ENVIRONMENTAL IMPACT ASSESSMENT

Jumby Bay Beach: Silt Removal and Replacement

Antigua, West Indies

Prepared by:
ETC Ltd.
(Environment Tourism Consulting Ltd.)
St. John's, Antigua, W. I.

ENVIRONMENTAL IMPACT ASSESSMENT
JUMBY BAY BEACH: Silt Removal and Replacement

Antigua, West Indies

Submitted to: Michelle Thomas

September 2021

Prepared by:
ETC Ltd.
(Environment Tourism Consulting Ltd.)
P.O. Box W375
All Saints Road
St. John's, Antigua

T/F: +1 (268) 560 5703
M: +1 (268) 764 0304
E: lucia_mings@yahoo.com

ACKNOWLEDGEMENTS

This Environmental Impact Assessment was prepared by ETC Ltd. who wishes to further acknowledge and thank the team of consultants who participated in this study:
Everon Zachariah
Coastal Engineer, CEAS Limited
Ruleo Camacho
Marine Biologist

ETC Ltd. is grateful for the input of:

Conely Browne, Blue Ocean Marine Limited
Department of Environment, Ministry of Health, Wellness and the Environment
Department of Analytical Services

TABLE OF CONTENTS

List of Maps

List of Figures

List of Photos

List of Tables

ENCLOSURES

ABBREVIATIONS

EIA	Environmental Impact Assessment
JBIC	Jumby Bay Island Company Ltd.
DCA	Development Control Authority
DOE	Department of Environment
SLR	Sea Level Rise
SST	Sea Surface Temperature
SIRMZP	Sustainable Island Resource Management Zoning Plan
NPDP	National Physical Development Plan
UNFCC	United Nations Framework Convention on Climate Change
Ha	Hectare
Ft	Feet
M	Metre
MSL	Mean Sea Level
MM	Millimetre
sq. ft	Square feet
ToR	Terms of Reference
NEMMA	North East Marine Management Area
AOI	Area of Interest
PPA	Physical Planning Act
EPMA	Environmental Protection and Management Act
CBD	Convention on Biological Diversity
IUCN	International Union for the Conservation of Nature
CEAS Ltd	Civil Engineering and Associated Services Limited

EXECUTIVE SUMMARY

Jumby Bay Island Company Ltd. submitted two separate applications - an application to the Development Control Authority (DCA) to carry out beach maintenance works on the resort's main beach, Jumby Bay Beach. Both applications were reviewed by the Department of Environment (DOE) which indicated that there was a requirement for further environmental assessment to inform a final recommendation on the project approval. The works specifically include:

1. Removal of 1200 m3 of mucky slimy silt from an area in the nearshore of the beach, then replacing it with coarse sand of larger particle size, sourced from approximately 1000 ft offshore, to improve bathing quality and overall aesthetics. This is captioned in DOE Plan Application Review REF #9/6 F6-Silt Removal.
2. The project proponent also wishes to remove the accreted sand on the south side of the Guest Arrival Jetty on the southern 3rd of the beach and placement of that sand on the northern side as captioned in application #G13 2021.

The project site is located in a mixed use area of the North East Marine Management Area (NEMMA) that is dominated by high end tourism development. The project proponent also notes that historically activities to improve the aesthetics and functionality of the beach and the docking area have been conducted. In 2013 there was an attempt to improve the sand quality at the beach and the company has periodically moved accumulated sand from the jetty area.

The project is made up of the following components:

- The area proposed for removal of silt is 800ft long (north to south) by 40ft wide (west to east), ranging from 20 ft to 40 ft from the shore. The excavation will take place at depths ranging from 0.5m-1.5m. It is proposed that 16 inches (1.5-2ft) or Volume 1200 m3 of silt material will be removed across the dredge site (CEAS Ltd, 2021).
- The proposed area for sourcing the sand is 32,000 square feet (sq. ft) or approximately 0.73 acres or approximately 3000 m2 (CEAS Ltd, 2021).
- The contractor has proposed that the excavated material be placed in a hopper and disposed of at an approved designated offshore disposal site (with coordinates 17 03 00 Lat, 62 01 30 Long).

An area about 1000ft offshore and south of the project site has been proposed as the source of material. ETC will assess this site for suitability and propose alternatives for suitable replacement sand (CEAS. Ltd, 2021).

Jumby Bay Island Company Ltd. submitted 2 separate applications to the Development Control Authority (DCA) to carry out beach maintenance works on the resort's main beach, Jumby Bay Beach. Both applications were reviewed by the Department of Environment (DOE) which indicated that there

was a requirement for further environmental assessment to inform a final recommendation on the project approval. The works specifically include:

1. Removal of 1200 m3 of mucky slimy silt from an area in the nearshore of the beach, then replacing it with coarse sand of larger particle size, sourced from approximately 1000 ft offshore, to improve bathing quality and overall aesthetics. This is captioned in DOE Plan Application Review REF #9/6 F6 -Silt Removal
2. The removal of accreted sand on the south side of the Guest Arrival Jetty on the southern 3rd of the beach and placement of that sand on the northern side as captioned in application #G13 2021.

The project site is located in a mixed use area of the North East Marine Management Area (NEMMA) that is dominated by high end tourism development. The project proponent also notes that historically activities to improve the aesthetics and functionality of the beach and the docking area have been conducted. In 2013 there was an attempt to improve the sand quality at the beach and the company has periodically moved accumulated sand from the jetty area.

ETC was contracted by Jumby Bay Island Company Ltd. to perform environmental impact assessment on both activities in response to the request for information from the DOE and the DCA. No terms of reference was provided by the DCA or the DOE to guide this process, further there was no input from the Fisheries Division as such ETC conducted a rapid screening exercise to inform the scope of the assessment. The major environmental issues were identified related to Marine Ecology and Coastal impacts. As per the PPA 2003 there is also a legal requirement for EIA to be performed for dredging activities . These conclusions were supported by the reviews of the DOE for both project activities. ETC therefore in carrying out the assessment ETC has included a Coastal Engineer and a Marine Ecologist in its team of EIA Specialists. Additionally, the technical expertise of the Department of Analytical Services was used in Microbiological analysis. Annex 1 outlines details of the consultants engaged.

A mixed methodological approach comprising of, desk-based analysis, stakeholder consultation, biological and field studies were used to develop an understanding of the present conditions of the project site and to carry out the assessment. The assessment process resulted in the development of suitable mitigating activities to the identified risks. ETC has also included alternatives to the project design as part of the mitigation strategy. Details on the methodologies applied to the EIA process are provided below.

The main activities to be carried out by this project is dredging. Potential impacts of this dredging activity include increased sedimentation at the removal site, removal of benthic material and organisms and changes to the coastal dynamics and morphology. The activity is also expected to have a positive impact on the aesthetics of the beach and on the function of the hotel. The loss of native seagrass is the major negative impact that has been identified, although this is unavoidable and

irreversible a suite of mitigation measures that offset these impacts have been outlined within Section 6.

The assessment also found that the proposed source material was not appropriate to achieve the desired result, therefore, JBIC has decided to source the sand of the appropriate grain size from Barbuda and that no sand will be sourced from offshore by dredging.

