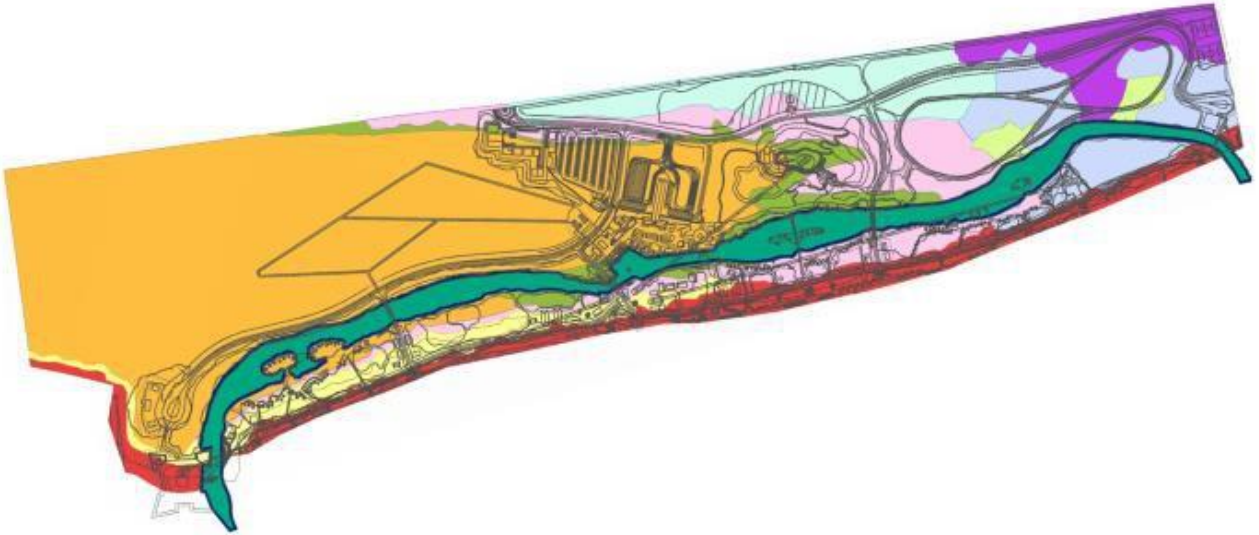




**VEGETATION MANAGEMENT PLAN
CARNIVAL GRAND PORT EMP**



Submitted to:

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Envirologic International Ltd.
6 West Atlantic Dr, Freeport
Grand Bahama, The Bahamas

Submitted by:

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February 7, 2020

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Land Management Recommendations for Terrestrial Habitats During Waterway and Upland Construction

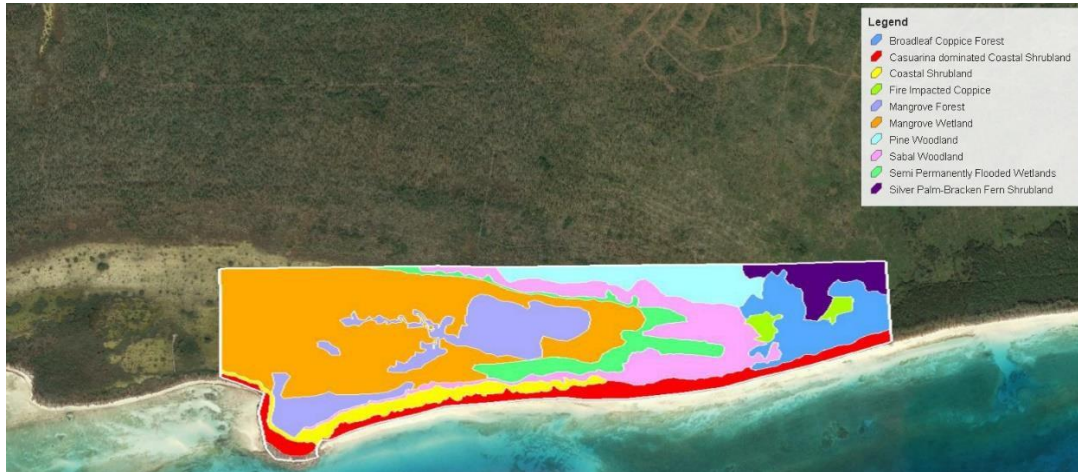
- Invasive Species: Casuarina, Scaevola, Brazilian Pepper are eradicated from the property prior to construction
- Sustainable Management of Forest Resources during Land Clearing: Prior to land clearing activity for roads, construction and/or excavation, a pre-clearance survey to be conducted to determine the impact of clearing activity on protected species (flora and fauna), species of interest and cultural resources. Based upon this pre-clearance survey a comprehensive reforestation program (including long term monitoring) will be prepared in coordination with CGBI's landscape designers who have already prepared a list of plants for landscaping (Appendix V-1). This reforestation program will be based upon GBPA regulations and upon the experience of similar programs carried out in other Carnival ports in the region and submitted to the GBPA for their consideration and determination. A significant portion of The Bahamas' native flora is shared with South Florida, and wholesale native plant nurseries can serve as source stock for native replantings to occur onsite. See Table 3 at the end of this Appendix for information regarding local and Florida Plant Nurseries (Table 4 at the end of this Appendix shows highlighted species which are native to The Bahamas).
- Preservation of key habitat/species for nature walk: Ephemeral wetlands dominated by Pond apple should be preserved where possible due to its unique ecological niche on the property. These microhabitats support a diversity of wetland flora and fauna which thrive in the fresh water collecting in these habitats. Preservation of the endemic *Agave braceana* from areas slated to be disturbed is recommended, as these are hardy species and will transplant readily into the landscape.
- Preservation of Dunes: During invasive species harvesting, and construction of Clam Shells, Cabanas and Bungalows in coastal areas, the vegetation community and dune integrity should be preserved as much as possible to prevent erosion of the dune crest and foredune areas. Heavy equipment utilized for invasive species removal and construction will refrain from walking onto the back of dune, dune crest or fore dune. Minimally invasive methods for boring of wooden pilings and trenches is recommended to reduce impacts on the dune habitats. Some unavoidable disturbances to the dune habitat are expected during invasive species removal and construction, after which restorative activities to replenish eroded sand or disturbed plant communities should be employed.
- Survival Rates of Nursery Grown Species are estimated to be 80-90% and wild harvested species at 50-60%. Newly planted species should receive the supplemental water, organic fertilizer and maintenance for 12-18 months after transplanting. Preserved areas to be monitored throughout the lifetime of the Project Invasive species will be managed throughout the life of the Project.

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Figure 1. Terrestrial Habitat Map of Carnival Grand Port property



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Mangrove Conservation and Restoration

The property has an approximately 14-acre mangrove wetland, which connects to a larger coastal wetland spanning approximately 400 acres along the southern shoreline of the area. The mangrove wetland is naturally a closed system, however during the recent Hurricane Dorian, the southern boundary of the wetland bordering the coastline was breached, and now exists an active exchange between the open ocean and formerly interior mangrove wetland. Other breaches have occurred within the larger mangrove wetland beyond the property boundary.

