level along with the equivalent noise level for the one minute measurement period. In many instances, particularly in location 3, noise levels regularly exceed 80 dBA.

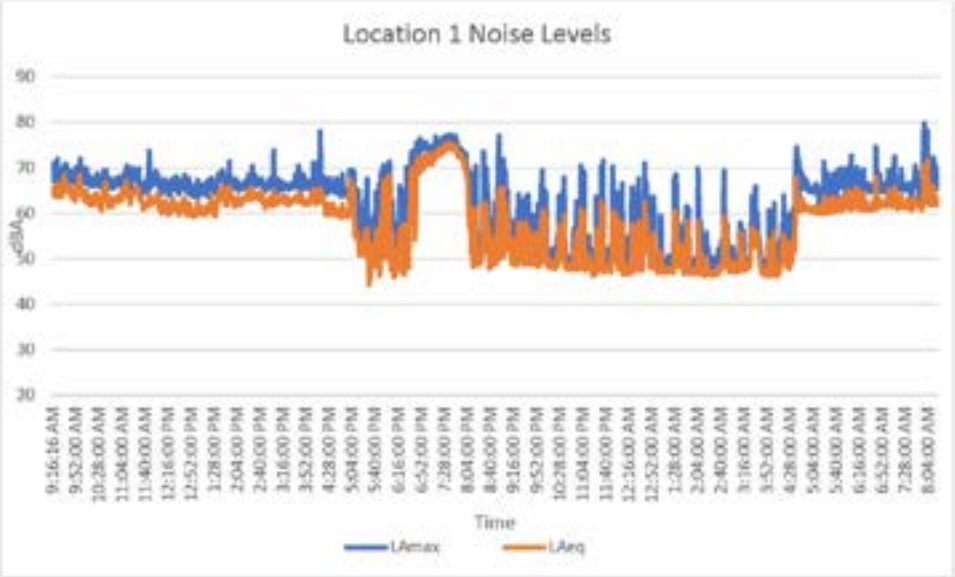


*Chart 1*

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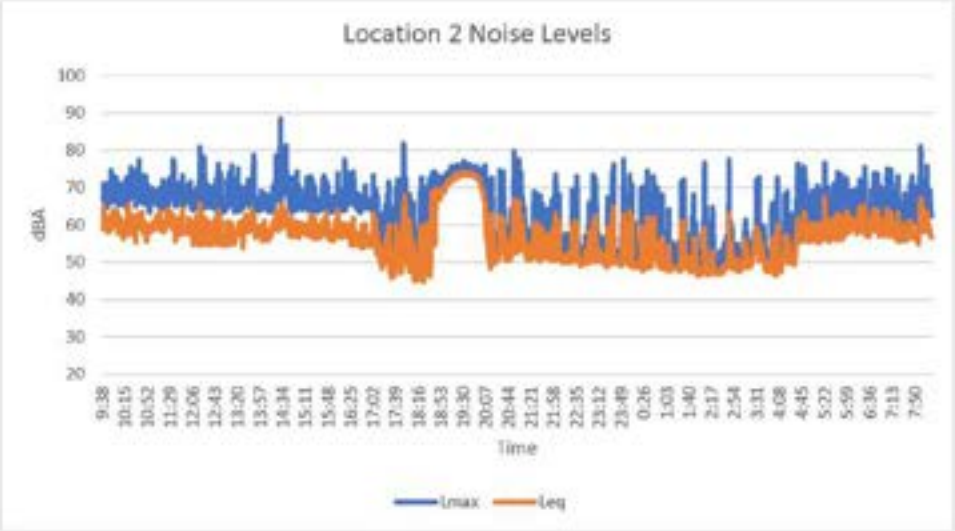


*Chart 2*


*Chart 3*

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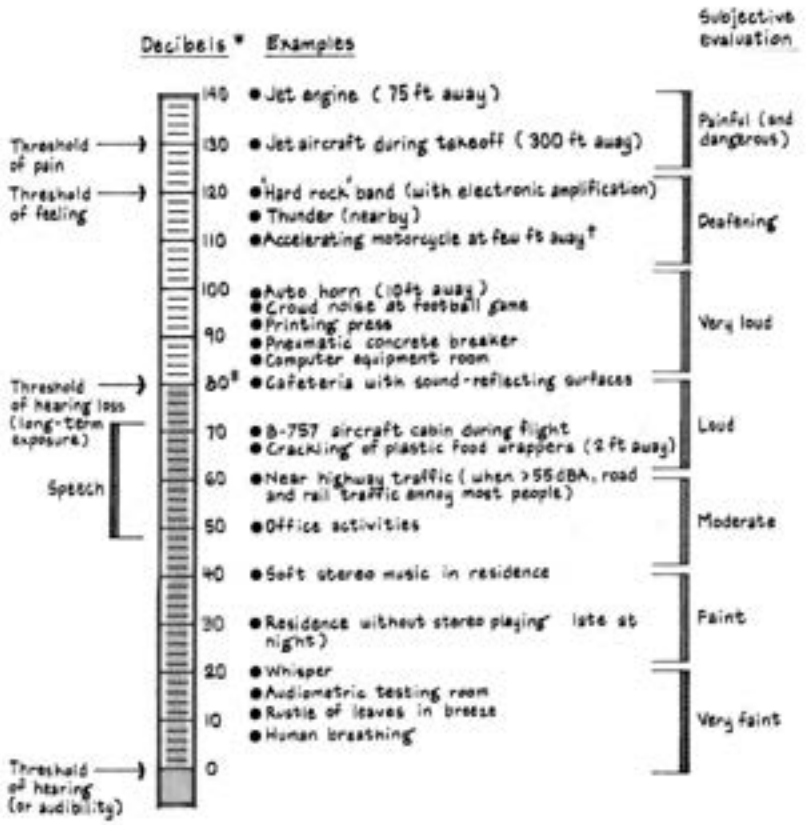


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## Results and Discussion

Generally, daytime noise levels are within the 55 dBA range and can approach 60 dBA with the entry of ships into port. Overnight noise levels decrease to 44-46 dBA at meter location 3 which again does not include significant palm tree noise. Please refer to Figure 1 above for Measurement Locations.

Included in the measurements results above are a series of noise events which are common when there are ships in port. The measurements in the Table 1.0 below were collected at varying meter locations 1-3.

| Source | Noise Level |
|---|---|
| Jet ski | 65 dBA |
| Aircraft flyover | 60-62 dBA |
| 2 ships in port (announcements and music) | 55 dBA |
| Palm Noise | 55-57 dBA |
| Pilot ship | 57-58 dBA |
| Ship horn | 80-85 dBA |

**Table 1 – Typical event noise levels at long term meter locations**

In addition to the long-term sound level meter locations, snapshot measurements were also conducted within the courtyard of the villa which will be immediately adjacent to the facilities building and plant. The measurements conducted at this location are important because it will be the closest residential property line to Royal Caribbean Beach Club property.

| Source | Noise Level |
|---|---|
| Idling Ship | 48 dBA |
| Villa Dock | 43-45 dBA |
| Tour Boat | 66 dBA |
| 2 ships in port (with music) | 52 dBA |
| Air condition condensing unit (@ 6ft away) | 55-58 dBA |

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Table 2 – Typical event noise levels at villa courtyard

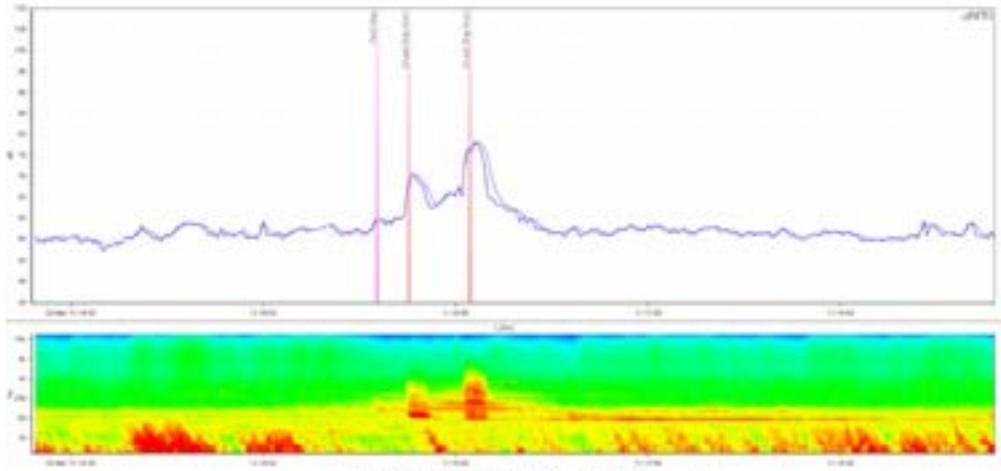

Chart 4.0 - Typical ship entry into port

## Noise Ordinances and Penal Codes

In our research we have found that there no definitive noise ordinances found in either the Bahamian Statute Law or the Florida State Law. Both jurisdictions do not define allowable property line noise requirements as found in many municipal and state ordinances. However, within the Bahamian Environmental Planning and Protection act (No 40 of 2019) we did find one reference to overall dB level. Question 22 is included in its entirety below.

*22. Will the activity generate significant levels of noise (i.e. for more than 1 hour per day at levels exceeding 60 dB) during its operational phase? Yes [ ] No [ ]*

For reference, we have included the following Hillsborough County Noise Ordinance which is enforced in Tampa, Florida. The ordinance includes octave band noise levels which can be used to help define allowable property line low frequency noise content at residential property lines. While the octave band noise level limits are reasonable, we would recommend lower allowable nighttime property line noise level considering that existing overnight noise levels are within the 45-50 dBA range.