Measures to mitigate against the impacts identified include educating staff on ecologically anchoring and mooring practices; implementing strategies to contain excessive sedimentation on the day of dredging; and implementing a monitoring regime for the ecosystem and coastal morphology periodically to note and respond to any adverse impacts.

The main benefit of this project is that it will allow JBIC to maintain the high quality vacation experience and services its guests have come to expect. Thereby, it should aide their ability to preserve the livelihoods of its numerous employees and sub-contractors, in addition to its overall contribution to the economy of Antigua and Barbuda.

1.0 INTRODUCTION

1.1. Project Proponent

ETC Ltd. was retained by Jumby Bay Island Company (JBIC) Ltd. to undertake this Environmental Impact Assessment (EIA). Jumby Bay Island Resort is one of Antigua and Barbuda's top five-star properties and part of the OETKER Collection which are iconic and one-of-a-kind, properties offering unique and memorable experiences to affluent and astute travelers. It markets itself as an exclusive, private island where pristine, white-powdered sand beaches can be found.

1.2 Project Purpose

Jumby Bay Island Company Ltd. submitted two separate applications to the Development Control Authority (DCA) to carry out beach maintenance works on the resort's main beach, Jumby Bay Beach. The works specifically include:

- Removal of 1200 m3 of mucky slimy silt from an area in the nearshore of the beach, then replacing it with coarse sand of larger particle size, sourced from approximately 1000 ft offshore, to improve bathing quality and overall aesthetics.
- The project proponent also wishes to remove the accreted sand on the south side of the Guest Arrival Jetty on the southern 3rd of the beach and place on the northern side as captioned in application G13 2021.

1.3. Project Description

The project is made up of the following components:

- The area proposed for removal of silt is 800ft long (North to South) by 40ft wide (West to East), ranging from 20 ft to 40 ft from the shore. The excavation will take place at depths ranging from 0.5m-1.5m. It is proposed that 16 inches (1.5-2ft) or Volume 1200 m3 of silt material will be removed across the dredge site (CEAS Ltd, 2021).
- The proposed area for sourcing the sand is 32,000 square feet (sq. ft) or approximately 0.73 acres or approximately 3000 m2 (CEAS Ltd, 2021).
- The contractor has proposed that the excavated material be placed in a hopper and disposed of at an approved designated offshore disposal site (with coordinates 17 03 00 Lat, 62 01 30 Long).

An area about 1000ft offshore and south of the project site has been proposed as the source of material. ETC will assess this site for suitability and propose alternatives for suitable replacement sand (CEAS. Ltd, 2021).

1.4 Project Scope

While it is customary for the DoE to append a Terms of Reference (ToR) outlining its preferred structure of the EIA report, it was not done in this instance. Therefore, the EIA Consultant used standard EIA best practices and knowledge of how the DoE structures its ToRs in the past to develop this document. Therefore, a rapid scoping exercise was conducted utilising the Plan Application Review prepared by the DoE and site visits conducted by the EIA Team.

1.5. Project Benefits

In recent times Jumby Bay Beach has become heavily silted with mud and clay like material. The result of this has been guest dissatisfaction with the declining quality of the beach evidenced by the increased frequency of guest complaints and bad publicity for the resort via negative social media reviews.[1]The direct benefit of the project would be to restore the beach back to its former state of being a white-powdered sand beach, but the indirect benefits should be considered also. Increasing and sustained negative feedback could have knock-on and far-reaching consequences for the long-term viability of the resort. This would place the livelihoods of many locals at risk. Hence, it can be argued that this project is of corporate and national significance.

1.6. Limiting Conditions

Inherent in any EIA are limitations on the content and scope of work included in the report. Predicting future events is not an exact science but may be based on what has happened in the past, impacts that have occurred in similar situations or from scientific literature predicting future impacts such as those from climate change. Any time topography is altered, or natural environments are removed, predictions may be well informed based on extensive modeling, but possibilities for error will remain. Assumptions are made based on the willingness of the Developer to follow mitigation plans, monitoring and recommendations made by this report. There are also assumptions related to the effectiveness of these mitigation efforts in reducing environmental impacts to acceptable levels.

The Project proponent is under immense pressure to improve the conditions at the site prior to the start of the next high season. The project was therefore undertaken over a strict and limited time of 4 weeks consisting of site investigations, technical assessments, and EIA development. Therefore, observations were limited in temporal scale. The NEMMA is a marine protected area which is managed under the Fisheries Act of 2016. At the time of issuing this report the Fisheries Division had not yet provided the required import to the proposed development plan, thus specific considerations, and an accurate depiction of the current circumstances in the NEMMA is not completely captured. Nevertheless, the EIA focuses on the area within the boundaries of the Jumby Bay Beach as shown in Map 1, as well as neighbouring areas of high environmental sensitivity, such as coastal waters. Other limitations include:

- Lack of long-term (10+years) water quality data
- Lack of sediment quality data (contaminants) & load stability (geotechnical)

It is against this backdrop, the EIA aims to understand the possible implications of the project, thus benthic marine, coastal and water quality assessments were commissioned to highlight the existing conditions of the site area and recommendations to address these areas of concern.

I. Risks fugitive sediment may pose to marine life
II. Extraction of seagrass meadows

As the project is located within the NEMMA it, therefore, requires guidance from the Fisheries Division. Although efforts were made to contact the agency, their review of the application was not available at

[1] Personal Communication with the management of Jumby Bay Island Ltd., August 31, 2021

the time of authoring. However, considering time pressures, the developer has decided to proceed with the EIA.

Map 1: Site Location- Jumby Bay Beach (CEAS Ltd, 2021)

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Legislation

The DoE highlighted the following legislation and policies as being of relevance to the project:

- Physical Planning Act 2003
- Environmental Protection and Management Act 2015 (2019)
- Fisheries Act

2.1.1 Physical Planning Act, PPA (2003)

This act makes provisions for orderly and progressive development of and to preserve and improve the amenities within. The act also grants permission for the control of the use of the land as well as the regulations on building construction and other related matters. It is the main legal framework for development of land and planning.

2.1.2 Environmental Protection and Management Act, EPMA (2019)

The Environmental Protection and Management Act (2019) is an act created to protect the natural environment. The Act falls under the jurisdiction of the Minister in charge of the Environment. It states the functions and responsibilities of the Minister, the directors and the powers of the department, the appointment of inspectors and the delegation of powers. Apart from detailing the special powers of the inspectors and directors it also considers the National Environmental Framework – implementation, review or policies and plans, framework for EIA's and compliance. Pollution Control regulations are incorporated in the act as well as pollution sources, pollution control permits, registers on sources of pollution, pollution charges, permits and liability for historical pollution. Environmental Management and monitoring guidelines are provided as well as the management of watersheds and wetlands.

2.1.3 Fisheries Act (2006)

This Act makes provisions for the management and conservation of marine fisheries resources of Antigua and Barbuda, for the registration of local fishing vessels and the designation of Marine Reserves and Fishing Priority Areas and provides rules relative to aquaculture.