Figure 2. Breach in mangrove-dune interface along SW corner of the property



Figure 3. Remnant peat deposits and root tips from breach mangrove habitat



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Figure 4. Eroded shoreline between blown out areas of mangrove-dune interface along SW shoreline



Figure 5. Eroded shoreline between blown out areas of mangrove-dune interface along SW shoreline



The breach located on the property serves as a major exchange point for the altered hydrology of the site. Drain patterns within the mangrove wetland indicate a south-westerly flow of surface water through the wetland towards the SW corner of the property. The breach has occurred less than 200 meters from the SW boundary, allowing the natural surface flow of the mangrove to remain intact

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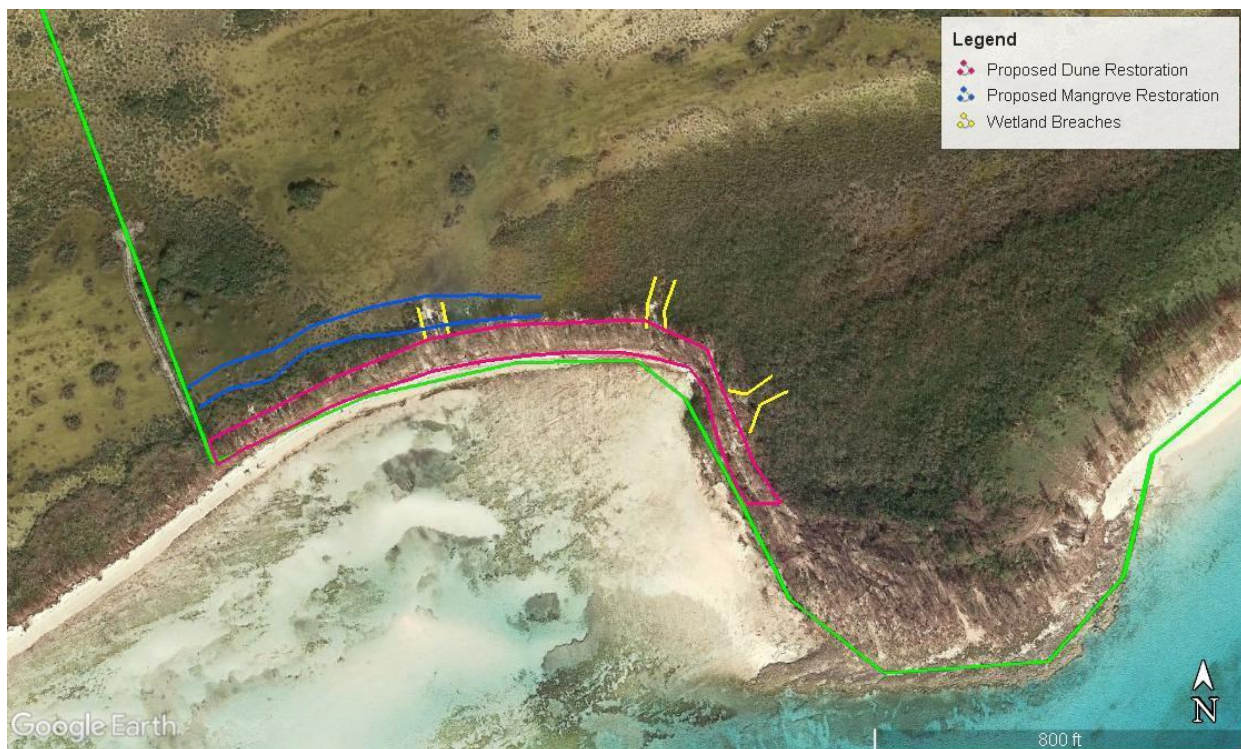
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during outflowing of the wetland at low tide. With the breach as is, there is also infiltration of saltwater from the open sea into the interior wetland during high tides and surge events. The current exchange between the mangrove wetland and open ocean is an exchange of nutrient rich/ low oxygen wetland water with salty/oxygenated seawater.

CGBI will restore the mangrove buffer between the wetland and open ocean. Restoring the wetland to its pre-Hurricane Dorian state would involve restoring the breach and natural hydrodynamics of the site. It would require the creation of stabilized dune systems on the seaward side of the new ridge, and a replanted mangrove forest on the interior wetland side of the new ridge.

Figure 6. Map illustrating breaches areas, and recommended areas for mangrove and dune restoration activities



Direct impacts to the 14-acre mangrove wetland is expected during the construction of the waterway and other site features (Port operations facility, Parking lots, roads etc.). Prior to land filling and grading for construction, efforts to conserve mangrove wetland species should be undertaken to mitigate against the loss of that habitat on the site. A mangrove restoration program (including long-term monitoring) will be prepared based upon the experience of other Carnival Ports in the region (see Appendix V-2 MBCC Mangrove restoration program).

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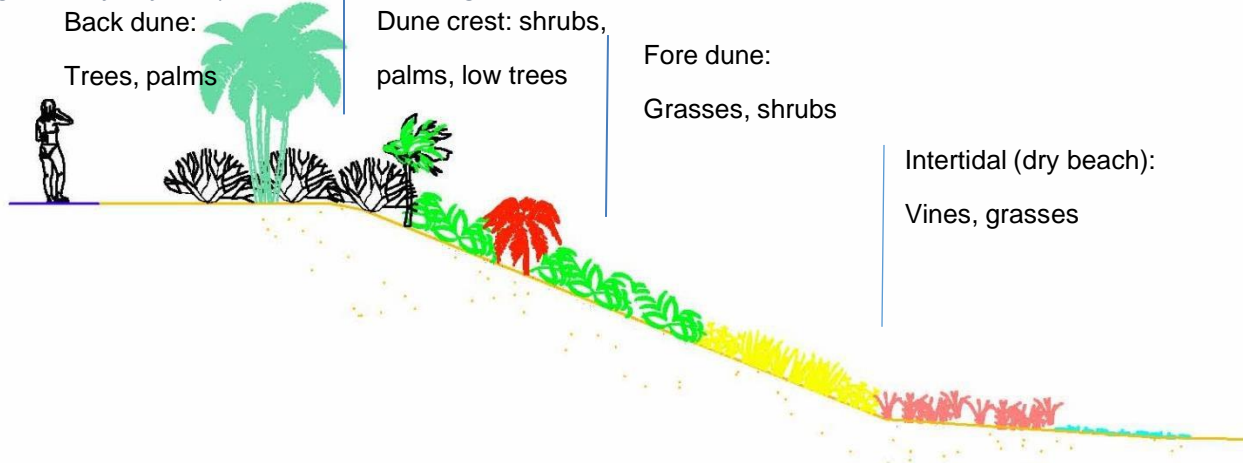
A conservation mangrove wetland area has been designated for the western portion of the property and will not be disturbed during the construction and operations process. The conservation wetland could serve as a source stock for propagules required for the mangrove restoration program as well as a planting site for newly rooted propagules. The red mangrove is found within the wetland, but buttonwood surrounds the perimeter of the wetland.

Red mangrove plantings will be monitored for 3-6 months after propagule plantings to confirm establishment via leaf production and branch growth with an expected survival rate of 70%. Survival rates increase with planting young trees versus propagules.