***Hillsborough County Noise Ordinance***

The noise standards are determined by the type of land receiving the noise and are generally stricter for residential properties. The decibel limits indicated for each receiving property type may vary by time of day, as shown in the chart below:

| Receiving Property Type | Time Period | A-Scale Limit in Decibels* |
|---|---|---|
| Residential | 7:00am - 10:00pm | 60 |
| | 10:00pm - 7:00am | 55 |

*measured as an equivalent continuous noise level, Leq, over a 10-minute period of time

### Octave Band Standards

*In addition, the following individual octave band standards apply to sources of sound that impact residential property:*

| Time Period | Octave Band | A-Scale Limit in Decibels |
|---|---|---|
| 7:00am - 11:00pm | 63 | 70 |
| | 125 | 64 |
| | 250 | 57 |
| 11:00pm – 7:00am | 63 | 65 |
| | 125 | 59 |
| | 250 | 53 |

***Other Municipal Noise Ordinances***

To help establish reasonable noise levels in designated entertainment districts, some municipalities have separated allowable entertainment district noise levels from historical noise limits. This allows these areas to operate at levels expected by the patrons while maintaining the culture established by the venues. The following are excerpts from each example city and ordinance.

*Austin:*
*9-2-4 - RESTRICTION ON DECIBEL LEVEL.*

*A person may not operate sound equipment at a business that produces sound:*

> *(1) in excess of 85 decibels between 10:00 a.m. and 2:00 a.m., as measured at the property line of the business;*

*Washington D.C. (Constitutional Bill):*

*To amend the Construction Codes Approval and Amendments Act of 1986 to regulate sound attenuation standards for new residential construction in activity areas or entertainment areas; to amend the Office of and Commission on Nightlife and Culture Establishment Act of 2018 to create a grant program for soundproofing entertainment venues; to amend Chapter 8 of Title 47 of the District of Columbia Official Code to create a property tax deduction for soundproofing buildings; and to require the Mayor to publish a report on strategies to accommodate outdoor performances.*

*(A) Residential units meet or exceed a composite Outdoor/Indoor Transmission Class of not less than 32*



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*(B) Residential units achieve an indoor sound level reduction for frequencies between 80 and 160 hertz of not less than 30 dBA*

The combination of allowable adjacent noise levels as noted in the Austin ordinance and the Washington D.C. bill which addresses minimum construction standards would be ideal in a modern ordinance. The Washington D.C. constitutional bill is by far the most advanced and forethought plan to date which addresses new and existing constructions for residential buildings near an entertainment district. The bill requires minimum construction standards for residential construction so that business owners are not penalized for creating a culture in the entertainment which attracts new residential construction in the area.

## Environmental Noise Model

An environmental noise model was created using the iNoise software and calibrated with the measurements taken during the site visit. Additionally, typical beach activity sound levels were provided by Royal Caribbean as collected on the CocoCay Island. We understand that the measurements were collected with an iPhone and measurement distances from the recorded noise source were noted for incorporation into the iNoise model. Additionally, existing audiovisual drawings from some CocoCay guest areas were provided to approximate the closest real-world conditions. With this information in hand, the following assumptions were made regarding each of the proposed areas for the Royal Caribbean Paradise Island Beach Club environmental noise model.

*Modeling assumptions*

Loudspeakers – All loudspeakers were modeled assuming a coverage angle of 90 degrees in both the horizontal and vertical directions.

Cabanas – One loudspeaker is shown installed centrally located in each cabana facing the direction of the cruise port. Loudspeaker height is 1.8m above the ground plane.

Bars – At least two loudspeakers are shown and assumed to be installed 2.5m above the listening areas. In the case of one bar, a third loudspeaker is noted to improve even sound coverage in the listening areas.

Restaurants – Two loudspeakers are noted at each restaurant area and mounted 2.5m above the listening areas.

Pool - All pools are surrounded by ground mounted loudspeakers to provide even sound levels as noted within the iNoise map. To simulate a worst-case condition, the loudspeakers are assumed to be installed at 1 meter above the ground.

BOH Walking Paths – General back of house noise levels and background music noise levels are estimated using a line source in the iNoise software. This approach results in a sound gradient along the path that helps to illustrate the noise impact both the background noise and back of house equipment. The line source in the model assumes a spherical noise source installed on 5m centers.

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Engine Generator (Diesel) – Noise levels were modeled using the engine generator spectrum found in the iNoise source database. The levels were adjusted based on our experience with similar sized units. Included in the model is both the intake, discharge, and hot gas noise levels.

MEP and Pump Room Louvers – Data was provided from RCBI for these units based on collected noise levels at their existing wave pool building on Coco Cay.

DJ Booth – Two large format loudspeakers were assumed for the DJ booth and loudspeaker levels surround the pool were increased to match a party atmosphere. The loudspeakers were assumed 2.5m above the ground plane.

Shopping Village – A total of 7 speakers were installed above each of what is assumed to be the doors leading to each of the shops.

Ambient Guest Noise Levels – To simulate typical noise levels found on the beach and areas surrounding the pools, restaurants and bars, a large area source was assumed in each of these conditions. The area source assumes a spherical noise source installed in a 10m x 10m grid over the surface of the source. The area source was assumed 1.5 above the ground plane.

Welcome Band - The Welcome Band at the main dock has assumed 2 large format loudspeakers installed 2m above the ground plan.

In Port Ships – Cruise ships were modeled as buildings in iNoise to approximate the resultant barrier effect of a similarly sized object.

Based on the above modeling assumptions, Map 1 was created. Topographical and existing building information was imported into the software from Google Earth. Map 1 illustrates average noise levels due to typical island activities when a Royal Caribbean ship is in port. The levels shown in map 1 do not assume any significant noise reductions as a result of acoustical noise abatement with the exception of the engine generators and the use a barrier wall. As noted in the map, typical noise levels on the Royal Caribbean portion of the island can range from 49 dBA along the westernmost portion if the island to upwards of 100 dBA near the engine generator and mechanical room louvers. Sound levels near the welcome band and DJ booth are estimated at ~90dBA with typical sound levels in the party pool ranging from 73-90+ dBA. Sound levels for the residences adjacent to the back of house and diesel engine generator are anticipated to be within the low 50 to mid 40 dBA range assuming the use of a 17ft tall screen wall to separate the back of house areas from the residential villa buildings. As noted above, typical daytime background noise levels on the island range from 50-60 dBA depending on activities in port.

***Noise attenuation options***

The most significant noise sources as defined in the iNoise model are the result of mechanical noise and louvers with the exception of the large format speakers for the DJ booth and Welcome Band. Particularly, mechanical room noise and the engine generators tend to radiate

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noise efficiently if not addressed with acoustical mitigation techniques. To help reduce noise levels for these sources, the following methods and equipment may be used to minimize noise impacts.

*Acoustical Louvers and silencers*

Acoustical louvers and silencers are instrumental in reducing noise levels generated by mechanical rooms. Acoustical louvers are designed to provide a barrier that controls the transmission of sound while allowing for the free flow of air. These specialized louvers incorporate sound-absorbing materials and innovative airflow designs, dispersing, reflecting, and absorbing sound waves to minimize noise. Additionally, silencers are employed in ductwork systems to further attenuate noise. Silencers are designed with sound-absorbing materials and baffles that help to dissipate and absorb sound energy as air passes through the ducts. By combining the use of acoustical louvers and silencers, noise levels from mechanical rooms can be significantly reduced, creating a quieter and more comfortable environment for occupants around the building.

*Acoustically absorptive wall panels*

Acoustically absorptive fiberglass wall panels are a commonly used material for acoustical absorption in mechanical rooms due to their excellent sound-dampening properties. By installing fiberglass panels or insulation in these rooms, the overall noise levels can be significantly reduced before the sound exits the space via a duct or louver.

*Barrier walls*

Sound barrier walls are highly effective in reducing noise levels by creating a physical barrier that intercepts and absorbs sound waves. These walls are typically constructed using materials like concrete, wood, or metal. Generally, the mass of the barrier wall should be at least 2.2 lbs/sq ft to meet the acoustical requirements. When sound waves encounter a sound barrier wall, a portion of the energy is reflected back towards the source, while another portion is absorbed by the wall material if an absorptive material is selected for the face of the wall. Additionally, sound barrier walls also create a "shadow zone" behind them, where the noise levels are further diminished due to the obstruction of sound waves. The amount of noise reduction provided by sound barrier walls can vary depending on factors such as wall height, specific noise source, height of the noise source, and height of listener. Generally, sound barrier walls can achieve noise reductions ranging from 5 to 17 decibels (dB), significantly improving the acoustic conditions in the protected area.

*Turbine Generators*

Turbine generators may be an option for reducing the impact of noise on the site. Compared to diesel generators, turbine generators are generally known to be quieter due to their different operating mechanisms. Turbine generators use rotating blades or propellers to generate power, resulting in a smoother and more continuous power generation process. This smooth operation helps to reduce the overall noise level produced by the generator. However, it's worth noting

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that turbine generators may exhibit a significant high-frequency whine, which can be deemed annoying if not properly addressed. This high-frequency whine arises from the interaction of rotating components, such as blades or rotors, and can be more noticeable in certain operating conditions. To mitigate this issue, various noise-reduction techniques can be implemented, such as using sound-absorbing materials, optimizing the design of rotating components, or employing acoustic enclosures. These measures aim to minimize the high-frequency whine and create a more pleasant and less intrusive acoustic environment when utilizing turbine generators.