2.2. International Conventions and Protocols

As it is necessary to consider the role and responsibility of Antigua & Barbuda as a member of international treaties, compliance with international standards is necessary to maintain the country's status as an active party to these conventions. The values of the following organisations and international agreements were considered during the preparation of this EIA:

- United Nations Framework Convention on Climate Change (UNFCCC)
- Convention on Biological Diversity (CBD)
- Convention on the Prevention of Marine Pollution (MARPOL)
- International Union for the Conservation of Nature (IUCN)
- Kyoto Protocol to the UN Framework Convention on Climate Change
- Specially Protected Areas and Wildlife (SPAW) Protocol to the Cartagena Convention

3.0 METHODOLOGY

The project proponent, JBIC originally submitted a Plan Application #G13-2021 (Appendix 1) to the Development Control Authority (DCA) for "Beach Improvements Works" for the Jumby Bay Beach located on the western coastline of Long Island. As mandated by the Physical Planning Act (PPA) No. 6 of 2003, the DCA referred the application to the Department of Environment (DOE) for its recommendation on approval. Under the same legislation, dredging as the main development activity, involved in both components of the development, automatically triggers submission of an Environmental Impact Assessment (EIA) to inform the DOE's recommendation to the DCA. Based on the Plan Application report DOE-Ref# D.o.E 9/6 F6 Silt Removal (Appendix 2), further information regarding existing environmental conditions, intended operational procedures and potential effects on surrounding areas through a coastal and benthic assessment were pertinent in the decision-making process.

To this end, this EIA was produced with the expertise of EIA Specialists, Coastal Engineer, Marine Biologist, and the technical expertise of the Analytical Services in Microbiological analysis. Annex 1 outlines details of the consultants engaged. Utilising a mixed methodological approach, desk-based analysis, stakeholder consultation, biological and field studies were useful in addressing the requirements of the Terms of Reference which assisted in developing an understanding of the present conditions of the project site and which facilitated development of suitable mitigating activities to the identified risks. Details on the applied methodologies are provided below.

3.1 Coastal and Biological Field Assessments

To identify the current conditions and the potential impacts of the proposed project, a series of biological and field assessments were conducted to include coastal assessment to determine the effects on the coastal dynamics of the site and its surroundings, benthic marine assessment to determine marine environment conditions as well as water quality assessment to document and monitor marine water quality existing and future conditions pre and post development. These studies were carried out using a combination of on-site observations and surveys supplemented by remote sensing, laboratory testing, scuba-diving, snorkeling and data analysis. The findings were then synthesized to identify possible impacts on existing conditions and appropriate mitigation measures.

3.1.1. Coastal Engineering Assessment

The coastal assessment was conducted by Civil Engineering and Associated Services Limited (CEAS Ltd.) using field observations and measurements coupled with information from bathymetric charts and predicted nearshore wave climate. The evaluation of the coastal zone was to determine likely impacts of the coastal processes on the proposed sand replacement works and the likely impact on the coastal dynamics and zone with considerations from a coastal morphological perspective. Following the technical assessments, a report was prepared highlighting further useful information, guidelines, and best practices for achieving required objectives.

I. Sand Replacement

The proposed development therefore envisages the removal of approximately 16 inches of the existing fine sandy silt (CEAS. Ltd, 2021-Enclosure 1) over approximately 800 feet (ft) in length at the central section of the beach from approximately 20 feet (ft) from the shoreline at approximately 40 feet (ft)

wide. This amounted to a total material replacement volume of 1200 m^3 over an area of 3000 m^2. The depth of the water where the sand replacement is to be carried generally varies between 0.5 m to1.5 m. This is not the entire cordoned off swimming area, but the area termed the wade area where one is able to walk in the water.n The depth of the water where the sand replacement is to be carried generally varies between 0.5 m to1.5 m. This is not the entire cordoned off swimming area, but the area termed the wade area where one is able to walk in the water.

The characteristics of the replacement sand has not been specified, however an approximate location of the proposed mining site at 1000 feet (ft) from the shoreline in a perpendicular direction was provided. Samples 3,4,6 identified in (CEAS. Ltd, 2021-Enclosure 1) were collected from the proposed mining area and laboratory sieve analysis conducted to determine particle size. It was therefore concluded that there is no suitable sand to any significant extent from which the required sand could be mined at the said location.

II. Extraction, Disposal and Replacement

Based on consultation with the marine contractor, the intention is to use an excavator mounted on a barge to excavate between 1.5 to 2 ft. of the existing material located approximately between 20 ft. from the shoreline to 60 ft from the shoreline. The excavated material will then be placed in a hopper and disposed of at the approved designated offshore disposal site with coordinates 17 03 00 -Latitude and 62 01 30 -Longitude [St. John's Deep Water Harbour Port Environmental Impact Assessment- 15th November 2017] (CEAS, Ltd, 2021). This method of disposal is in keeping with the agreed disposal methodology and location and prevents the fines excavated from contaminating or "siltizing" the replenished sand, thereby fostering the development of the mushy/ slimy feel as currently exists (CEAS. Ltd, 2021).

Suitably sized sand would then be mined offshore of the beach and be transported to the nearshore area where the sandy silt was removed (CEAS.Ltd, 2021). The depth of sand to be mined would be kept to a minimum (1 ft.) while using a larger area 4,500 m^2 to produce the required volume. By keeping the depth of the mined sand to a minimum, the expected effects of dredging activity will be minimised (CEAS.Ltd, 2021). Suitably sized sand was identified on the southern end of Long Island approximately 1.5 km away, adjacent to the channel between Long Island and Maiden Island. Alternatively, it is recommended the replacement sand be imported by barge from Barbuda (CEAS.Ltd, 2021).

Findings from observations, scuba-diving and data analysis shows the latter is preferred as the sand shape is more spherical and contains less silt. The replacement process is expected to be conducted in a timely manner, thereby minimizing the likelihood of any natural movement of silt to fill the temporary cavity produced during removal (CEAS.Ltd, 2021). It was elaborated within the coastal assessment that the hopper will be used for the offshore disposal and sand replacement if the sand is being mined locally. However, if the sand is imported from Barbuda, another barge may be commissioned as the sand would be required immediately after the excavation is completed (CEAS.Ltd, 2021). Samples of appropriate sand particle sizes were collected from beaches which provided the beach feel and water clarity that JBIC is trying to achieve. The grain size analyses for these are presented in Appendices 1,2, 3 & 4 of CEAS.Ltd (2021) is very similar to the sand currently found onshore.

III. Sand Bypassing

The quantity of sand to be relocated was not indicated. However, estimations from onsite observations suggest that an area of approximately 100 m^2 could be removed immediately along the south side of the dock (CEAS.Ltd, 2021). The depth of sand to be removed is dependent on the location and is estimated to vary from 0 up to a maximum of 1 m (CEAS. Ltd, 2021). The total volume of sand to bypass the jetty is estimated to be in the region of 50 m^3 which is a relatively small volume.

3.1.2 Coastal Analysis

A Storm Surge Atlas was developed by The Caribbean Institute for Meteorology & Hydrology for USAID/ OAS Caribbean Disaster Mitigation Project October 1999) to assist in providing nearshore parameters for analysis and design. This Atlas provides Storm Surge levels at various locations around the Coastline for various storm intensities/ return periods. Similar wind and wave probabilistic charts were developed by PDGM (May 2001) for USAID. Relevant data was then extracted regarding nearshore wave climate, which assisted in determining the findings of the coastal assessment.