Dune Plantings and Stabilizing Vegetation

Diversity of dune vegetation is essential to stabilizing ecological and coastal conditions on the property. The root systems of the native plant species vary in their habits and depths reached, enhancing their abilities to consolidate the dunes against erosion. This can be achieved in tandem with a general landscaping plant species that will provide an overall system that is aesthetically pleasing while providing useful advantages such as coastal defense and hydraulic relief/drainage. The use of shrubby and herbaceous dune vegetation is essential to reduce Aeolian (wind-driven) sand transport. Please refer to figure 7 below in conjunction with tables 1 & 2 for recommended dune planting zones and species.

Figure 7. Profile of dune phases and associated vegetation



Dune and Backshore Planting Zones

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Table 1 Native Dune Plant Species

<u>Scientific Name</u>	<u>Common Name</u>
<i>Scaevola plumieri</i>	Inkberry (native Scaevola)
<i>Uniola paniculata</i>	Sea Oats
<i>Ambrosia hispida</i>	Bay Geranium
<i>Strumpfia maritima</i>	Strumpfia
<i>Lantana involucrata</i>	White Sage
<i>Baccharis dioica</i>	Broombush
<i>Salmea petrobioides</i>	Bush Salmea
<i>Sporobolus virginicus</i>	Seashore Rush Grass
<i>Heliotropium curassavicum</i>	Seaside Heliotrope
<i>Ipomoea macrantha</i>	Moon Vine
<i>Ipomoea pes-caprae</i>	Railroad Vine
<i>Jacquinia keyense</i>	Joewood
<i>Opuntia spp.</i>	Prickly Pear
<i>Turnera ulmifolia</i>	Bahamian Buttercup
<i>Crossopetalum rhacoma</i>	Poison Cherry
<i>Suriana maritima</i>	Bay Cedar
<i>Canavalia rosea</i>	Bay Bean
<i>Chrysobalanus icaco</i>	Cocoplum
<i>Cakile lanceolata</i>	Sea Rocket
<i>Coccoloba uvifera</i>	Sea Grape
<i>Yucca aloifolia</i>	Spanish Bayonet
<i>Cocos nucifera</i>	Coconut Palm
<i>Spartina patens</i>	Saltmarsh Cordgrass
<i>Hymenocallis arenicola</i>	Spider-lily

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Table 2 Native General Landscaping Plant Species

<u>Scientific Name</u>	<u>Common Name</u>
<i>Cordia sebestena</i>	Geiger Tree
<i>Capparis cynophallophora</i>	Caper Tree
<i>Urechites lutea</i>	Wild Alamanda
<i>Nerium oleander</i>	Oleander
<i>Jacquinia keyense</i>	Joewood
<i>Turnera ulmifolia</i>	Bahamian Buttercup
<i>Canella winteriana</i>	Wild Cinnamon
<i>Croton linearis</i>	Granny Bush
<i>Bursera simaruba</i>	Gammalamme
<i>Suriana maritima</i>	Bay Cedar
<i>Guaiacum sanctum</i>	Lignum Vitae
<i>Chrysobalanus icaco</i>	Cocoplum
<i>Coccoloba uvifera</i>	Sea Grape
<i>Coccothrinax argentata</i>	Silver Palm
<i>Bucida buceras</i>	Black Almond
<i>Tabebuia bahamensis</i>	Five Finger Tree
<i>Samanea saman</i>	Monkey Pod Tree
<i>Plumeria obtusa</i>	Frangipani
<i>Clusia rosea</i>	Autograph Tree
<i>Thrinax morrissii</i>	Thatch Palm
<i>Swietenia mahagoni</i>	Mahogany
<i>Psychotria nervosa</i>	Wild Coffee
<i>Psidium longipes</i>	Sweet Margret
<i>Piscidia piscipula</i>	Jamaican Dogwood Tree
<i>Sideroxylon foetidissimum</i>	Mastic
<i>Guettarda elliptica</i>	Smooth Velvet-Seed
<i>Guapira discolor</i>	Small Leaved Bolly
<i>Eugenia axillaris</i>	Red Stopper
<i>Eugenia foetida</i>	Spanish Stopper
<i>Chiococca alba</i>	Snowberry

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Invasive Species Management

Problematic invasive species on site include *Casuarina equisetifolia* (Australian Beefwood), *Scaevola taccada* (Hawaiian Lettuce), *Schinus terebinthifolius* (Brazilian Pepper) and *Typha domingensis* (Cat Tail). *Casuarina* and *Hawaiian Lettuce* are mostly restricted to the coastal coppice shrubland and dune vegetation along the southern shore of the property. *Brazilian Pepper* has established populations within the *Sabal Palm* ephemeral wetlands and interior broadleaf coppice, and *Typha* dominates the interior ephemeral wetlands on the property.

Disturbances within vegetation communities provides opportunities for invasive species to colonize these new areas, dominating other species native to the area. The development on the Project continues, it is critical to effectively manage current population of invasive species onsite to prevent further outbreaks into newly exposed areas impacted by construction activities.

The management of invasive species will continue throughout the life of the project. The goal is to eradicate established populations of *Casuarina equisetifolia*, *Scaevola taccada* and *Schinus terebinthifolius* from the coastal ecosystems within 1 year of the Project. Also prevention of further spread of invasive species into new areas on the property Preserved habitat and associated species will be monitored throughout the life of the Project, maintaining 90% of identified keynote species, and maintaining species richness count for the habitat. Installed species will be monitored for 12-18 after planting.

***Casuarina Equisetifolia* (Australian Beefwood) Management Recommendations**

To mitigate against damage to the coastal zone through erosion and suppression of native species, it is recommended that *Casuarina*, *Hawaiian Lettuce* and *Brazilian Pepper* are eradicated from terrestrial habitats on the property. After the recent Hurricane Dorian, it is critical to begin active management of invasive species onsite as soon as possible, as newly disturbed areas risk colonization by these aggressive species, further exacerbating negative impacts on the terrestrial habitats.

Management of the species will require mechanical removal of large and small individuals, chemical control of remaining roots and/or stumps and continued mechanical removal of newly sprouted seedlings throughout the life of the Project.

During management of *Casuarina* in the coastal zone, consideration must be given to maintain the integrity of the existing dune and its associated vegetation. Felling of trees will utilize heavy equipment and chainsaws to remove large trees from the dune system. Heavy equipment will not track directly onto the fore dune, crest or back of dune.

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The Casuarina populations consist of large trees averaging 50ft in height, up to 50cm in diameter, with smaller saplings and seedlings distributed within the native dune vegetation. Large individuals are located throughout the dune system, i.e. along the fore dune, dune crest and back of dune. Removal of large trees from the dune crest and back of dune will be accessed from the existing coastal road on the property.

Large Casuarina trees along the fore dune which have fallen due to the hurricane, or are unable to be accessed by heavy equipment from the coastal road can be moved by the following methods:

- Via felling by chainsaw (depending on their size) and removal of stumps by hand or tow line to pull stumps onto coastal road. Towing felled trees and stumps through the dune crest may damage existing native vegetation.
- by accessing the fore dune and intertidal areas with heavy equipment through a defined path which does not pass through an intact dune, at a defined time in which low tide allows heavy equipment to walk along the flat rocky intertidal zone now exposed on the property's southern shoreline. Proposed access areas are either previously degraded, washed over, or disturbed during extraction of Casuarinas from the dune crest and back of dune. Access areas are to be replenished with beach compatible sand and revegetated with native dune species once clearing of fore dune and intertidal areas are completed.