*Pipe and equipment lagging*

Pipe and equipment lagging is an effective solution for reducing noise levels generated by mechanical systems, plumbing, pumps, and other mechanical equipment. It involves wrapping insulation material around these noise sources to dampen and absorb sound waves produced by flowing fluids, vibrations, or mechanical noise. The insulation material has significant mass and acts as a barrier, preventing the transmission of noise to the surrounding environment. By reducing the radiated noise levels from the body of pipes and equipment, lagging minimizes the noise generated and attenuates its propagation. Additionally, the insulation material used in pipe lagging helps to absorb and dissipate sound energy, further contributing to noise reduction. This simple yet effective technique is commonly employed in residential, commercial, and industrial settings, providing a quieter and more comfortable environment for occupants.

*Mufflers*

Mufflers play a vital role in reducing exhaust noise from engine generators, ensuring a quieter operating environment. Different muffler types are available for various applications, including hospital grade, critical, and super critical mufflers. Hospital grade mufflers are designed specifically for healthcare facilities where noise reduction is crucial to maintaining a peaceful environment for patients and staff. In conditions where listeners are very close to the exhaust outlet, hospital grade mufflers can be specified where necessary. They employ advanced sound attenuation technologies to achieve significant noise reduction while maintaining optimal exhaust flow. Critical mufflers, on the other hand, are utilized in settings where moderate noise reduction is required, such as other residential or commercial areas. They provide a balance between noise reduction and airflow efficiency. Super critical mufflers are the most effective in reducing exhaust noise, often used in industrial or high-noise environments. They incorporate sophisticated noise-cancelling techniques, including intricate internal designs and sound-absorbing materials, to achieve the highest level of noise reduction. The selection of the appropriate muffler type depends on the specific noise requirements and application, ensuring that the engine generator operates at a lower noise level while maintaining optimal performance.

*Acoustical Doors*

Acoustical doors are specialized doors designed to provide sound insulation and reduce noise transmission between different areas or rooms. These doors are constructed with multiple

layers of sound-absorbing materials and often feature a solid core or honeycomb core design. Acoustical doors are engineered to have a higher Sound Transmission Class (STC) rating, which measures their ability to block sound. Compared to standard solid core doors, acoustical doors offer superior soundproofing capabilities. They are specifically designed to minimize sound leakage, preventing noise from passing through the door and ensuring a quieter environment on either side.

In the design of the engine generator, it has been our experience that large format doors should be avoided. Instead, the installation and removal of the generators should occur through the louvers and/or silencers to minimize the potential for the failure of the large format door over time.

Considering the above attenuation options, a second model (Map 2) was created to simulate noise levels assuming the use of acoustical louvers and silencers installed on the MEP buildings. The diesel generators were also swapped in the model to estimate the impact of turbine generators on the site.

## Conclusions and Next Steps

The acoustical modeling results show that the sound levels from Royal Caribbean Beach Club activities on Paradise Island are anticipated to be well within typically allowable noise levels for impacted residential properties. Residential villas immediately adjacent to the back of house/engine generator areas must be separated with the use of an acoustical barrier wall to minimize the impact to the residences. Other residential areas further away from eastern portion of the Royal Caribbean Beach club are anticipated to experience noise levels in the mid 40 dBA range which is generally below the existing background noise levels found on the island. Calculated noise levels across the port are below 35 dBA which is below the anticipated background noise levels in these areas. It should also be noted that the model only reflects the noise sources found on the Royal Caribbean property and we would anticipate that noise sources across the port may also contribute to the calculated noise maps.

As the detailed design of the project continues, we recommend continuing to refine the acoustical environmental noise model to reflect acoustical performances of selected mechanical equipment and loudspeaker design. Individual sound power levels of equipment are available for most mechanical equipment from the manufacturer. Additionally, detailed conditions including interior room dimensions, building sizes, lover/silencer attenuation data, building orientation etc. can play a large part in the performance and noise levels at varying distances from the noise sources. Refining the model in the later design stages will help to ensure model accuracy and predict overall results.

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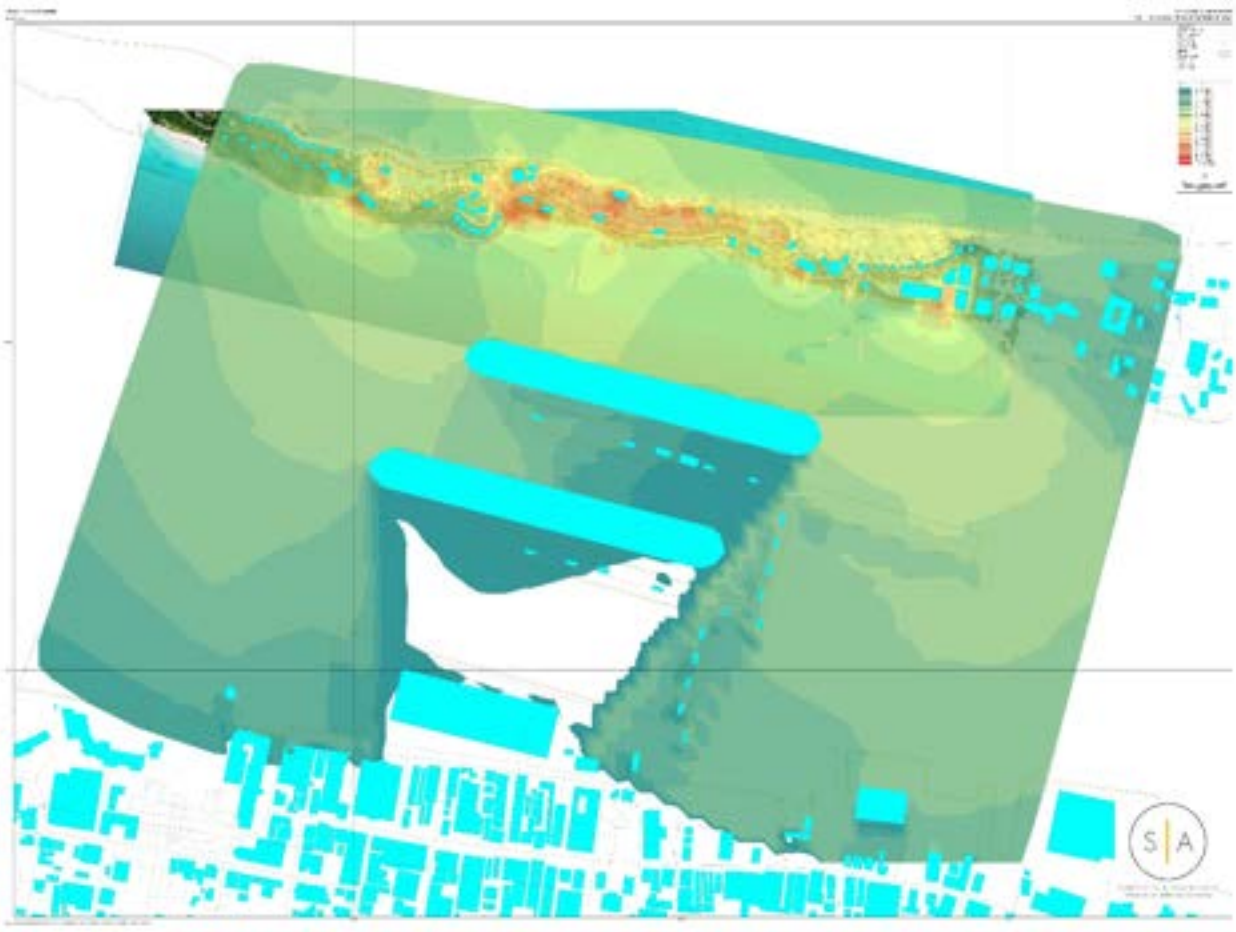
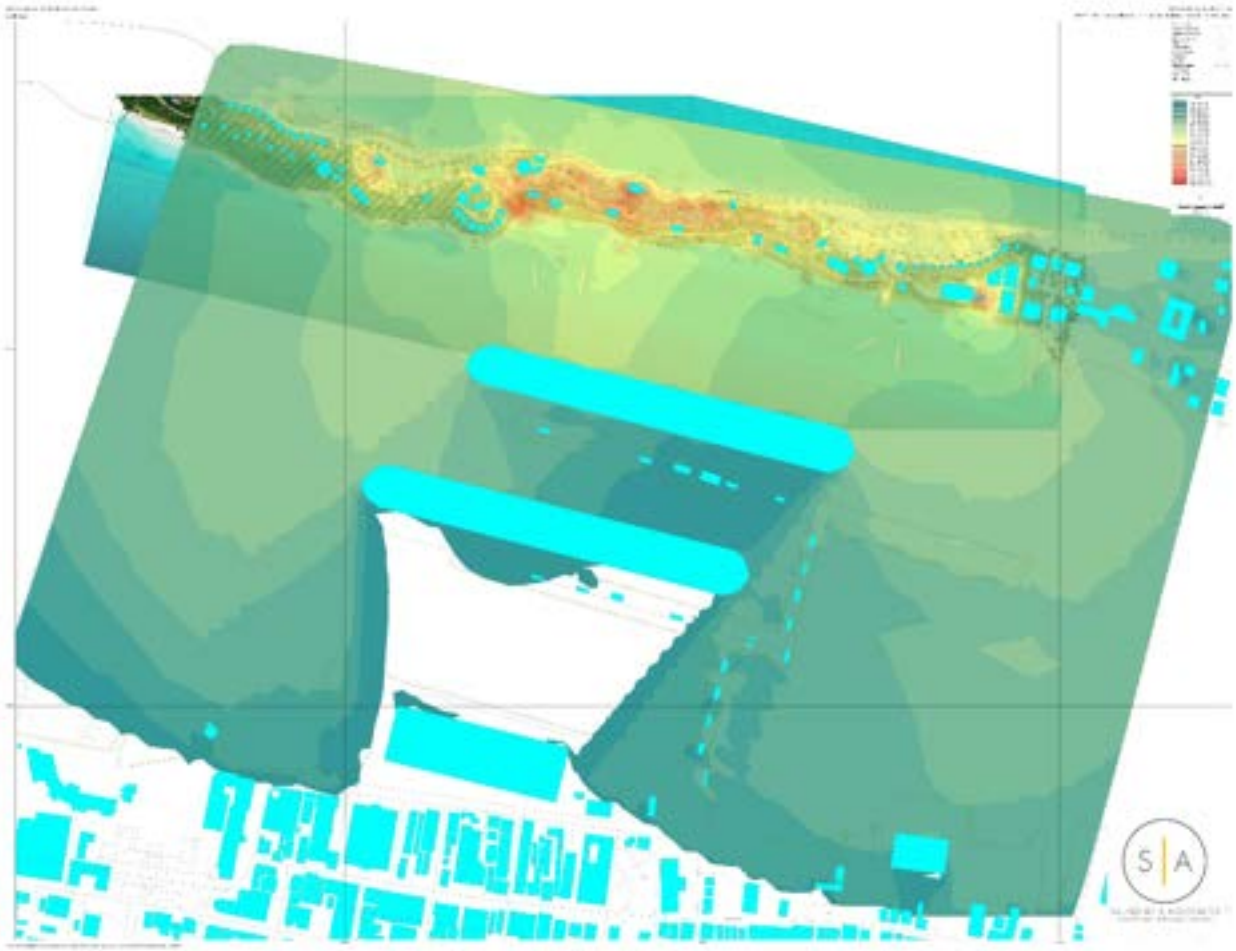
# SECTION 6.0