Table 1: Wave Probability (CEAS. Ltd, 2021)

Probability of Occurrence	Wave Height	Storm Surge	Wind Speed
10 %/ year/ 10 year return period	1.5 m	0.5 m	30 m/s
4%/ year/ 25 year return period	1.7 m	0.9	38 m/s
2%/year 50 year return period	1.8	1.2	44 m/s
1 % / year / 100 year return period	2.0	1.6	49 m/s

The data in Table 1 above indicates that the waves during the conditions specified can approach the shoreline and will cause erosion, resulting in the sand onshore and in the surf zone (extended surf zone) being transported offshore (CEAS. Ltd, 2021).

3.1.3 Benthic Marine Assessment

I. Seagrass Surveys

To confirm the primary benthic habitat, desk-based analysis concluded the dominant habitat as seagrass. To corroborate these findings, an assessment of seagrass was adopted based on a formal protocol via scuba-diving developed by the Marine Ecologist. This same method has been used to assess seagrass in the Nelson Dockyard National Park. Photo 1 shows the equipment used to conduct these surveys.

Photo 1: Equipment used to Conduct Seagrass Surveys (Camacho, 2021)

The following steps outlines the developed protocol in Camacho (2021):

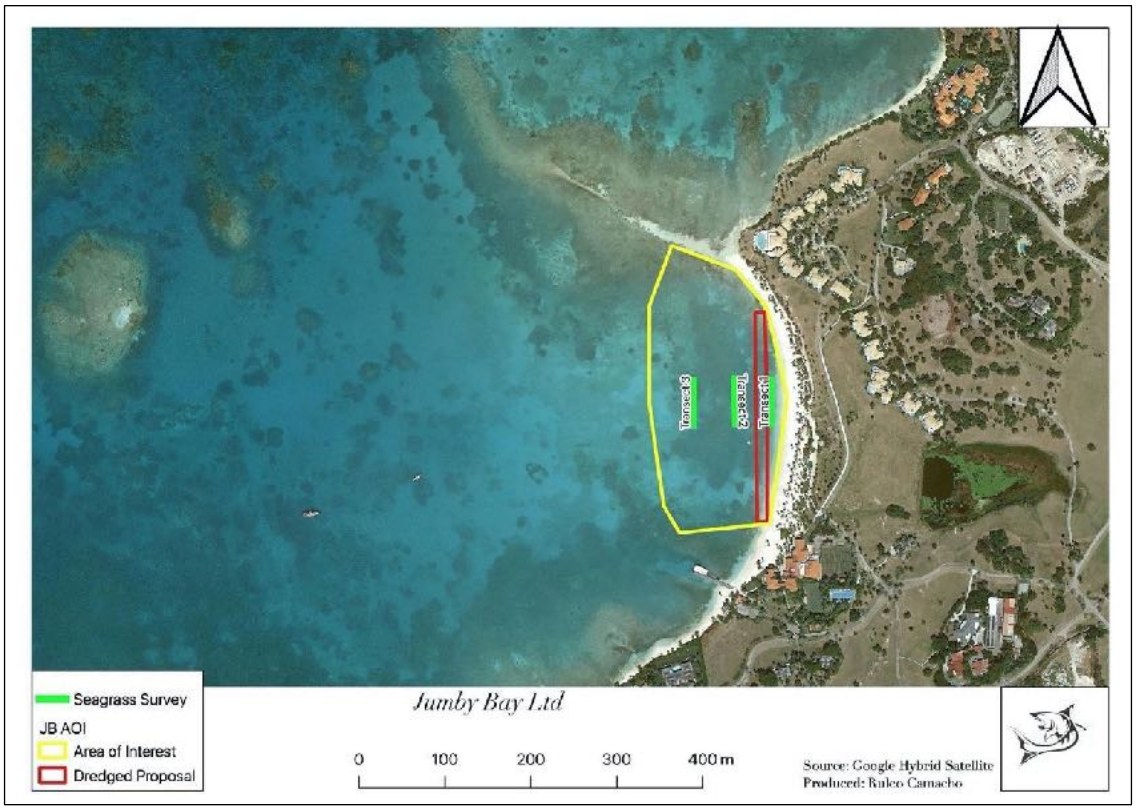
1. A 50 m transect was positioned along the seagrass bed parallel to the shore where possible and the following recorded within a 1m belt on either side of the transect:
    - # Of conch (adult and juvenile)
    - # Of urchins (differentiate by species)
    - # Of sea cucumbers
    - # Of other fauna (upside down jellyfish, starfish, etc.)

2. Approximately every 5 m (starting at 0m) at alternating sides along the transect tape using a 1-meter squared quadrant, the following were measured and recorded:
    - % Cover of Seagrass, live coral, sand, other (specify if possible).

** Living fauna were ignored, but organisms beneath were recorded. **
** If invasive species of seagrass were found, the % cover was measured and % cover of other species of seagrass for comparison**

    - Abundance and species richness of Seagrass within the quadrant
    - Average canopy height of Seagrass to the nearest mm

3. The above processes were repeated to obtain at least 3 transects per survey site, at progressively shallow depths, for example 7 m, 5 m, and 3 m.
4. Each transect was separated by 130-150ft (39-46m) to capture the ecological characteristics of the area of interest specified in Map 2.



Map 2: Site Area for Seagrass Surveys (Camacho, 2021)

5. The data was transcribed from under-water sheets to Microsoft Excel and analysed

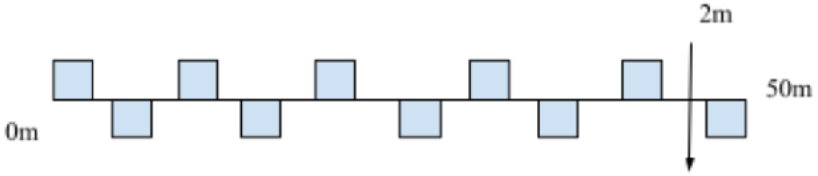


Figure 1: Visual Representation of Seagrass Survey Methodology (Camacho, 2021*)*

Transect 1 was conducted nearest to the shore, in an average depth of 3.5ft (1m). Transect 2 was conducted adjacent to the swim platform in the swim area at 6ft (1.8m). Transect 3 was executed beneath the swim line, and the depth average was 5.5ft (1.7m). Photo 2 shows how this was conducted.

Photo 2: Example of Quadrant positioning showing Manatee Grass dominating the transect area (Camacho, 2021)

II. Coral Surveys

Coral surveys were then used to assess and understand the ecological condition of the coral reef areas within proximity of the project site. These surveys were conducted using the photo-transect methodology and in-situ assessment of coral reef sites to the west of the study sites. The following protocol in Camacho (2021) was used:

1. A 10m transect was positioned along the reef area and where possible, a lead line used to reduce movement that would cause damage to the coral reef environment

2. Using a measuring tape and a tripod pole, the substrate was placed at a distance where a width of 50cm was visible in the camera frame.