Chemical Control of Invasive Species

After extraction/felling of trees, any remaining roots or stumps should be fully removed. CGBI's will try to maximize the removal of roots or stumps using mechanical means, but in certain cases could also be treated with Garlon 4 Ultra by a trained applicator. Garlon is a broad-spectrum herbicide for basal stump application in woody species and uses a non-petroleum, seed oil base to reduce environmental impact. See Garlon Product Label below:



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During felling of trees with chainsaws, stumps to be treated with Garlon should be cut flat and level to allow herbicide to soak into wood efficiently.

Use a 20%-30% solution of Garlon 4 Ultra. The solution can be mixed in a spray bottle with a protective chemical seal, or a small backpack sprayer. A paint brush can be used to apply herbicide to cut surface to reduce incidental spread of herbicide to nearby native plants.

Personal Protective Equipment (PPE) should be worn to protect eyes, skin and air passages from exposure to the herbicide.

Be sure cut surface is free from sawdust and wood chip. Apply Garlon directly to cut surface, concentrating on the outer cambial layer of the stump.

It is advised not to apply herbicide during windy and/or rainy conditions to maximize efficiency of the product and minimize accessory damage to surrounding plants through accidental dispersal.

Figure 8. Illustration of cut stump application method for herbicides



Smaller individuals of Casuarina, Scaevola and Brazilian Pepper will not require heavy machinery, and can be managed using hand tools such as machetes, loppers, pickaxes, or a mechanical weed puller.

Cut stumps of saplings are to be treated with Garlon. A paint brush can be used to decrease the chances of incidental spread of herbicide.

Saplings and seedlings mechanically removed by pulling should leave behind no rooted material in the ground.

Regular scheduled removal of seedlings will be required to fully eradicate the species from the site.

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The semi aquatic *Typha domingensis* dominating the ephemral wetlands need to be completely uprooted to eradicate it from these areas. Any remaining portions of the rhizomes will stump sprout and revegetate. Use of chemical control is not necessary as populations can be removed using mechanical means. The resulting organic material is useful for future soil building and composting activities on site.

Management of Woody Debris during Invasive Species Removal

Large volumes of woody material will be extracted from the site in the effort to eradicate invasive species. Considerations for future use of the material as mulch, wood for benches or signage, fuel wood, or as packing material for the creation of dunes and/or the repair of blow out areas along the shoreline.

Large *Casuarina* trees possess a dense, heavy wood, which is very durable when cured correctly. Large trunks can be milled for use of the wood on property for various building or aesthetic purposes. Mulch from the *Casuarina* tree also makes a fine mulch suitable for hiking/nature trail systems.

It is not recommended that invasive material be used for composing and soil building, as the invasive species on site are typically prolific seeders, and can potentially spread viable seeds throughout the site via the composted material. It is especially recommended that all Brazilian Pepper plant material be removed from site and/or incinerated, as this species is especially problematic due to its prolific seeding.

To aid with recovery of some areas of the forest, the accumulated woody hurricane debris should be removed from the understory. Removal of understory hurricane debris will allow light to penetrate through to the forest floor for seed germination and seedling growth. Removal of woody debris will also reduce the amount of fuel wood in the event of wild fires. Wild fires are likely to occur as they are naturally common in Grand Bahama in the Pine Forest. An industrial grade wood chipper on site will aid in disposal of woody hurricane debris. The resulting organic material can be used for soil building and landscaping at later stages of the project.

Areas of the dune system which have been previously degraded, washed over, or blown out could be rebuilt utilizing the large woody trunks of the *Casuarina* trees. The felled trees can be cut into smaller portions using chainsaws, and used as the foundation of a newly built dune ridge. Trunks used in the dune reconstruction will be debranched to avoid seed germination within the dune. The stumps will be covered with sand and graded to match the existing dune system on the property.

Revegetation of the dune with rhizomatic/sprawling species such as *Uniola paniculata* (Sea Oats), *Ipomoea pes caprae* (Railroad Vine) and *Ambrosia hispida* (Bay Geranium) will assist in stabilizing the newly built dune ridge. The *Casuarina* stumps will slowly decay over a period of months, providing a food source for the growing roots of the growing dune vegetation. Seaweed wrack washed ashore can be used to supplement the *Casuarina* logs by providing additional stability and nutrient provision to the dune.

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Table 3. Local and International Native Plant Nurseries

Source/Nursery	Address	Telephone Number	Notes
Leon Levy Native Plant Preserve	Governor's Harbour, Eleuthera, Bahamas	242-332-3811 www.levypreserve.org	source for locally grown native, endemic, rare, and endangered species
Native Tree Nursery, Inc.	Homestead, FL	305-247-4499 http://www.nativetreenursery.com/	wholesale source of field grown and container grown material (see attached plant list with native trees highlighted in yellow)
Green Seasons Nursery	Parrish, FL	941-776-1605 https://www.greenseasonsnursery.com/	Wholesale supplier of coastal and salt tolerant species
Florida Association of Native Nurseries	Florida, USA	https://www.afnn.org/professionals/2	link to wholesale Florida growers list

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Table 4. Species list for terrestrial flora onsite

Family	Genus	Species	Common Name	Habitat
Polypodiaceae	<i>Acrostichum</i>	<i>aureum</i>	Giant Leather Leaf Fern	SW
Scrophulariaceae	<i>Agalinus</i>	<i>maritima</i>	Salt March Agalinus	EW/PW
Agavaceae	<i>Agave</i>	<i>sisiliana</i>	Sisal	CS/CC/CP
Agavaceae	<i>Agave</i>	<i>braceana</i>	Agave	PW
Asteraceae	<i>Ambrosia</i>	<i>hispida</i>	Bay Geranium	IT/SD/CS
Rutaceae	<i>Amyris</i>	<i>elemifera</i>	White Torch	CP
Schizaceae	<i>Anemia</i>	<i>adiantifolia</i>	Pine Fern	PW
Apocynaceae	<i>Angadenia</i>	<i>sagraei</i>	Lice Root	SW/PW
Annonaceae	<i>Annona</i>	<i>glabra</i>	Pond Apple	EW
Primulaceae	<i>Ardisia</i>	<i>escallanoides</i>	Marlberry	EW/CC/CP
Scrophulariaceae	<i>Bacopa</i>	<i>monnieri</i>		EW
Fabaceae	<i>Bauhinia</i>	<i>variegata</i>	Poor Man's Orchid	CS
Blechnaceae	<i>Blechnum</i>	<i>serrulatum</i>	Marsh Fern	EW/SW
Rubiaceae	<i>Borreria</i>	<i>laevis</i>	Buttonweed	CS
Boraginaceae	<i>Bourreria</i>	<i>succulenta</i>	Strongback	CP
Scrophulariaceae	<i>Buchnera</i>	<i>floridana</i>		SW
Burseraceae	<i>Bursera</i>	<i>simaruba</i>	Gum Elemi	CS/CC/CP
Malpighiaceae	<i>Byrsonima</i>	<i>lucida</i>	Guana Berry	EW/SW/PW
Fabaceae	<i>Caesalpinia</i>	<i>bonduc</i>	Nicker Bean	CS/CC/CP
Boraginaceae	<i>Cakile</i>	<i>lanceolata</i>	Sea Rocket	IT/SD
Fabaceae	<i>Calliandra</i>	<i>formosa</i>	White Calliandra	CC/CP
Scrophulariaceae	<i>Capraria</i>	<i>biflora</i>	Goat Weed	CS/SW
Solanaceae	<i>Capsicum</i>	<i>annum</i>	Bird pepper	FI
Celastraceae	<i>Cassine</i>	<i>xylocarpa</i>	Olive-Wood	CS
Lauraceae	<i>Cassytha</i>	<i>filiformis</i>	Love Vine	CS/CC/CP/SW
Casuarinaceae	<i>Casuarina</i>	<i>equisetifolia</i>	Australian Beefwood	SD/CS/SW
Orchidaceae	<i>Cattleyopsis</i>	<i>lindenii</i>		EW/MN
Apiaceae	<i>Centella</i>	<i>asiatica</i>	Centella	EW
Rubiaceae	<i>Chiococca</i>	<i>alba</i>	Snowberry	CC/CP
Rubiaceae	<i>Chiococca</i>	<i>parviflora</i>	Pineland Snowberry	PW
Asteraceae	<i>Chromolaena</i>	<i>odorata</i>	Bitter Bush	FI
Sapotaceae	<i>Chrysophyllum</i>	<i>oliviforme</i>	Satin Leaf	CP
Chysobalanaceae	<i>Chysobalanus</i>	<i>icaco</i>	Coco Plum	CS/CC/EW
Vitaceae	<i>Cissus</i>	<i>tuberculata</i>	Warty Cissus	FI
Cyperaceae	<i>Cladium</i>	<i>jamaicense</i>	Sawgrass	EW/SW
Polygonaceae	<i>Coccoloba</i>	<i>uvifera</i>	Seagrape	CS/CC
Polygonaceae	<i>Coccoloba</i>	<i>diversifolia</i>	Pigeon plum	CP