## SECTION 6.0: NOISE ASSESSMENT



## 7.0 COASTAL STUDY – May 2023

# COASTAL ENGINEERING REVIEW OF ROYAL BEACH CLUB, PARADISE ISLAND, MASTERPLAN DESIGN

Prepared by:

Kevin R. Bodge, Ph.D., P.E.
Olsen Associates, Inc.

Prepared for:
Royal Caribbean Group

30 May 2023

**Introduction.**

This report describes my observations regarding proposed works near the western end of Paradise Island for development of the Royal Beach Club (RBC), with specific reference to the anticipated physical efficacy and littoral effects of the proposed shorefront (coastal) improvements. This report specifically reviews the masterplan design drawing for RBC provided by Royal Caribbean International on 23 May 2023 (see ***Figure 1***, following page).

This review draws upon my prior familiarity and coastal engineering experience with Paradise Island, particularly including our firm's design, construction review, and monitoring of shorefront improvements along the north, east and south shorelines of the island since about 1995. This includes mostly all of the contemporary coastal works along Atlantis, Cabbage Beach, Ocean Club, Ocean Club Estates, and select harbor-side improvements along the subject property (including docks, timber wave attenuators, and the interim dolphin pens for Atlantis-III) from about 1995 through 2011. Most recently, I examined the entire subject RBC site on 10 April 2019 to identify recommendations and limitations for coastal improvements for a possible "day destination" for Royal Caribbean Cruise Lines. My recommendations from that investigation were summarized in a report prepared for Island Site Development Ltd. (ISD), dated 24 June 2019. My current observations and recommendations are partly framed by that prior report, along with my prior 35 year experience with the analysis and design of beach & coastal improvement projects at sites throughout the Bahamas. Neither my firm (OAI) nor myself prepared the RBC masterplan that is reviewed herein; and so this report is an independent review of the proposed plan.

**Setting.**

Per the masterplan, the proposed project development area comprises approximately 3000 feet of shoreline (along each of the north & south shores) near the western end of Paradise Island commencing west of Paradise Beach Villas. No works or improvements are indicated along the westernmost 2400± feet of the island. See ***Figures 1 and 2***, below.

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**Figure 1:** RBC Masterplan, 23 May 2023. See ***Attachments A and B*** for enlarged 11"x17" drawings.

**Figure 2:** Approximate area of proposed project works (yellow rectangle), shown in Figure 1.

The project area's south-side harbor shoreline is principally rock, mostly sloping steeply or near-vertically into the water, with vegetation extending to just above the waterline and scattered areas of rock rubble, conch shell, and debris. See *Figure 3*, below. There are approximately 10 existing docks/piers along the site, including the 220-ft long L-dock at the far east end of the RBC site. Many or most of these structures are in deteriorated condition.

The *project* area's north-side oceanfront shoreline is comprised of three principal sections:
(1) Western 800-ft comprised of mostly natural sandy beach and the 300-ft long western end of the ironshore (with a short and low seawall);
(2) Central 1400-ft comprised of mostly steep & high ironshore with essentially no sand beach,
(3) Eastern 800-ft comprised of sand beach with a seawall (and rock revetment along the western 130-ft), with the seawall and revetment located boldly (seaward) upon the sand beach.
*Figures 4-a,b,c* on the following page, generally illustrate conditions along each of these three sections (photos from April 2019).

**Figure 3:** South-side harbor shoreline; near the approximate center of the development site.

North-side ocean shoreline:

**Figure 4a:** West-end. Existing sand beach (background), west of western most seawall and end of central ironshore (foreground).

**Figure 4b** (left): Central shoreline, with high vertical ironshore, and existing seawall along eastern half of central shoreline.

**Figure 4c** (below): Eastern shoreline, with seawall and revetment (background) located upon existing sand beach.

There are no existing coastal structures (groins or breakwaters or inlets) along the project area's oceanfront shoreline that extend into the sea – marginally excepting the rock revetment between the western and central sections of the shoreline [shown in ***Figure 4c***, which is basically a transition to the existing ironshore, along the waterline]. The existing seawall along the eastern ~550 ft of the shoreline is located upon the beach berm. Although it is landward of the mean high water shoreline, this existing seawall interferes with natural beach fluctuation and is adverse to the health and stability of the sand beach.

**Proposed Masterplan Works.**

***Attachment A***, and ***Figures 5a & 5b*** below, depict the 5/23/2023 masterplan overlain upon an aerial photograph of the island. The principal *existing* shorefront features – traced from March 2018 and December 2022 aerial photographs – are illustrated by black polylines and labelled as Existing. These black lines include the *existing* seawalls, boulder revetment, seaward edge of vegetation and ironshore, harborside docks, and typical location(s) of the mean high water line. The proposed RBC development is shown by the color illustration, in which the principal shorefront features are outlined by blue polylines and labelled as (RBC). These blue lines include the proposed seaward edge of development, beach cabanas, promenades, docks, pools, etc.

***Attachment B***, and ***Figures 6a & 6b***, likewise depict the principal shorefront features of the masterplan (blue polylines) overlaid on the existing island photograph. As described above, the island's principal existing features (seawalls, vegetation line, etc) are highlighted in black.


**Figure 5a:** RBC masterplan with annotation of existing island features (black polylines). Western third.



**Figure 5b:** RBC masterplan with annotation of existing island features (black polylines). Central and Eastern thirds.

RBC – Coastal Engineering Report – 30 May 2023

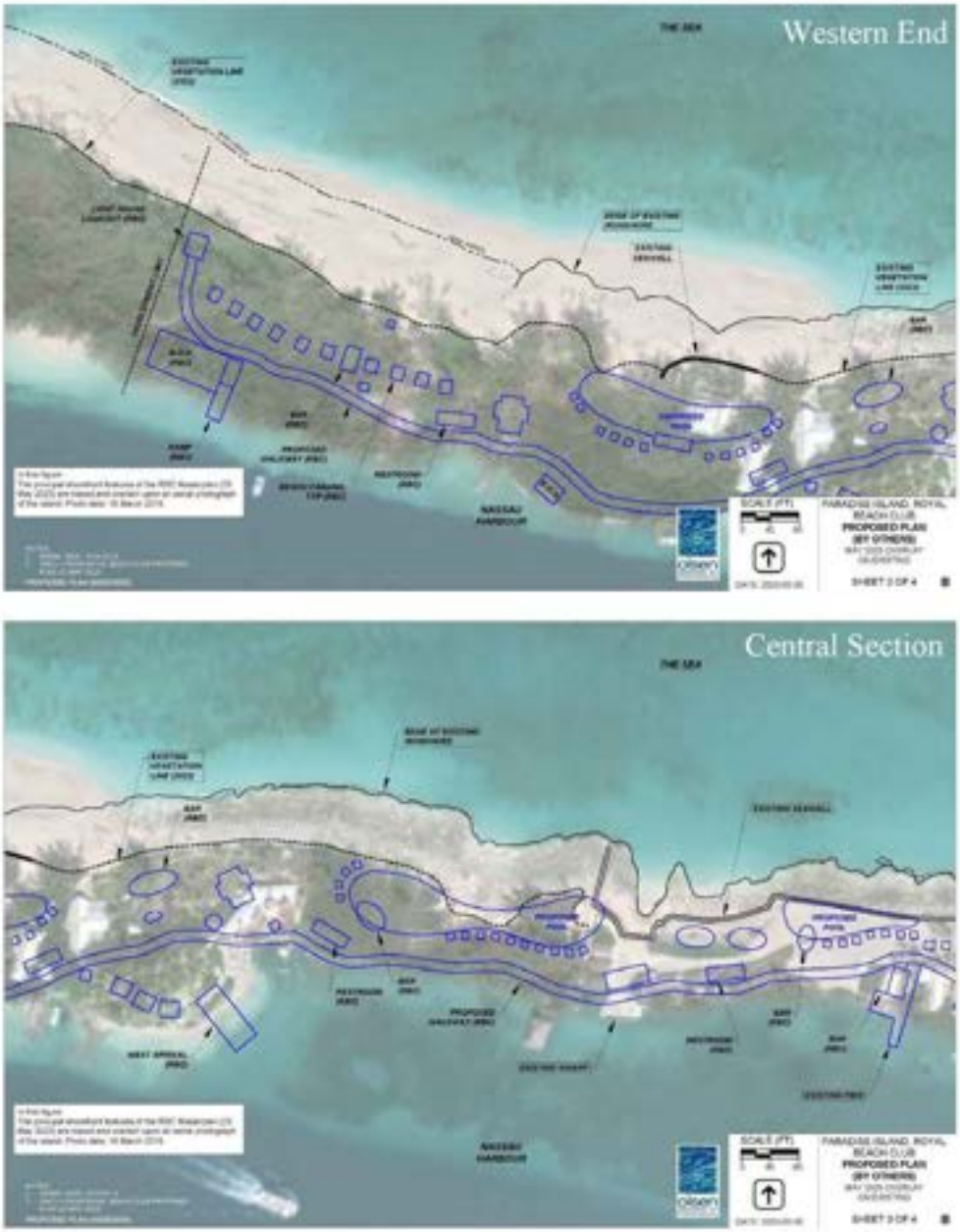


**Figure 6a:** Principal features of RBC masterplan (blue polylines) illustrated atop existing island conditions. Existing island features annotated by black lines. Western & Central thirds.