3. Using an 'Olympus TG-6' camera, sequential photos were taken along the left of the 10m line, ensuring that there is minimal overlap between pictures. This was performed along both sides of the transect line and a photo-transect survey conducted covering $10m^{2.}$

4. Photos were processed using the 'Coral Point Count' program with excel extensions (6)

    - Ten (10) points were randomly assigned to each picture. The substrate type under each point was identified using a substrate code, then submitted for processing

5. Using Microsoft Suite, the final analysis was conducted, and graphical representations of the data produced.

III. Other Marine Checks

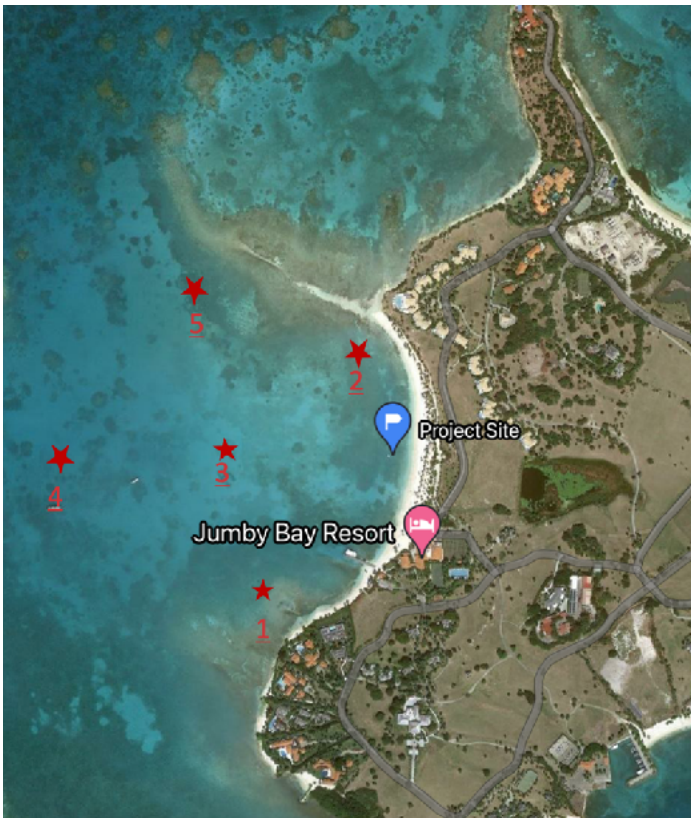
To better understand the marine environment of the surrounding area, additional “spot-checks” were conducted around the site via snorkelling and dominant benthic characteristics recorded using the data collection method. Through observations and GPS recordings, the following parameters were used to document the findings and are detailed in Section 5.0.

- Location
- General and Faunal Observations
- Depth (ft)

3.1.4 Water Quality Assessment

The ETC team commissioned The Department of Analytical Services within the Ministry of Agriculture, Lands and Barbuda Affairs to perform water quality sampling within the site area to establish a baseline of existing marine quality conditions. Snapshot Samples were taken in five (5) sites, three (3) times over a three (3) week period in Map 3 to establish baseline measurements for possible impact zones for fugitive material to decipher a holistic picture of the water quality within the bay. The results from the sampling process were recorded and will be reviewed in the future to measure the effects of the proposed dredging activities upon the quality of the marine environment. Follow up sampling will be conducted to deduce this. During the surveys a sampling rod with a polycarbonate bottle attached was immersed one foot below the water’s surface; in the direction of the flowing water to prevent contamination. The parameters tested included:

- Temperature (C)
- pH
- Turbidity (NTU)
- Salinity (%)
- Phosphate (ppm)



Map 3: Marine Water Sampling Sites (Google Maps, 2021)

3.2 Desk-Based Analysis

To arrive at the content and conclusions within this EIA, documents such as historic technical studies and reports relating to the site and surrounding areas were critically appraised to determine existing circumstances. Additionally, assessment of maps, charts, unpublished technical materials were also utilised to supplement an understanding of baseline conditions. This collection of information was thereby supplemented by professional expertise and literature review.

3.3 Stakeholder Consultation

Through inception meetings with the client, public and private sector actors, and commercial stakeholders, relevant information to inform EIA design, dredging methods, and issues regarding general implementation were received via liaising with relevant parties.

3.4 Sand Bypassing

There was no biological analysis for the sand bypassing as there is no biological content within the sand.

4.0 Analysis of Alternatives

4.1 No Action

The beach is currently heavily silted with slimy mud and clay like material. The result of this has been guest dissatisfaction with the declining quality of the beach evidenced by the increased frequency of guest complaints and bad publicity for the resort via negative social media reviews. The no action alternative will result in a further decline in the satisfaction of guests and negative impact on the tourism product.

4.2 Alternate Sand Source

Originally the developer proposed that the source of alternative material be an area approximately 1000ft away from the dredge site. ETC conducted analysis of the sediment quality and determined that the material available from benthic sources in the vicinity of the site were not appropriate for use as replacement as the grain size was too small. For the desired aesthetic improvements to be achieved, it is recommended that sand with a D_{50} particle size of 0.3 to 0.4 be used in the sand replacement. Unfortunately, the only available source of sand of these qualities is that sourced from Barbuda. It is therefore recommended that sand from Barbuda be used. Alternatively, the developer may seek to source sand with a D_{50} particle size of 0.3 to 0.4 from other regional sources. However, in the event this option is selected there would be resulting delays in the project due to the requirement for additional biological analysis of the source material.

4.3 Disposal of Dredged Material

Originally the developer proposed to transfer the dredged material to trucks for transportation to an undisclosed on shore site. However, during the assessment consultations were conducted with the contractor and it was agreed that the following alternative would be used for dredge disposal. The excavated material is to be placed in a hopper and disposed of at a previously used the approved designated offshore disposal site used for disposal of material from the ongoing deepwater harbour project (with coordinates 17 03 00 Lat, 62 01 30) Long[2] (CEAS. Ltd, 2021).