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Family	Genus	Species	Common Name	Habitat
Polygonaceae	<i>Coccoloba</i>	<i>swartzii</i>	Swart'z Pigeon Plum	CP
Polygonaceae	<i>Coccoloba</i>	<i>tenuifolia</i>	Bahama Pigeon Plum	CP/PW
Arecaceae	<i>Coccothrinax</i>	<i>argentata</i>	Silver Thatch Palm	CC/CP/PW
Combretaceae	<i>Conocarpus</i>	<i>erectus</i>	Buttonwood	EW/MW
Boraginaceae	<i>Cordia</i>	<i>sebestena</i>	Geiger Tree	CS/CC
Celastraceae	<i>Crossopetalum</i>	<i>rhacoma</i>	Poison Cherry	CS
Apocynaceae	<i>Cynanchum</i>	<i>blodgettii</i>		SD/CS
Cyperaceae	<i>Cyperus</i>	<i>planifolius</i>	Coast Cyperus	CS
Cyperaceae	<i>Dichromena</i>	<i>floridanum</i>		SW/PW
Euphorbiaceae	<i>Drypetes</i>	<i>laterifolia</i>	Guiana Plum	CP
Verbenaceae	<i>Duranta</i>	<i>repens</i>	Pigeonberry	FI
Cyperaceae	<i>Eleocharis</i>	<i>cellulosa</i>	Spike Rush	EW
Rubiaceae	<i>Erithalis</i>	<i>fruticosa</i>	Black Torch	CS/CC
Rubiaceae	<i>Ernodea</i>	<i>littoralis</i>	Golden Creeper	SW/PW
Erythroxylaceae	<i>Erythroxylum</i>	<i>rotundifolium</i>	Rat Wood	SW
Myrtaceae	<i>Eugenia</i>	<i>foetida</i>	Stopper	CS/CC/CP
Myrtaceae	<i>Eugenia</i>	<i>axillaris</i>	Stopper	CC/CP
Rubiaceae	<i>Exostema</i>	<i>caribeum</i>	Prince Wood	CP
Sapindaceae	<i>Exothea</i>	<i>paniculata</i>	Butter Bough	CP
Moraceae	<i>Ficus</i>	<i>aurea</i>	Strangler Fig	CP
Asteraceae	<i>Flaveria</i>	<i>linearis</i>		CS/SW
Nyctaginaceae	<i>Guapira</i>	<i>obtusata</i>	Beefwood	CC/CP
Nyctaginaceae	<i>Guapira</i>	<i>discolor</i>	Narrow Leaf Blolly	CS/CC/SW
Rubiaceae	<i>Guettarda</i>	<i>scabra</i>	Velvet Seed	CP/SW
Asteraceae	<i>Gundlachia</i>	<i>corymbosa</i>	Horse Bush	CS
Malvaceae	<i>Hibiscus</i>	<i>rosa-sinensis</i>	Hibiscus	CS/CC/CP
Amoryllidaceae	<i>Hymenocallis</i>	<i>arenicola</i>	Spider Lily	SD/CS
Aquifoliaceae	<i>Ilex</i>	<i>krugiana</i>	Krug's Holly	CS/CC
Convolvulaceae	<i>Ipomoea</i>	<i>pes-caprae</i>	Railroad Vine	IT/SD/CS
Convolvulaceae	<i>Ipomoea</i>	<i>violaceae</i>	Moon-vine	SD/CS/FI
Convolvulaceae	<i>Ipomoea</i>	<i>microdactyla</i>	Wild Potato	FI
Primulaceae	<i>Jacquinia</i>	<i>keyensis</i>	Joewood	CS/CC/SW
Asteraceae	<i>Koanophyllon</i>	<i>villosum</i>	Jackmada	FI
Rhamnaceae	<i>Krugiodendron</i>	<i>ferreum</i>	Iron Wood	CC/CP
Verbenaceae	<i>Lantana</i>	<i>invulcrata</i>	White Sage	CS/CC
Poaceae	<i>Lasciacus</i>	<i>divaricata</i>	Bamboo Grass	CP
Fabaceae	<i>Leuceana</i>	<i>leucocephala</i>	Jumbey	CC/CP
Fabaceae	<i>Lysiloma</i>	<i>latisiliquum</i>	Wild Tamarind	CP/SW
Malvaceae	<i>Melochia</i>	<i>tomentosa</i>	Velvet Leaf	CS/SW