**Figure 6b**: Principal features of RBC masterplan (blue polylines) illustrated atop existing island conditions. Existing island features annotated by black lines. Eastern third.

In the figures, the indicated location of the MHWL is nominal (recognizing that it fluctuates along the beach). It illustrates typical locations from prior observations and aerial photographs.

The 5/23/2023 masterplan, depicted above, proposes the following works – focusing herein only upon those elements that are nearest the shorefront. Along the ***north-side oceanfront shoreline***, all of the works are located wholly above (*landward* of) the existing mean high water line, and *landward* of the existing vegetation line and existing seawalls.

(1) Western 800-ft: About 500-ft length of the existing sand beach, beginning west of the ironshore, is to be expanded *landward* by up to about 100-feet width behind the existing vegetation line, within the casuarina and other vegetation. Beachfront cabanas and F&B (food & beverage) are located 60 to 80 feet *landward* of the existing vegetation line, on the 'back-side' (south) of the island's existing ridge line. The promenade/walkway is located further south on the 'back-side', about 110 to 140 feet landward of the vegetation line. At the far west end of the beach & walkway, an observation deck is located about 30 feet *landward* of the vegetation line. There is no beach fill, excepting sand that may need to be added along the upland edge within the existing casuarina/vegetation area.

The upland behind the 300-ft long, low western end of ironshore includes a pool & deck -- located *landward* of the existing vegetation line and seawall, and about 100-120 feet inland from the ironshore edge. The proposed plan does not remove or alter the existing ironshore (which otherwise forms the ephemeral boundary of the sand beach at its eastern end).

(2) Central 1400-ft: Upland swimming pools, decks, F&B concessions, and related facilities are to be set-back along the high ironshore; all of which are to be located *landward* of the existing vegetation line and existing masonry seawall, and landward of the boulder revetment that terminates the east end of this area. No development or modifications are proposed seaward of the existing seawalls or vegetation line.

(3) Eastern 800-ft: The existing concrete seawall which runs along the eastern 550± feet of the sand beach is to be removed (demolished). The new upland edge of hardscape – i.e., promenade/walkway, F&B concession, and/or terrace walls -- are established at 20+ to 80+ feet *landward* of the demolished concrete seawall. Most of the new hardscape is setback between 40 and 70 feet landward of the demolished seawall. Beach cabanas are illustrated at 40 to 70+ feet landward of the demolished seawall (though closer at the far east end). At the far west end of this beach, the rock revetment – which is an existing transition between the current seawall area and the ironshore -- is shown remaining at its existing location.

At the far east end of the beach, the upland hardscape edge (i.e., walkway) merges with the location of the existing seawall – such that at least the eastern 100+ feet of this walkway will require a seawall face, although such seawall would be constructed 10 to 50 feet landward of the existing to-be-demolished seawall along the east end. A 'lookout' deck is proposed at the far eastern end, presumably above-grade and over the location of the existing concrete seawall.

The masterplan expands the sand beach into the upland – by about 40 to 70+ feet landward of the to-be-demolished concrete seawall. In this plan, no beach fill is proposed or required, except for that necessary to replace the existing upland grade (behind the seawall) with an appropriate thickness of beach-quality sand that is established at natural beach & berm slopes landward of the existing to-be-demolished seawall.

Along the ***south-side harbor shoreline***, the masterplan presents approximately six (6) dock or ramp/wharf structures. These replace or reconstruct the approximate ten (10) dock/ramp structures that currently exist (mostly in disrepair). These proposed waterfront 'piers' include two guest arrival docks (one each near west and east ends), two operations ramps (one each near west and east ends), an overlook deck/dock (atop an existing pier), and potential re-use of an existing wharf. There are no other proposed structures or over-water buildings in the masterplan.

Occasionally elevated wave energy in the harbor has previously indicated the value or need for wave sheltering of boat docks at this location, at least for small to medium size vessels. To wit, rock and timber breakwaters were constructed along and west of the Gilbert Lloyd docks, as recently as 2005. These structures are now damaged or semi-derelict. They will likely require repair or replacement to improve wave shelter at the new RBC docks; or, one can anticipate that they will likely be removed and replaced with wave attenuation structures proximate to the RBC docks – i.e., replacing existing wave attenuation structures with new ones.

*Figure 7* illustrates cross-sections of the proposed masterplan through the island at typical (central) locations of the west beach and the east beach, at 3:1 exaggerated vertical scale. We independently developed these graphics based upon the site's topographic survey data, the locations of the existing vegetation line (west beach) and seawall (east beach), and overlay of the proposed masterplan improvements.

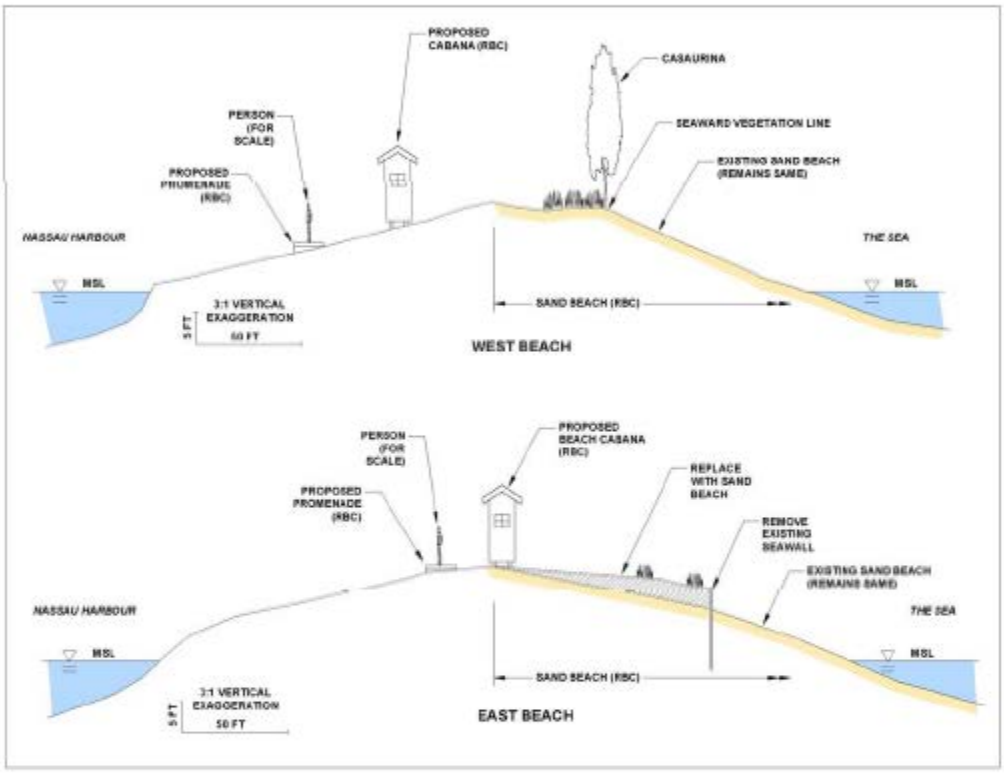


**Figure 7:** Illustrative cross-sections of the island and proposed RBC masterplan development at typical (central) locations of the west beach and east beach. [3:1 vertically exaggerated scale].

Along the west beach, the section illustrates that the existing natural sand beach will remain "as-is" and will be expanded at least 50+ feet landward into the back-beach by removal of casuarina and otherwise amidst the existing vegetation. Proposed structural improvements – such as the beach cabanas and promenade/walkway – will be sited on the 'back-side' of the ridge, about 100 ft and 130+ ft landward of the existing vegetation line, respectively. The masterplan does not propose seaward advance of the west beach.

Along the east beach, the section illustrates that the existing natural sand beach will remain "as-is" seaward of the existing seawall. That existing seawall is generally located upon the beach berm within the normal wave run-up zone. (As such, it is called an "offending structure" in coastal engineering parlance.) The seawall will be removed. The retained land behind the wall will be graded down and replaced by about 1 to 3 ft thickness of beach-quality sand so as to continue the natural beach & slope by 40+ to 70+ feet landward of the wall to establish a natural beach berm elevation and beach recreational area that is not otherwise interrupted by a seawall. This restored beach berm elevation can thus reach +12 to +15 ft MSL (consistent with the natural west beach berm). This might yet require a 0' to 3' high wall at the landward edge of the beach berm (to match the existing upland topography), but such wall would be located well landward of the active beach and would therefore act as a landscape/terrace wall. The cabanas will be sited at/landward of the elevated beach berm. The promenade/walkway (hardscape) will be landward of the cabanas -- mostly on or near the 'back-side' (south) of the island ridge. Conditions at the far east end of the east beach are narrower. The masterplan does not propose seaward advance of the east beach.