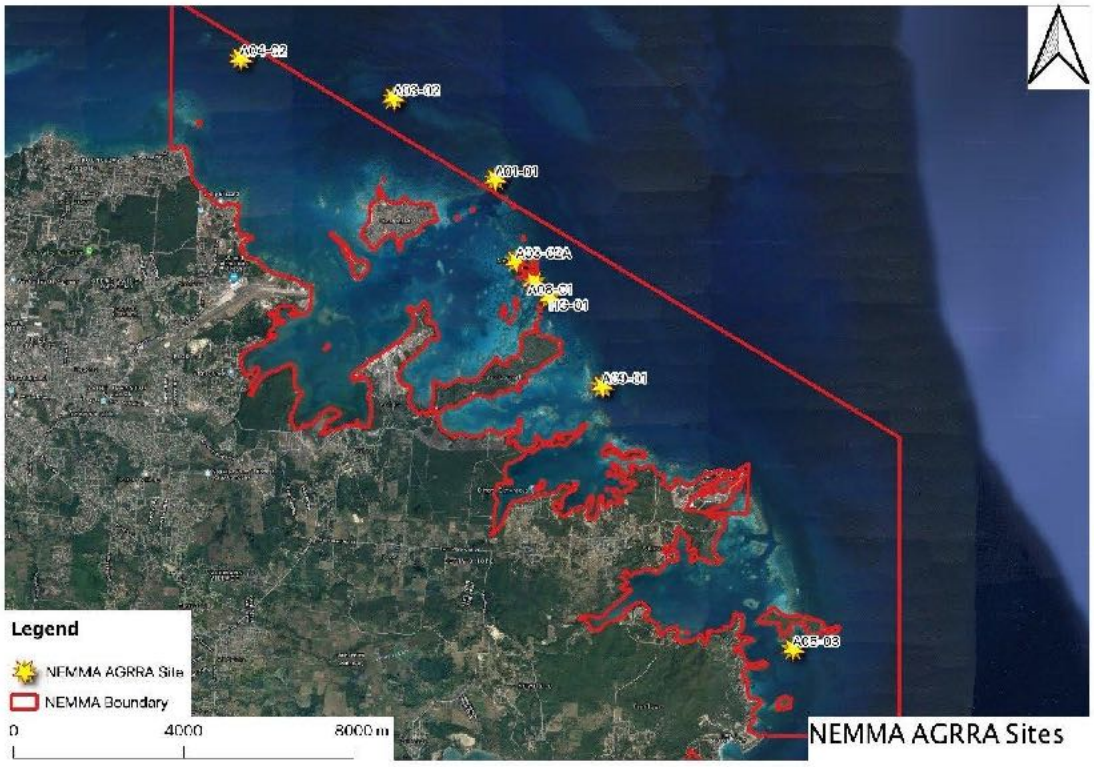
The excavated material is to be placed in a hopper and disposed of at the approved designated offshore disposal site (with coordinates 17 03 00 Lat, 62 01 30) Long. This method of disposal is in keeping with the agreed disposal methodology and location and prevents the material excavated from contaminating or “siltizing” the replenished sand, thereby fostering the development of the mushy/ slimy feel as currently exists.

[2] St. John’s Deep Water Harbour Port Environmental Impact Assessment- 15th November 2017

5.0 Baseline Site Description

Antigua and Barbuda currently have four declared Marine Protected Areas (MPAs), the oldest, Diamond Reef and Palaster Reef were declared since 1973 as no-take reserves for the purpose of fisheries conservation. Cades Bay Marine Reserve (CBMR) and the North-East Marine Management Area (NEMMA) were declared in 1999 and 2005 respectively as larger, multiple use MPAs that include both coastal systems such as wetlands, mudflats, and beaches as well as marine habitats including seagrass beds and coral reefs. The NEMMA is currently legally protected by the Fisheries Act 2016 under the jurisdiction of the Fisheries Division (ECL, 2007).

This NEMMA is known for its high economic value, hosting many industrial and tourism related activities contributing to the overall economy of Antigua & Barbuda. Map 4 showcases the extent of the NEMMA boundary. The NEMMA consists of numerous offshore islands, approximately 13 of which are privately owned and uninhabited except for Long Island which is home to luxury villas and the famous Jumby Bay Island Resort. This section discusses the "Project Site" at hierarchical spatial scales to include the overarching historical circumstances of the NEMMA and the specific existing conditions of the area of interest at Jumby Bay Beach shown in Map 5.



Map 4: Map Showing NEMMA Boundary (Camacho et al., 2020)

Map 5: Area of Interest (Blue Ocean Ltd, 2021)

5.1 North East Marine Management Area (NEMMA)

The NEMMA comprises about 10,475 hectares of rich marine and coastal areas in the north-eastern coastline of Antigua spanning over 30 square miles. including 28 named offshore islands. The NEMMA also includes numerous archaeological and historical sites. The NEMMA was officially declared a marine reserve in 2005 under the 1983 Antigua and Barbuda Fisheries Act (Cap 173, section 22) although it was already recognised informally as a "reserve" for years before. The management of the NEMMA is delegated to a not-for-profit company, the NEMMA Management Partnership, composed of government agencies and statutory bodies, the private sector, community groups and NGOs such as the Environmental Awareness Group (EAG).

NEMMA was designated as a Marine Managed Area (MMA) in 2005 under the 1983 Antigua and Barbuda Fisheries Act, Cap 173. It encompasses an area of 30 sq-miles (77.7km2) at the North-Eastern side of the mainland and is the largest MMA in Antigua & Barbuda. A management plan was created for the NEMMA region in 2008 which detailed the objectives and the scope of the area. NEMMA is recognized as a globally "globally significant research and conservation site as a refuge for endemic, rare and globally important wildlife including the critically endangered Antigua Racer Snake *(Alsophis antiguae*), the Hawksbill Turtle (*Eretmochelys imbricata*) and the vulnerable West Indian Whistling Duck (Dendrocygna arborea). This management plan is however in need of review to better address the needs of the area.

The extensive coastal area within the NEMMA has a long history of multiple uses; relatively calm waters and various offshore islands have long attracted recreational boaters, for both day trips and overnight excursions. Residents from bordering communities such as Seatons and Parham regularly ply the protected waters and shallow reefs in small-scale fishing efforts, joined in recent time by modernised sport fishing and fly fishing enthusiasts. A soothing seascape interrupted by rugged coralline islands and very little else has attracted surging numbers of tourists each year, arriving on several day charter tour boats. Anchorages in the vicinity of Non-Such Bay and Great Bird Island have also become attractive among the yachting community.

In addition to the local communities bordering the NEMMA, small residential areas also exist on some offshore islands. Long Island is home to the Jumby Bay hotel and residences, while Maiden Island and Pelican Island are privately owned and currently under development. Guiana Island, the largest land mass within the NEMMA has been the site of several development proposals, often met with public controversy owing to the extensive local use of the area and the grand scale of the proposed developments.

The NEMMA is also recognized as a globally significant research and conservation site as a refuge for endemic, rare and globally important wildlife including the critically endangered Antiguan racer snake (*Alsophis antiguae*), the hawksbill turtle (*Eretmochelys imbricata*), and the vulnerable West Indian whistling duck (Dendrocygna arborea). Consistent research, habitat restoration, and awareness-raising have been the cornerstones of over a decade of internationally supported conservation efforts on this site.

Encompassing over 30 square miles rich in coastal and marine resources, the North East coast has been brought into sharp focus for management agencies. From an ecological perspective, the offshore islands offer a living laboratory, serving as indicators to allow for the measurement of changes that have affected local conditions and the rest of the Caribbean over time. Economically speaking, and provided that sustainable use is practiced, the areas resources can provide a viable source of income for local fishery and tourism sectors, as well as a playground for local recreationalists. In August 2005, the NEMMA was declared a Marine Reserve under the 1983 Antigua and Barbuda Fisheries Act, Cap 173, in accordance with section 22 (1). This legislation was welcomed by many groups, in fact many users referred to the area as a “park” or “reserve” for years before the designation became official.

5.1.1 Demographics

Based on CIA World Factbook (September 2021), the following statistics are reflective of the most up to date national demographics of Antigua & Barbuda.

Population: 99,175 (July 2021 est.)
Ethnic Groups: African descent 87.3%, mixed 4.7%, Hispanic 2.7%, White 1.6%, other 2.7%, unspecified 0.9% (2011 est.)

AGE STRUCTURE

0-14 years: 22.52% (male 11,243/female 10,871)

15-24 years: 16.15% (male 7,891/female 7,961)
25-54 years: 41.68% (male 18,757/female 22,167)
55-64 years: 10.74% (male 4,693/female 5,848)
65 years and over: 8.91% (male 3,736/female 5,012) (2020 est.)