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Family	Genus	Species	Common Name	Habitat
Anacardiaceae	<i>Metopium</i>	<i>toxiciferum</i>	Poison Wood	CC/CP/PW/SW
Rubiaceae	<i>Morinda</i>	<i>royoc</i>	Rhubarb	FI/PW/SW
Myrtaceae	<i>Myrcianthes</i>	<i>fragrans</i>	Naked Wood	CP/SW
Myrtaceae	<i>Myrica</i>	<i>cerifera</i>	Bay-Berry	FI/PW
Primulaceae	<i>Myrsine</i>	<i>cubana</i>		CP
Lauraceae	<i>Ocotea</i>	<i>coriacea</i>	Lancewood	CP
Orchidaceae	<i>Oeceoclades</i>	<i>maculata</i>	African Spotted Orchid	CP
Cactaceae	<i>Opuntia</i>	<i>stricta</i>	Prickly Pear Cactus	CC/CP
Apiaceae	<i>Oxypolis</i>	<i>filiformis</i>	Water Dropwort	EW
Passifloraceae	<i>Passiflora</i>	<i>suberosa</i>	Small Passion Flower	SD
Apocynaceae	<i>Pentalinon</i>	<i>luteum</i>	Wild Allamanda	CS/CC/SW
Polypodiaceae	<i>Phlebodium</i>	<i>aureum</i>	Serpent Fern	CP
Simaroubaceae	<i>Picramnia</i>	<i>pentandra</i>	Snake-Root	CP
Pinaceae	<i>Pinus</i>	<i>caribea var. bahamensis</i>	Caribbean Pine	PW
Fabaceae	<i>Piscidia</i>	<i>piscipula</i>	Dogwood	CP
Plantaginaceae	<i>Plantago</i>	<i>major</i>	Common Plantain	CS
Polypodiaceae	<i>Pleopeltis</i>	<i>polypodoides</i>	Ressurrection Fern	CP
Asteraceae	<i>Pluchea</i>	<i>odorata</i>	Marsh Fleabane	EW/SW
Rubiaceae	<i>Psychotria</i>	<i>nervosa</i>	Wild Coffee	CP
Dennstaedtiaceae	<i>Pteridium</i>	<i>aquilinum</i>	Bracken Fern	FI/PW/SW
Rubiaceae	<i>Randia</i>	<i>aculeata</i>	Box Briar	CS/CC
Apocynaceae	<i>Rhabdadenia</i>	<i>biflora</i>	Mangrove Swamp Vine	EW/MW
Rhizophoraceae	<i>Rhizophora</i>	<i>mangle</i>	Red Mangrove	MW
Areaceae	<i>Sabal</i>	<i>palmetto</i>	Sabal Palm	CS/CC/EW/CP
Goodeniaceae	<i>Scaevola</i>	<i>taccada</i>	Hawaiian Lettuce	CS/CC
Anacardiaceae	<i>Schinus</i>	<i>terebinthifolius</i>	Brazilian Pepper	EW/CC/CP
Fabaceae	<i>Senna</i>	<i>occidentalis</i>	Stinking Pea	FI
Aizoaceae	<i>Sesuvium</i>	<i>portulacastrum</i>	Sea purslane	SD
Malvaceae	<i>Sida</i>	<i>aculeata</i>	Slippery Dick	CS/CC
Sapotaceae	<i>Sideroxylon</i>	<i>foetidissimum</i>	Mastic Tree	CP
Sapindaceae	<i>Sideroxylon</i>	<i>salicifolia</i>	Willow Bustic	SW/PW
Simaroubaceae	<i>Simarouba</i>	<i>glauca</i>	Paradise Tree	CP
Iridaceae	<i>Sisyrinchium</i>	<i>sp</i>		SW
Smilacaceae	<i>Smilax</i>	<i>havanensis</i>	Razor Vine	CS/CC/CP/SW
Solanaceae	<i>Solanum</i>	<i>erianthum</i>	Wild Tobacco	FI
Asteraceae	<i>Sphagneticola</i>	<i>triloba</i>	Wedelia	FI

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Family	Genus	Species	Common Name	Habitat
Verbenaceae	<i>Stachytarpheta</i>	<i>jamaicense</i>	Blue Flower	SD/CS
Scrophulariaceae	<i>Stemodia</i>	<i>maritima</i>	Obeah Bush	SW
Fabaceae	<i>Stylosanthes</i>	<i>hamada</i>	Pencil Flower	SD/CS/FI
Surianaceae	<i>Suriana</i>	<i>maritima</i>	Bay Cedar	CS/CC
Meliaceae	<i>Swietenia</i>	<i>mahagoni</i>	Caribbean mahogany	SW/PW
Bignoniaceae	<i>Tabebuia</i>	<i>bahamensis</i>	Five Finger	CP/PW/SW
Melastomaceae	<i>Tetrazygia</i>	<i>bicolor</i>		CP/PW
Bromeliaceae	<i>Tillandsia</i>	<i>balbisiana</i>	Cuttlefish	EW/MN/SW
Bromeliaceae	<i>Tillandsia</i>	<i>fasciculata</i>	Wild Pine	CP
Boraginaceae	<i>Tournefortia</i>	<i>gnaphalodes</i>	Sea Lavendar	IT/SD/CS
Boraginaceae	<i>Tournefortia</i>	<i>volibulis</i>	Soldier Vine	CS/CC
Anacardiaceae	<i>Toxicodendron</i>	<i>radicans</i>	Poison Ivy	SW/PW
Cannabaceae	<i>Trema</i>	<i>lamarckianum</i>	Pain in Back	CS/CC/FI
Passifloraceae	<i>Turnera</i>	<i>ulmifolia</i>	Bahama Buttercup	SD/CS
Typhaceae	<i>Typha</i>	<i>domingensis</i>	Cattail	EW
Fabaceae	<i>Vachellia</i>	<i>choriophylla</i>	Cinnecord	CS/CC/CP/PW
Boraginaceae	<i>Varronia</i>	<i>bahamensis</i>	Cat's Tongue	SW/PW
Malvaceae	<i>Waltheria</i>	<i>indica</i>	Wooly Buggar	SW/PW
Rutaceae	<i>Zanthoxylum</i>	<i>coriaceum</i>	Hercules Club	CP
Endemic Species	SD-Sandy Dune Community	EW-Ephemeral Wetland	PW-Pine Woodland	
Protected Species	CS-Coastal Shrubland	MW-Mangrove Wetland	CP-Coppice Forest	
Invasive Species	CC-Coastal Coppice	SW-Sabal Woodland	FI-Fire Impacted	

HABITAT KEY: PW – PINE WOODLAND; SD – SANDY DUNE; CS – COASTAL SHRUBLAND; SW – SABAL WOODLAND; IT – INTERTIDAL ZONE; CP – BROADLEAF COPPICE; MW – MANGROVE WETLAND; FI – FIRE IMPACTE

Adaptive Management – Operational Phase

During the operational phase of the development, vegetative cover will be adaptively managed to encourage native, drought resistant assemblages. Removal of exotic species, weed cover and trimming will occur on an ongoing basis through the life of the development. The establishment of shade trees will be encouraged and large specimens will be pruned on an annual basis to minimize the potential for catastrophic damage from hurricanes. Species choice and distribution will be adaptively managed based on the success rate of plantings, with an overall goal to encourage mature greenspace consisting of native vegetation with a minimum use of fertilizer and irrigation.

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APPENDICES

Caribbean Coastal Services Ltd.

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Appendix V-1

EMP - Proposed Landscape Plants - by Area

Grand Port- Freeport , Grand Bahama

Proposed Landscape Plant Palette- General Notes

1. Native plant species shall generally be utilized in wetland and upland natural areas.
2. The plants listed in each of the areas below may be utilized in the various passenger areas as determined by design criteria or site conditions.
3. Additional plant species, not listed below, may be utilized on the project.
4. Plant species, listed as 'prohibited' or 'invasive' in the Freeport Environmental Bylaws shall not be used.
5. If existing, plant species listed as 'prohibited' or 'invasive' in the Freeport Environmental Bylaws shall be removed from the site.