Herein, we did not illustrate a section through the central ironshore segment of the project shoreline, because the masterplan indicates that all the development would be located at and *landward* of the existing masonry seawalls -- and landward of the existing vegetation line where there is not a seawall. Practical island experience indicates that limiting site development to elevations and locations that are as high as, and landward of, existing (historical) seawalls and natural vegetation lines is the basis of prudent design practice. The presented masterplan is consistent with this practice.

In sum, all of the proposed works along the north-side oceanfront shoreline are located wholly above the mean high water shoreline, and all are located *landward* of the existing vegetation line and existing seawalls. Along the far east end of the sand beach, the proposed works will remove about 550 feet of existing concrete seawall (that is otherwise sited upon the active beach), and will concurrently relocate the seaward edge of development to about 40–70 feet *landward* of that existing seawall's location. There are no groins, jetties, breakwaters or other coastal structures proposed along the shoreline, beach, or in the sea. There is no proposed beach fill or beach expansion -- except to widen the beach along its *landward* edge, upland of the existing casuarina/vegetation line (along the west beach) and *landward/upland* of the existing to-be-demolished seawall (along the east beach).

The proposed works along the south-side harbor shoreline are limited to the construction of six docks/piers/ramps, of which two will utilize existing structures, and the other four will replace between 4 and 7 existing derelict docks/ramps. No groins or jetties or over-water structures are proposed in the masterplan. Wave attenuation structures for the docks -- if/as required -- may be anticipated to replace or improve existing semi-derelict wave attenuation structures.

**Anticipated Littoral (Coastal-Shoreline) Effects.**

Per my review, the proposed RBC masterplan design described above does not exhibit potential for adverse littoral impacts to the subject or adjacent shorelines. This reflects the reasonable expectation that the works do not reduce the sand beach elevations that presently exist, nor substantially alters ironshore that presently exists, nor establishes on-grade hardscape that is seaward of the existing vegetation line; and further noting that the proposed masterplan appears consistent with all of these expectations. The proposed plan is also consistent with my prior observations and recommendations described in my 24 June 2019 report to ISD with specific regard to improving existing oceanfront beach conditions and avoiding nearshore/littoral impacts.

The plan does not include any coastal structures that would impede nearshore circulation or littoral drift (viz., groins, jetties, breakwaters, seawalls, or inlet cuts), or which would otherwise encroach upon the existing natural sand beaches. All of the proposed works are *landward* of the mean high water line and *landward* of existing seawalls and existing vegetation lines.

Along the oceanfront east beach, the plan includes 40 to 70+ ft *landward* relocation of most of the existing seawall, off of the active sand beach, along its 550-feet eastern end. This is highly preferable (beneficial) for the overall beach system. It represents a "managed retreat" strategy which removes a historically constructed 'offensive structure' that otherwise interferes with natural beach fluctuation. An overlook structure is proposed at the far east end of the beach; but so long as this is an elevated deck structure constructed upon pilings located over and proximate to the existing seawall, it will not adversely impact beach/littoral processes beyond the seawall that already exists at this location. No modifications to the existing beach are proposed. Instead, the existing beach would be expanded into the *upland*, sloping up to its natural berm height, landward of the existing seawall which is to be removed.

Along the central oceanfront ironshore, the plan's proposed works are located *landward* of the existing seawalls, existing vegetation line, and rock revetment. As such, this plan indicates no changes relative to existing conditions, seaward of the existing seawall and vegetation line. Structural improvements to the existing masonry seawall and lengthening of the wall along the existing vegetation line west thereof may be required; but the latter is shown as 70+ feet upland of the ironshore edge. In contrast, the existing masonry seawall is only 35 to 60 feet upland of the ironshore edge. As such, repair or expansion of the seawall along the ironshore, along the existing seawall alignment and/or existing vegetation line, would be set-back from the ironshore at equal or greater width than the existing wall's setback and would not affect nearshore/littoral processes.

Along the oceanfront western end, the plan proposes a *landward* expansion of the beach, with the seaward-most structures (beach cabanas, F&B) located 60 to 80 feet *landward* of the existing vegetation line, on the 'back-side' (south) of the island's existing ridge line. The promenade hardscape is located further south on the 'back-side'. An overlook deck structure at the far west end of the beach is located ~30 feet landward of the vegetation line, and can be elevated

on pilings. There is no encroachment of structure upon the existing sand beach. No seaward expansion of this beach is proposed in the plan.

Along the south-side harbor shoreline, no structures are proposed other than repair and replacement of existing pile-supported dock structures, described as follows. Six (6) dock/pier/wharf structures are indicated in the masterplan relative to the approximate ten (10) mostly derelict structures that presently exist -- of which two of the structures will replace those that already exist, and some of the remaining eight existing structures will apparently be removed. No groins or jetties are otherwise proposed in the masterplan. To the extent that wave attenuating structures may be required for the new docks, it is reasonably anticipated that the existing (mostly derelict) structures will be repaired or replaced to service the new docks.

In sum, the proposed RBC masterplan does not exhibit potential for adverse littoral impacts to the subject or adjacent shorelines. My observations herein are solely limited to the project's littoral effects (i.e., sand transport, nearshore circulation, beach erosion, etcetera).

**Concerns Regarding Impacts.**

In terms of concerns raised regarding the project's development, I can and will only address those directly associated with *littoral* and nearshore impacts.[1] Per above, and to my knowledge, the RBC masterplan includes:

- No proposed seaward expansion of beach areas (except landward, into the upland – which is preferable).
- No plan to modify the beaches -- except for *landward* expansion into the upland (within the casuarina & vegetated back-beach along the west beach, and via removal of the existing seawall along the east beach, which is a preferred "retreat" strategy in contemporary beach management).
- No seawall construction upon a sandy beach. Instead, there is *landward* relocation of the existing east-end seawall – which is beneficial for the beach, as noted above.
- No overwater cabanas or other overwater structures (other than dock replacement on the harborside).
- No jetties, breakwaters, revetments or other similar engineered structures that protrude into the sea or beyond the high water line.
- No construction at or seaward of the high water shoreline, and no expansion of the beach or hard structure into the sea.
- No hardscape development seaward of the existing vegetation lines and/or existing seawalls.
- No excavation of nearshore rock or ironshore.

[1] As part of this review, I examined prior reports including "Marine Baseline Assessment, Royal Beach Club at Paradise Island" by JSS Consulting (April 2023); "Environmental Impact Assessment; Royal Beach Club at Paradise Island" by Islands by Design (Dec 2020); "Coastal Processes Study; Royal Paradise Island" by Moffatt & Nichol (Dec 2020); and media articles and communications regarding the project during the past 4 months.

- No modifications to the southside harbor shoreline, beyond new pile-supported docks that repair and/or replace some existing docks, that would adversely affect nearshore processes beyond those structures that presently exist.
- No plan to alter or create pocket beaches along the ironshore or elsewhere.

In regard to coral reef and benthic communities, particularly along the north seabed and Colonial Reef (offshore and north/west of the project site): potential impacts to nearshore hardbottom communities *may* occur where significant beach fill or coastal structures is/are constructed along the shoreline and into the sea where hardbottom is present and close to shore. In the present case, there are no beach fills, or structures, or other works extending seaward of the mean high water line (or within about 10 m of the shoreline for removal of the existing east-end beach seawall). Per the masterplan and my understanding, the existing beach is to be left "as-is" -- excepting expansion into *the upland*, away from the sea, which is preferable in this high-energy environment. As such, it may be reasonably concluded that there are no significant anticipated impacts to sub-tidal benthic colonies (i.e., coral) associated with the physical works, because the proposed works are to be landward of the existing waterline. Along the south-side harbor shoreline, the proposed works are associated with relatively routine removal of existing structures and the construction of new docks.

Implementation of standard "Best Management Practices" (BMP) for work adjacent to the waterline, including upland siltation fences (or turbidity curtains if required along the harborside works) may be conservatively prudent to avoid impacts to nearshore resources, noting that the works do not encroach upon or extend beyond the waterline, excepting that work required along the harborside for structure (dock) removal and/or new construction.

In regard to how the project will prevent [beach] erosion on the site, the following is noted. In contemporary beach management (in absence of large-scale, long-term beach nourishment projects – not appropriate herein), the preferred strategy to "prevent" beach erosion is to develop a beach design that is consistent with existing conditions. Such prudent and preferred design respects the existing shoreline conditions, expands the beach into the upland, and removes offending beachfront structures -- where practicable -- rather than aggressively expanding into the sea. The proposed RBC masterplan exactly accomplishes this strategy. Otherwise, means to "prevent" beach erosion along an open, healthy coastline is an oxymoron or counter-productive. Beach erosion (and recovery) is a natural process; and engineering means to "prevent" erosion on an open, healthy coastline – such as at this site – can lead to unintended adverse erosion consequences. Along an open coastline, the best strategy is to allow the beach its maximum space to fluctuate, including by removing offending seawall structures, and to not "over-expand" the production or expectations of beach area. Again, the proposed RBC masterplan is consistent with this strategy. As such, the masterplan does not include coastal engineering beach structures.

In the worst projected acute case, after severe storm impacts, the RBC project beaches can be restored through routine beach nourishment in order to more promptly resume operations. In the present case (two beaches comprising 1200-ft total beach length), a nominal emergency post-

storm renourishment would likely comprise less than 20,000 cubic yards of sand replenishment. That is a relatively modest quantity in coastal engineering practice; e.g., it is less than 1/5 of that placed by Atlantis (Kerzner International) along Cabbage Beach after beach erosion impacts from Hurricane Floyd in 1999/2000.

Beyond these topics regarding coastal and littoral impacts – described above - any comment regarding the project's maintenance, traffic, stormwater, wastewater, tourism impacts etc, is outside of my professional expertise, and is not addressed herein.