MEDIAN AGE
Total: 32.7 years
Male: 30.7 years
Female: 34.4 years (2020 est.)

POPULATION GROWTH RATE
1.17% (2021 est.)

BIRTH RATE
15.3 births/1,000 population (2021 est.)

DEATH RATE
5.63 deaths/1,000 population (2021 est.)

NET MIGRATION RATE
2.06 migrant(s)/1,000 population (2021 est.)

PARISHES & POPULATION
St. George: 7,839
St. Peter: 5,307
St. Philip: 3,490

LIVELIHOODS AND COMMUNITIES
Data availability at the appropriate spatial scale, i.e the NEMMA however, was not readily available due outdated population census. However, estimations can be drawn from the analysis of the 2001 Housing and Population Census in ECL (2007) which indicated that in this year, the NEMMA area constituted about 12 % of the population of Antigua and Barbuda, consisting of 22 communities.
The following communities can be found surrounding the NEMMA:

- Hodges Bay
- Fitches Creek
- Coolidge Airport
- Parham
- Vernons
- Glanvilles
- Seatons
- Willikies
- Long Bay
- Long Lane
- Browns Bay / Mont Pellier / Gaynors
- Mill Reef / Half Moon Bay
- Royals
- Cedar Grove
- New Winthorpes
- Piggots
- Crabbs
- Pares
- Jumby Bay (Long Island)

Equally, the main sources of employment and income generation within these communities are fishing and tourism activities (e.g., boat tours, diving and snorkelling, and yachting). as well as agriculture and commercial businesses and industry. Unemployment is at 8.4% in these communities and is slightly higher for women than men indicating other socio-cultural factors at play (Canari, 2017). Business

activities were found to be most prevalent in New Winthorpes, Parham and Piggotts while Glanvilles, Seatons and Coolidge had the least business activity (Jackson, 2008).

5.1.2 Resource Uses

I. Tourism

Tourism is an important and growing activity within the NEMMA and is one of the top 5 tourist attractions in the country. Its pristine waters and scenery are major contributors of the tourism product and a prime example of the role of environmental resources in the performative aesthetic of places facilitating economic and recreational activities (Photo The assets of the NEMMA which contribute to this are its beaches, mangrove wetlands and offshore islands (Camacho, 2021). For instance, boat excursions have become quite popular and attract many one-day cruise ship visitors where the focus is typically on the scenic waters of the North Sound, making stops at various islands or cays such as Great Bird Island, Prickly Pear, Green Island and Hell's Gate (Jackson, 2007).

According to Canari (2017), approximately 18 boating excursion companies were operating within the NEMMA's North Sound area, highlighting that it is a significant business activity. Tour boat operations are also regulated by law, requiring renewal of licenses and cruise permits annually. Updated figures, however, were unavailable at the time of this report, but trends between 2007-2017 indicate that tour boats are key contributors to the thriving environmental tourism market in the NEMMA (Canari 2017; Jackson, 2007). This coincides with findings in ECL (2007) with up to 300 people being accommodated per day during the peak season. Tourist attractions, such as Sting Ray City in Photo 2, has also been established within the NEMMA community (Canari, 2017).

Photo 3: Stingray City Dock within the NEMMA (Visitantiguabarbuda.com, 2021*)*

Other tourism related activities include the following:

- Recreation: Swimming, diving, and snorkelling

- Water Sports Activities and Rentals: Jet-Skis, sail craft, kayaks, surfboards, kites, and snorkelling gear
- Marina and Jetties: Yacht anchorages typically occur around Nonsuch Bay, Green Island, and Great Bird Island. There is also a marina and boat yard at Shell Beach and private jetties at Jumby Bay (Long Island), Maiden Island, and Harmony Hall and Barnacle Point
- Hotels such as Jumby Bay Hotel on Long Island is serviced by two ferries which operate frequently throughout the day between Beachcomber Dock and Parham Harbour.

II. Fishing

Fishing is a traditional activity within the NEMMA, operating on an informal basis with majority of fisherfolk considered part-time or seasonal (Jackson, 2008). Within the NEMMA, Emerald Cove/Willikies and Mill Reef are primary landing sites as outlined in ECL (2007) and majority coincide with the major communities including: Beachcomber, Hodges Bay, Shell Beach, Fitches Creek, Parham, Seaton, Willikies, and Mill Reef where hotels are located. Local fishermen tend to derive most of their business for the "Fresh Catch" requirements of hotels along the coast. Most fishermen based within the NEMMA sell their catch in the villages as well as it is not large enough to warrant transport to the market in St. John's (ECL, 2007). Due to changes in the environment over the years however, the Fisheries Division has indicated the NEMMA has decreased in importance in terms of livelihood, but its importance as a key biodiversity habitat in the health of its reefs and wetlands which serve as fish nurseries and feeding grounds for birds (Canari, 2017).

III. Industrial

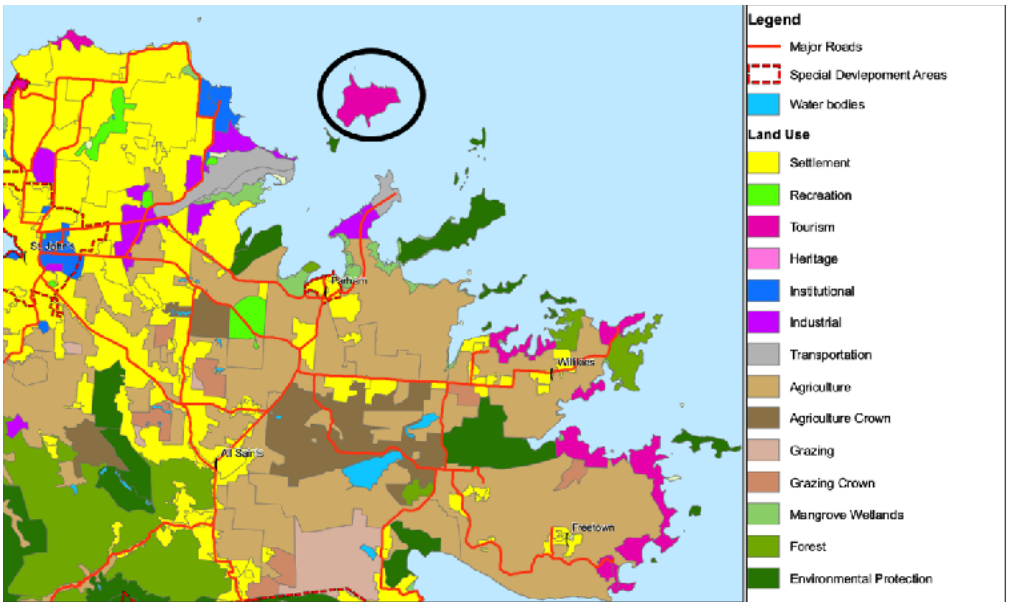
Industrial activities in the NEMMA include two electricity and power plants, a desalination plant, a brewery, a cement receiving facility and harbour all located on Crabbs Peninsula (Jackson, 2008). There are also industrial estates at Coolidge and Tomlinson, within the watersheds draining into the NEMMA as well as the international airport at Coolidge.