Beach Plant Palette

Existing Trees-partial list

Seagrape	<i>Coccoloba uvifera</i>
Green Buttonwood	<i>Conocarpus erectus</i>
Gumbo Limbo	<i>Bursera simarouba</i>
Sabal Palm	<i>Sabal palmetto</i>

Shrubs and Groundcover-partial list

Seagrape	<i>Coccoloba uvifera</i>
Sea Lavender	<i>Argusia gnaphalloides</i>
Sea Oxeye Daisy	<i>Borrchia spp.</i>
Sea Oats	<i>Uniola paniculata</i>
Beach Lily	<i>Hymenocalis latifolia</i>
Bay Tansey	<i>Ambrosia hispida</i>
Golden Creeper	<i>Ernodea litoralis</i>
Railroad Vine	<i>Ipomea pes-caprae</i>

Waterway Lagoon Plant Palette

Existing Trees-partial list

Green Buttonwood	<i>Conocarpus erectus</i>
White mangrove	<i>Laguncularia racemosa</i>

Gumbo Limbo	<i>Bursera simarouba</i>
Seagrape	<i>Coccoloba uvifera</i>
Silver Thatch Palm	<i>Leucothrinax morrisii</i>
Sabal Palm	<i>Sabal palmetto</i>

Proposed Additional Trees and Palms-partial list

Green Malayan Coconuts	<i>Coco nucifera</i>
Florida Thatch Palm	<i>Thrinax radiata</i>
Silver Thatch Palm	<i>Leucothrinax morrisii</i>

Exotic Trees /plants -to be removed as required

Australian Pine	<i>Casurina spp.</i>
Brazilian pepper	<i>Schinus terebithifolia</i>
Scaevola (exotic)	<i>Scaevola taccada</i> <i>Scaevola naupaka</i>

Shrubs and Groundcover -partial list

Seagrape	<i>Coccoloba uvifera</i>
Cocoplum	<i>Chrysobalanus icaco</i>
Jamaican caper	<i>Capparis cynophallophora</i>

Maidenbush	<i>Savia bahamensis</i>
Sea Lavender	<i>Argusia gnaphalloides</i>
Sea Oxeye Daisy	<i>Borrchia spp.</i>
Sea Oats	<i>Uniola paniculata</i>
Beach Lily	<i>Hymenocalis latifolia</i>
Bay Tansey	<i>Ambrosia hispida</i>

Appendix V-1

EMP - Proposed Landscape Plants - by Area

Grand Port- Freeport , Grand Bahama

Golden Creeper *Ernodea litoralis*
Railroad Vine *Ipomea pes-caprae*

Proposed Additional Planting -partial list

Green Malayan Coconuts *Coco nucifera*

Villages & Recreation Area Plant

Palette

Existing Trees-partial list

Green Buttonwood *Conocarpus erectus*
Gumbo Limbo *Bursera simarouba*
Seagrape *Coccoloba uvifera*
Chicken Toe *Tabebuia bahamensis*
Lignum vitae *Guaiacum sanctum*
Strongbark *Bourreria succulenta*
West Indian Mahogany *Swietenia mahogani*
Hog Cabbage Palm *Pseudophoenix sargentii*
Silver Thatch Palm *Leucothrinax morrisii*
Sabal Palm *Sabal palmetto*

Shrubs and Groundcover -partial list

Seagrape *Coccoloba uvifera*
Cocoplum *Chrysobalanus icaco*
Firebush *Hamelia patens*
Jamaican caper *Capparis cynophallophora*
Locustberry *Brysonia lucida*
Maidenbush *Savia bahamensis*
Crabwood *Gymnanthes lucida*
Wild Allamanda *Pentalinon luteum*
Sea Oxeye Daisy *Borrchia spp.*
Golden Creeper *Ernodea litoralis*
Beach Lily *Hymenocallis latifolia*
Cordgrass *Spartina spp.*
Fakahatchee /gama grass *Tripsacun spp.*

Florida Thatch Palm *Thrinax radiata*

Exotic Trees -to be removed as required

Australian Pine *Casurina spp.*

Muhly grass *Muhlenbergia spp.*

Proposed Additional Planting -partial List

Specimen Trees

Cotton Tree (aka Kapok) *Ceiba pentandra*
Gumbo Limbo *Bursera simarouba*
Beautyleaf *Calophyllum*
'Shady Lady' Olive *Bucida buceras*

Ornamental Palms -partial list

Areca palm *Dypsis lutescens*
Date palm varieties *Phoenix dactylifera*
 Phoenix sylvestris
 Phoenix canariensis
 Phoenix roebelini
Fan Palm varieties *Livistonia spp.*
 Latania spp. Florida
Thatch Palm *Thrinax radiata* Christmas
palm *Veitchia merillii*
Montgomery palm *Veitchia montgomeriana*
Alexander palm *Ptychosperma elegans*

Tropical Ornamental Planting -partial list

Bougainvillea Green Island Ficus
Croton Hibiscus
Allamanda Copperleaf
Arbicola

Appendix V-1

EMP - Proposed Landscape Plants - by Area

Grand Port- Freeport , Grand Bahama

Turf grass - Zoysia , Bermuda, St. Augustine

Wild Dilly	<i>Manilkara bahamensis</i>
Saffron	<i>Chrysophyllum oliviform</i>
Silver Thatch Palm	<i>Leucothrinax morrisii</i>
Hog palm	<i>Pseudophoenix sargentii</i>

Shrubs and Groundcover -partial list

Seagrape	<i>Coccoloba uvifera</i>
Cocoplum	<i>Chrysobalanus icaco</i>
Jamaican caper	<i>Capparis</i>
<i>cynophallophora</i>	
Maidenbush	<i>Savia bahamensis</i>
Black Torch	<i>Erithalis fruticosa</i>
Spanish stopper	<i>Eugenia foetida</i>
Wild Allamanda	<i>Pentalinon luteum</i>
Sea Oxeye Daisy	<i>Borrchia spp.</i>
Beach Lily	<i>Hymenocalis latifolia</i>
Golden Creeper	<i>Ernodea litoralis</i>
Cordgrass	<i>Spartina spp.</i>
Fakahatchee /gama grass	<i>Tripsacun spp.</i>
Muhly grass	<i>Muhlenbergia spp.</i>

Upland Coppice and Pine Flatwoods Plant Palette

Existing Trees -partial list

Yellow Pine	<i>Pinus caribea</i>
Chicken Toe	<i>Tabebuia bahamensis</i>
Gumbo Limbo	<i>Bursera simarouba</i>
West Indian mahogany	<i>Swietenia mahogani</i>
Wild Fig	<i>Ficus aurea</i>
Pigeon Plum	<i>Coccoloba diversifolia</i>

Proposed Additional Planting - native
trees and shrubs only

Wetlands Plant Palette

Existing Wetland and Wet Fringe Plants-partial list

Green Buttonwood	<i>Conocarpus erectus</i>
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Appendix V-1

EMP - Proposed Landscape Plants - by Area

Grand Port- Freeport , Grand Bahama

White mangrove	<i>Laguncularia racemose</i>
Red mangrove	<i>Rhizophora mangle</i>
Black mangrove	<i>Avicennia germinans</i>
Sabal Palm	<i>Sabal palmetto</i>

Shrubs and Groundcover -partial list

Seagrape	<i>Coccoloba uvifera</i>
Cocoplum	<i>Chrysobalanus icaco</i>
Sea Oxeye Daisy	<i>Borrchia</i> spp.
Beach Lily	<i>Hymenocallis latifolia</i>
Golden Creeper	<i>Ernodea litoralis</i>

Proposed Additional Planting -native species only

Exotic Trees -to be removed as required

Australian Pine	<i>Casurina</i> spp.
Brazilian pepper	<i>Schinus terebithifolia</i>

-to be removed as required

Mangrove Restoration Program



The initial operation of the cruise ship port showed that in order to improve navigational safety, a reconfiguration of its Western sector should be carried out. Consequently, for achieving appropriate depths, a portion of this sector was dredged. This required depositing the dredged material in two areas which partially affected mangroves.