Thank you for the opportunity to offer these observations regarding the Royal Beach Club project at Paradise Island. Please contact me at kbodge@olsen-associates.com if you have any questions regarding this report.

Att A: RBC Masterplan with annotation of existing shorefront conditions (11"x17" drawings)

Att B: Key features of RBC Masterplan overlaid upon existing aerial photo (11"x17" drawings)

COASTAL ENGINEERING REVIEW OF
ROYAL BEACH CLUB, PARADISE ISLAND,
MASTERPLAN DESIGN


## ATTACHMENT A.

**RBC Masterplan** (5/23/2023) **with annotation of existing shorefront conditions**

11"x17 Sheets: 4 sheets.

olsen associates, inc. | 2618 Herschel Street | Jacksonville, FL 32204 | 904.387.6114 | FAX 904.384.7368
www.olsen-associates.com

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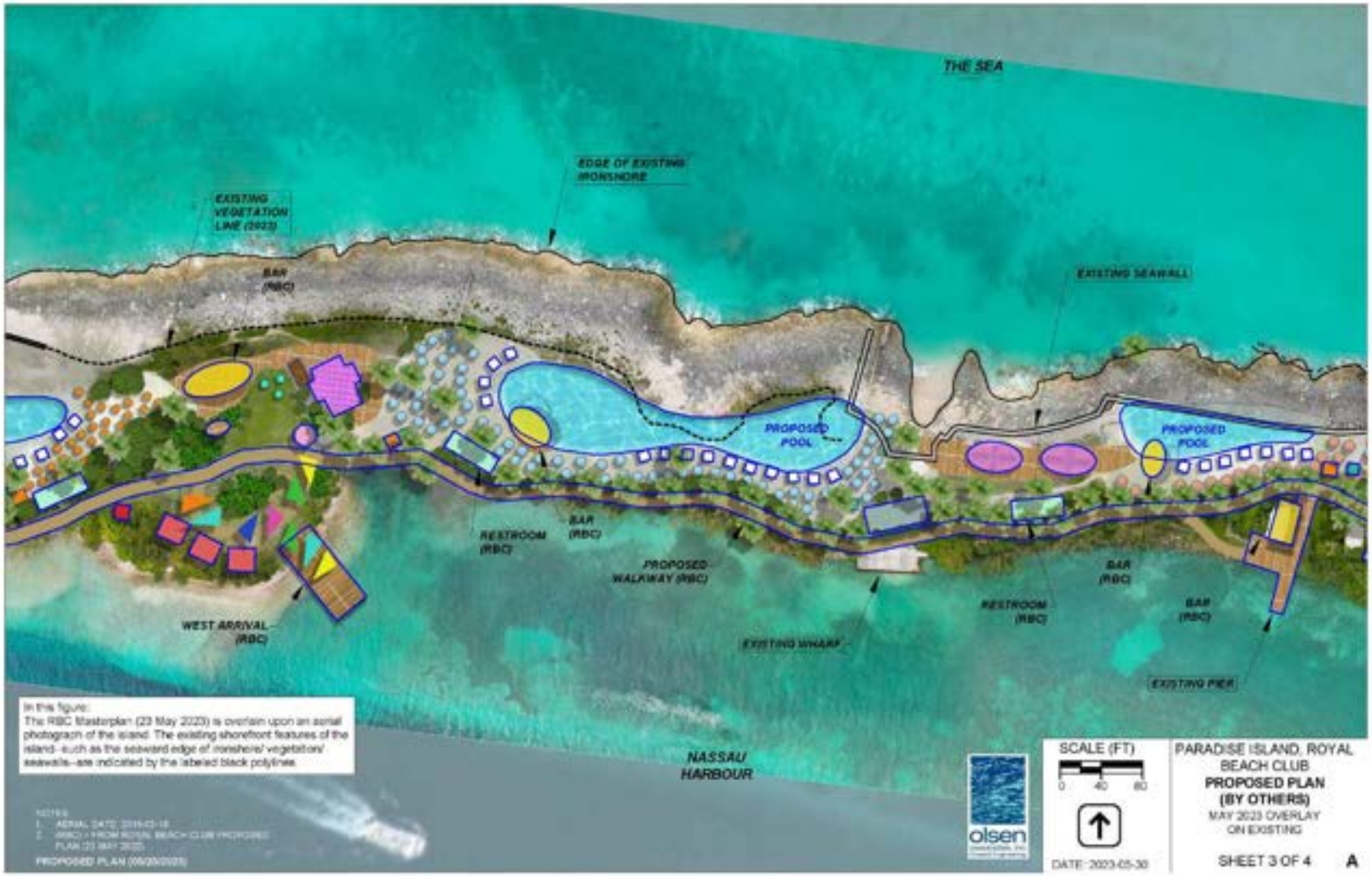
Following sheets are 11"x17".


THE SEA
SHEET 2
SHEET 3
SHEET 4
In this figure:
The RBC Masterplan (23 May 2023) is overlain upon an aerial photograph of the island. The existing shorefront features of the island--such as the seaward edge of ironshore/ vegetation/ seawalls--are indicated by the labeled black polylines.
NASSAU HARBOUR
olsen
SCALE (FT)
0 100 200
DATE: 2023-05-30
PARADISE ISLAND, ROYAL BEACH CLUB
PROPOSED PLAN (BY OTHERS)
MAY 2023 OVERLAY ON EXISTING
SHEET 1 OF 4
A

# ROYAL BEACH CLUB AT PARADISE ISLAND
# SUPPLEMENTAL ENVIRONMENTAL IMPACT ASSESSMENT
# SECTION 7.0


THE SEA
EDGE OF EXISTING IRONSHORE
EXISTING VEGETATION LINE (2023)
BAR (RBC)
EXISTING SEAWALL
PROPOSED POOL
PROPOSED POOL
RESTROOM (RBC)
BAR (RBC)
PROPOSED WALKWAY (RBC)
BAR (RBC)
RESTROOM (RBC)
BAR (RBC)
WEST ARRIVAL (RBC)
EXISTING WHARF
EXISTING PIER
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SCALE (FT)
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DATE: 2023-05-30
PARADISE ISLAND, ROYAL BEACH CLUB
PROPOSED PLAN (BY OTHERS)
MAY 2023 OVERLAY ON EXISTING
SHEET 3 OF 4
A


THE SEA
EDGE OF EXISTING IRONSHORE
IRONSHORE TRANSITIONS TO WALL
EXISTING ROCK REVETMENT
EXISTING SEAWALL (TO BE REMOVED) (RBC)
PARADISE LOOKOUT (RBC)
POOL CABANA, TYP. (RBC)
BAR (RBC)
BAR (RBC)
PROPOSED POOL
ECN
ECN
ECN
EXISTING & LLOYD DOCKS
EXISTING ROCK & TIMBER BREAKWATER
EAST ARRIVAL (RBC)
RESTROOM (RBC)
RAMP (RBC)
PROPOSED WALKWAY (RBC)
EXISTING L-DOCK
NASSAU HARBOUR
In this figure:
The principal shorefront features of the RBC Masterplan (23 May 2023) are traced and overlain upon an aerial photograph of the island. Photo date: 18 March 2016
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SCALE (FT)
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DATE: 2023-05-30
PARADISE ISLAND, ROYAL BEACH CLUB
PROPOSED PLAN (BY OTHERS)
MAY 2023 OVERLAY ON EXISTING
SHEET 4 OF 4
A

COASTAL ENGINEERING REVIEW OF
ROYAL BEACH CLUB, PARADISE ISLAND,
MASTERPLAN DESIGN

olsen
associates, inc.
Coastal Engineering

## ATTACHMENT B.

**Key features of RBC Masterplan** (5/23/2023) **overlaid upon existing aerial photo**

11"x17 Sheets: 4 sheets.

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DATE: 2023-05-30
PARADISE ISLAND, ROYAL BEACH CLUB
PROPOSED PLAN (BY OTHERS)
MAY 2023 OVERLAY ON EXISTING
SHEET 1 OF 4
B


THE SEA
EXISTING VEGETATION LINE (2023)
LIGHT HOUSE LOOKOUT (RBC)
DEVELOPMENT LIMIT
EDGE OF EXISTING IRONSHORE
EXISTING SEAWALL
EXISTING VEGETATION LINE (2023)
BAR (RBC)
B.O.H. (RBC)
BAR (RBC)
PROPOSED POOL
RAMP (RBC)
PROPOSED WALKWAY (RBC)
BEACH CABANA, TYP (RBC)
RESTROOM (RBC)
B.O.H.
NASSAU HARBOUR
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DATE: 2023-05-30
PARADISE ISLAND, ROYAL BEACH CLUB
PROPOSED PLAN (BY OTHERS)
MAY 2023 OVERLAY ON EXISTING
SHEET 2 OF 4
B


THE SEA
EDGE OF EXISTING IRONSHORE
EXISTING VEGETATION LINE (2023)
BAR (RBC)
EXISTING SEAWALL
PROPOSED POOL
PROPOSED POOL
RESTROOM (RBC)
BAR (RBC)
PROPOSED WALKWAY (RBC)
BAR (RBC)
RESTROOM (RBC)
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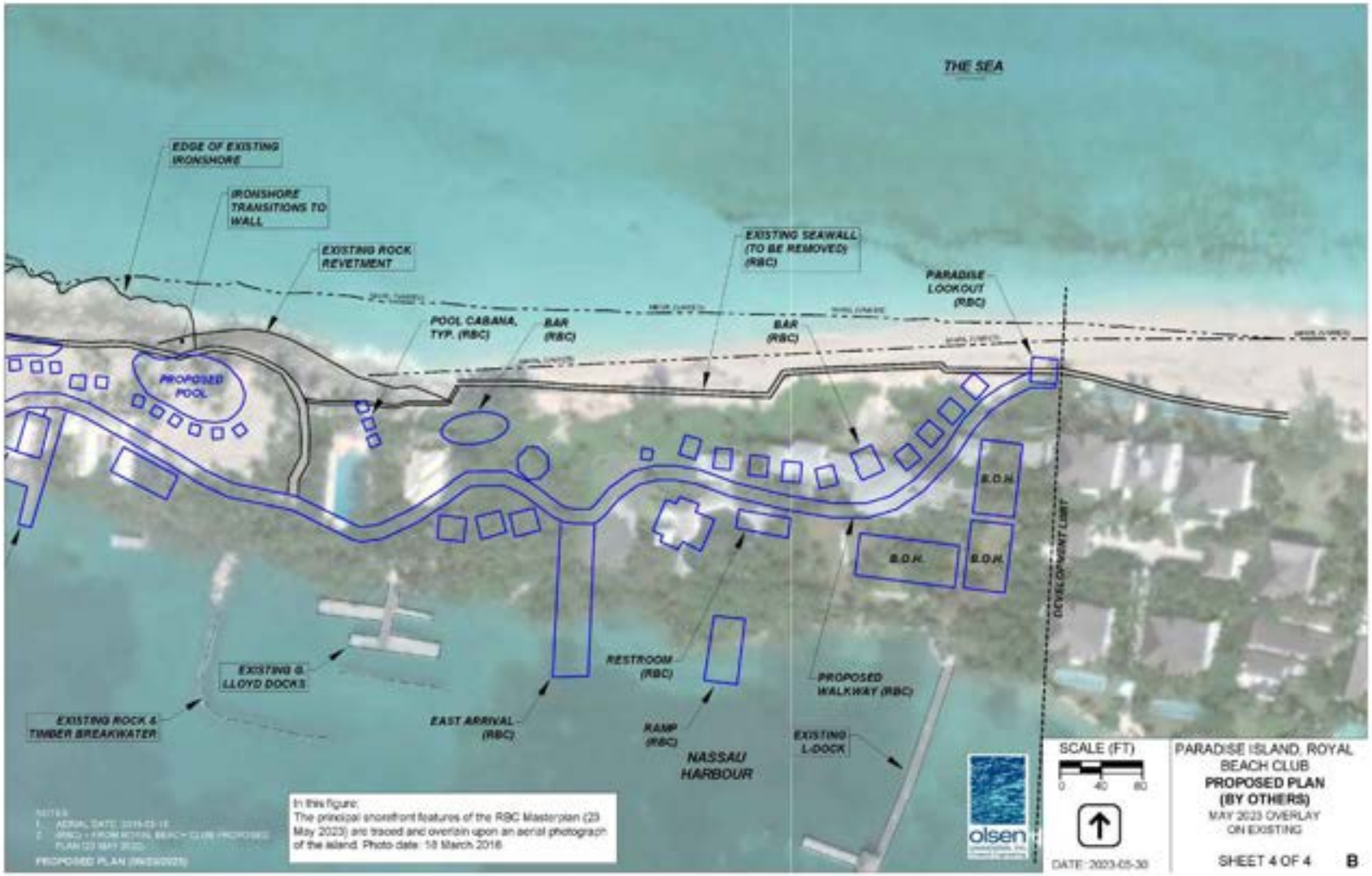
DATE: 2023-05-30
PARADISE ISLAND, ROYAL BEACH CLUB
PROPOSED PLAN (BY OTHERS)
MAY 2023 OVERLAY ON EXISTING
SHEET 3 OF 4
B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B.O.H.
B.O.H.
B.O.H.
DEVELOPMENT LIMIT
EXISTING G. LLOYD DOCKS
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PROPOSED PLAN (BY OTHERS)
MAY 2023 OVERLAY ON EXISTING
SHEET 4 OF 4
B

# 8.0 STORMWATER MANAGEMENT PLAN

## 1 INTRODUCTION

The goal of the Stormwater Management Plan will be to use site specific strategies to protect water quality and prevent flooding, erosion and other negative impacts to buildings, infrastructure and the natural environment and maintain hydraulic balance in each watershed.

### 1.1 STRATEGY

These strategies will include non-structural strategies including but not limited to;

- Limit site disturbance and soil compaction. It is important to minimize soil compaction and site disturbance caused by construction activities. Avoiding compaction increases soil infiltration capacity, maintains a healthy environment for vegetation and preserves drainage ways and natural catchment areas. Site specific strategies for minimizing disturbance through design and construction practices include:
    a. Limit areas of heavy equipment access and staging/storage of materials.
    b. Identify and protect high-quality and environmentally sensitive areas - do not allow any disturbance to take place in these areas.
    c. Identify areas which will be vegetated after construction - avoid disturbance in these areas (clearing, but not grading).
    d. Avoid extensive and unnecessary clearing and stockpiling of topsoil.
    e. Restore soil permeability to compacted areas that occurs during construction.
    f. Place temporary fencing around tree drip lines to avoid destruction of tree roots.
    g. Minimize grading by designing to the existing topography.

- Protect natural and intermittent streams and swales; maintain as natural habitat and site-amenity. Identify, protect, and utilize natural drainage features, such as swales, low areas and watercourses as a means of protecting water quality. This maximizes the site's natural hydrological characteristics, reducing the need for structural management practices and minimizing construction and maintenance costs. Items to consider:
    a. Identify and map natural drainage features (e.g., swales, streams, low areas, wetland, etc.). Use signage and fencing for protection.
    b. Utilize natural topographic/drainage features to guide site design.

c. Prevent erosion of natural drainage features by using upstream volume and rate control practices, such as level spreaders, erosion control matting, check dams, straw rolls, re-vegetation and outlet stabilization.

- Protect and restore buffer areas to promote filtration. Reducing impervious surfaces includes minimizing the dimension or area required for roads, drives, walks and parking. When pavement is reduced, the rate of stormwater runoff is decreased while infiltration is increased. Items to consider;
    a. Plan wide planted buffer zones/setbacks (50' buffers are preferred) around drainage courses, ponds and wetland.
    b. Limit the amount of impervious surfaces and industrial uses allowed adjacent to buffer areas.
    c. Restrict clearing of vegetation within a 100-year floodplain.
    d. Restore buffer areas by revegetating it with native plantings, where possible.

- Reduce impervious surfaces. Reducing impervious surfaces includes minimizing the dimension or area required for roads, drives, walks and parking. When pavement is reduced, the rate of stormwater runoff is decreased while infiltration is increased. Items to consider:
    a. Evaluate traffic volumes and parking requirements taking into consideration average and peak use demand.
    b. Remove unutilized/underutilized impervious coverage.
    c. Consider minimizing impervious road and parking areas by incorporating pervious paving materials, where appropriate.
    d. Use pervious materials for plazas and sidewalks, and bike parking areas, where appropriate.
    e. Reduce setbacks along roads to minimize length of access driveways and approach walks.
    f. Analyze the site to determine if smaller parking spaces, slanted parking stalls, compact car spaces, and narrowed traffic and pedestrian lanes are appropriate.

- Promote overland flow. Promote overland flow (where appropriate) to minimize need to costly infrastructure/reduce downstream impacts. When utilizing overland flow, consideration must be given to prevent erosion, wash-out, and to identify the water flow path that will occur. Water

should be directed away from buildings and sensitive areas to prevent water from entering buildings, entrances, washing out landscaping beds, etc.

- Work with existing terrain. Work with the site's existing terrain to mitigate negative environmental effects. Items to consider:
    a. Orient site surface features (roads, parking, walks, etc.) along existing contours to reduce need for cut/fill operations.
    b. Avoid increasing run-off on adjacent properties, as well as avoid impacting neighboring site overland flow.

## 9.0 BUILDING DEMOLITION PLAN

**1. Demolition Scope**

The project will also include the need for demolishing of existing buildings in an environmentally friendly manner without any significant environmental impacts and pollution on physical, biological and socioeconomic environment of the surrounding areas.

This Demolition Plan will control the requirements for;

- Salvaging non-hazardous demolition and construction waste.
- Recycling non-hazardous demolition and construction waste.
- Disposing of non-hazardous demolition and construction waste.

Non-hazardous waste is defined as Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, paint, or the like.

Hazardous material is defined as Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitability, corrosiveness, toxicity or reactivity, including lead and asbestos containing materials.

**2. Demolition of the identified structures will include the following requirements:**

- Application and receipt of all necessary permits.
- Identification of the disposal site.
- Information for local persons, businesses of timing and demolition process by means of formal written notice and notices on site fences and hoarding.
- Notice to all local utilities and written confirmation that all above and buried services have been terminated.
- The installation of physical site barriers to prevent unauthorized access to site.
- Agreement with relevant local authorities for the scheduling and planning for transportation of debris not to coincide with peak traffic flows. The proposed route will be identified to the demolition contractor.

**3. Performance Requirements**

- The Owner has established that this Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.
- Of the waste that is generated, as many of the waste materials as economically feasible shall be reused, salvaged, or recycled. Waste disposal in landfills or incinerators shall be minimized, thereby reducing disposal costs.

**4. Implementation**

- Implement waste management plan as approved by DEPP.
- Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

**5. Recycling**

- Asphaltic Paving - Asphaltic Concrete Paving: Break up and transport paving to asphalt recycling facility or recycle on-site into new paving.
- Masonry - Remove metal reinforcement, anchors, and ties from masonry. Crush remaining materials and use for fill on site as required.

**6. Disposal of Waste**

Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project Site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

- Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on site.
- Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- Do not burn or bury waste materials on or off site. Appropriate onsite topical application of ground gypsum or wood, or use of site paving as granulated fill is considered reuse, not waste.