In coordination with Honduras' Environmental Authorities, Roatán Cruise Terminal retained the services of BIOTA (a recognized Honduran environmental consulting company) to conceptually develop a Mangrove Restoration Project aiming to fully compensate for the impacts on mangrove population.

This document defined that the area to be replanted should be at least double the area impacted. It also defined those locations in the vicinity of Mahogany Bay Cruise Center having appropriate environmental characteristics to carry out the project, established species to be planted and that the seeds for this project should be procured only from the island of Roatán.

Once the concept was approved by Roatán Cruise Terminal (RCT) and Honduras's Environmental Authorities, RCT started its implementation with its own staff. The initial seeds/propagules were obtained from a healthy mangrove located in an area north of the pier and grown in a nursery before the seedlings were planted in their final location.



Stage 1: The first mangroves were planted in an area located next to the South Pier.

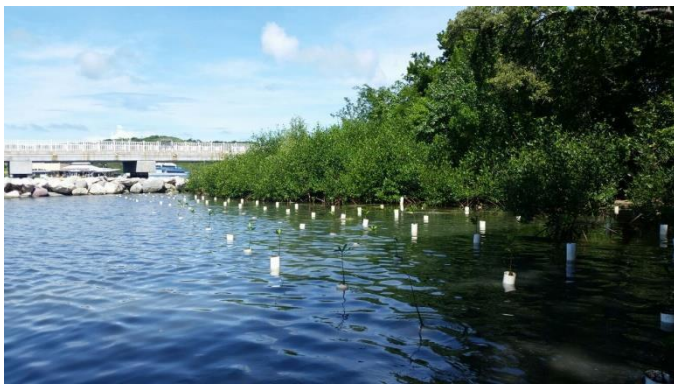
Red mangroves were planted in a small cove located next to the South Pier as well as along the shoreline adjacent to the north pier. In areas subject directly to waves and winds (as in the cove) seedlings were protected by PVC piping which, after the mangroves have "hooked" themselves into the substrate, is cut and removed.



Stage 2: Mangroves after 5 years of being planted. PVC piping has been removed.

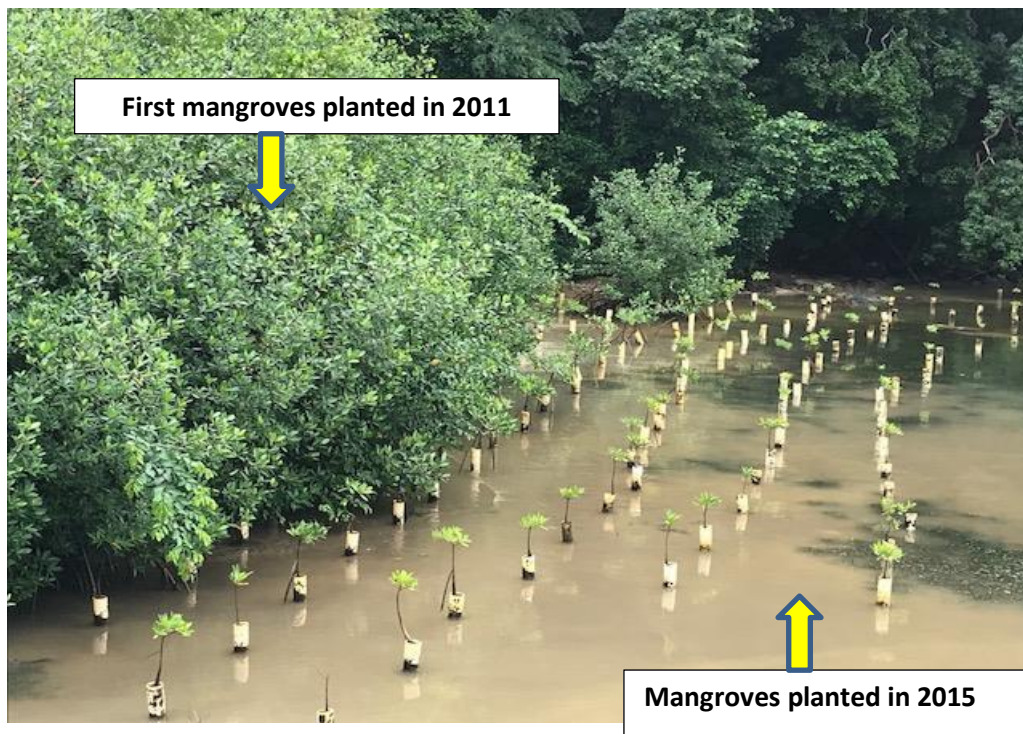
In total, for Stage 1, over 400 red mangroves (*Rhizophora mangle*) and 180 white mangroves (*Laguncularia racemosa*) were planted. White mangroves were planted in areas prone to flooding behind the red mangroves and also in various areas on land.

In 2015, new red mangroves were planted next to the original area of the cove. This time around, Mahogany Bay paired up with a local NGO, BICA (Bay Islands Conservation Association) who provided all the plants. Also, they helped to coordinate local public school students to help out MBCC staff members and planted 3 new sets of mangroves (dates are provided below).



Stage 3: New red mangroves planted in 2015 using the PVC technique.

The image below provides a view of mangroves planted in 2011 and in 2015.



For 2018 and 2019, a new program was developed between Mahogany Bay Cruise Center and the m/s Rotterdam. Environmental Officer Peter Tukker invited crew members of the Rotterdam to join Mahogany Bay and new areas were planted not only in the cove but now, expanding outside of the facilities, in the neighboring community of Brick Bay.



Stage 4: New red mangroves planted in 2018 and 2019 with crew members from M/S Rotterdam and MBCC staff members inside the cove area and neighboring community of Brick Bay.





MANGROVE REFORESTATION PROGRAM TOTALS

Date	Area	No. of mangroves trees planted
July 6, 2011	North Pier, MBCC	164 red 180 white
July 11, 2011	South Pier, MBCC	220 red
January 1, 2013	Cay, MBCC	9 red
March 23, 2015	South Pier, MBCC	45 red
July 17, 2015	South Pier, MBCC	55 red
November 6, 2015	South Pier, MBCC	55 red
May 17, 2016	South Pier, MBCC	30 red
April 25, 2018	South Pier, MBCC	25 red
November 29, 2018	Brick Bay School located near MBCC	40 red
Enero 30, 2019	Brick Bay School located near MBCC	30 red
Marzo 7, 2019	Brick Bay School located near MBCC	20 red
	TOTAL	873

**Approximately 40 red mangroves have been replaced from the pvc pipes because they died. Almost all of the dead mangroves have been replaced with success.*