IV. Other Activities

The NEMMA also comprises several small enterprises such as vending which occurs on some beaches where tents are utilised to display souvenirs and clothing. Additionally, the agriculture sector comprises of about 80 to 100 farmers that grows vegetables and root crops (Jackson, 2008).

5.1.3 Land Use and Zoning

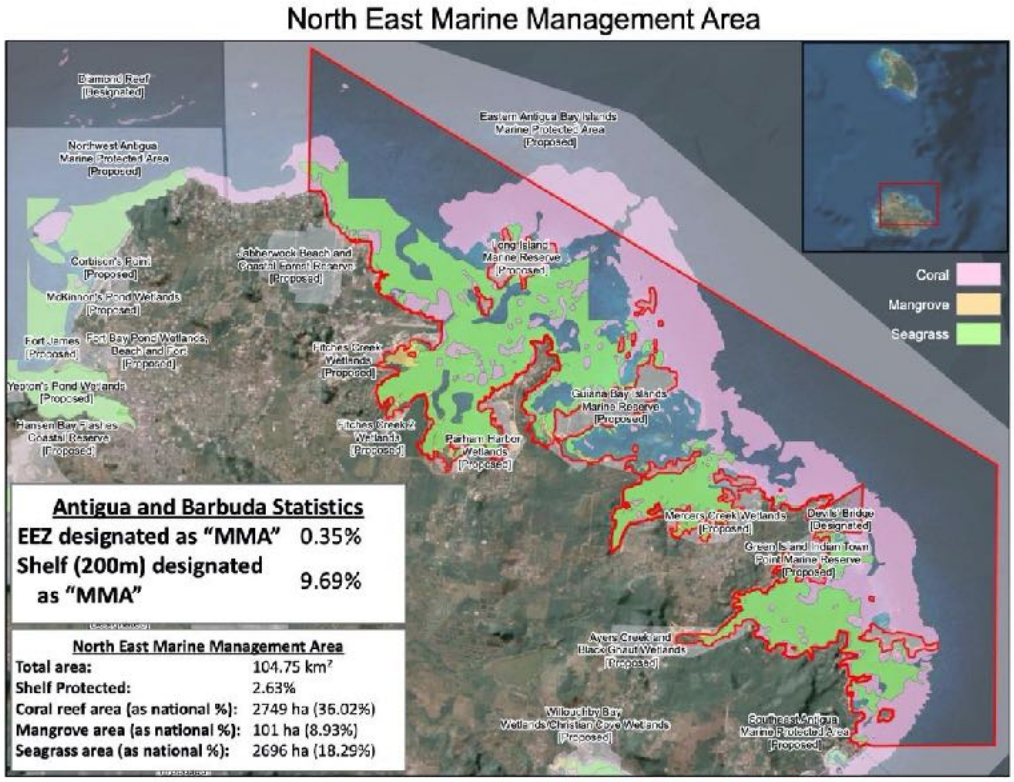
The Sustainable Island Resource Management Zoning Plan for Antigua & Barbuda (SIRMZP, 2011) outlines the land-use specifications for development in Antigua & Barbuda. In Map 6, the NEMMA boundary is indicated, where land-uses range from settlement in the north, to forest, institutional, transportation, environmental protection, tourism, and agriculture along the coastline southward The map indicates that Long Island, the project site is earmarked for Tourism activities, thus the project is in line with this designation.



Map 6: Land-Use Map of the NEMMA area extracted from SIRMZP Land-Use (Genivar, 2011)

5.1.4 Environmental Resources

The primary marine assets found with the NEMMA region are coral reefs, mangrove wetlands and seagrass beds, all of which support a wide variety of marine life. Map 7 depicts the distribution of these resources where total area of the NEMMA is 104.75 kilometre squared (km2) with 2749 ha of coral reef (36.02%), 101 ha of mangrove area (8.93%) and 2696 ha of seagrass area (18.29%). The following section provides a brief overview of these key environmental resources in the context of the NEMMA.



Map 7: Overview of Environmental Resources in NEMMA Area (Conservation Gateway, 2007)

I. Mangroves

Mangrove woodlands in Antigua are essential for maintaining health beach and reef systems for their filtration function, removing heavy sediments from surrounding watersheds and releasing nutrient rich water to the seagrass beds and coral (Camacho, \2021). Mangrove wetlands within the NEMMA cover over 240 hectares and consists of 4 species: Red Mangrove (*Rhizophora mangle*), Black Mangrove (*Avicennia germinans*), White Mangrove (*Laguncularia racemosa*) and Buttonwood Mangrove (*Conocarpus erectus*). In total, eighteen (18) individual mangrove wetland sites have been recorded in the NEMMA region (Jackson, 2008). Equally, these mangroves are also important habitats (nurseries, feeding sites) for fishes and birds, useful for eco-tourism and "crabbing" (ECL, 2007). However, due to current climatic conditions, increased hurricanes from predicted climate change and development, they have reportedly been severely affected physically which reduces their functionality (Baldwin, 2000).

II. Coral Reefs

Coral reefs are a vital habitat for many marine organisms as well as providing habitat for life stages of many pelagic fish (Camacho, 2021). It is also an important fisheries resource for some fishermen. Antigua possesses an extensive coral reef system that facilitates habitat provision for a variety of species, supporting the country's high biodiversity. However, within the last few decades, the devastating effects of hurricanes have caused altered structures causing declining health in these reef systems (Cooper et al., 2001). Significant coral reef structures have been recorded in the NEMMA region, particularly in the outer regions of the area which has been identified as having some of the most extensive coral reef systems of the mainland Antigua (Kramer et al., 2016).

Coral reefs in these areas were reported to have the highest live coral cover (13%) based on surveys conducted in 2017. The primary reef types observed were patchy and fringing reefs dominated by branching corals including the Acroporid species, including the critically endangered *Acropora palmata* (Camacho et al., 2020). Coral structures have been subjected to a variety of pressures over the years, which include hurricanes, anchors, fishing gear, sedimentation, eutrophication, pollution, and diseases (ECL, 2007). Coral reefs in the area have been found to provide habitat for a variety of marine species, including the commercially important fish like Grouper (Serranidae) and Snapper (Lutjanidae), as well as Caribbean Spiny Lobster (*Panulirus argus*) (ECL, 2007).

III. Seagrass Beds

The North East Marine Management Area is known for its rich in marine biodiversity and recognized as a globally significant area for endangered and endemic species. Seagrass beds are reported common within the NEMMA, primarily within the shallow lagoons. Dominant seagrass species observed included the Turtle Grass (*Thalassia testudinum*), while other species such as Manatee grass (*Syringodium filiforme*) and Shoal grass (*Halodule wrightii*) have also been observed (ECL, 2007). Algal overgrowth by brown algae *Dictyota sp.* have been observed in some areas, particularly where there has been anchor scarring (Camacho, 2021). These seagrass beds are also known to provide habitat for marine turtles, including the Green Sea Turtle (*Chelonia mydas*) and the Hawksbill Turtle (*Eretmochelys imbricata*).

These beds occur on sandy bottoms, around fringing reefs and between coral patches. The seagrass beds provide important feeding grounds, shelter, and breeding areas for several species of juvenile fish, turtles, spiny lobster, and other marine organisms. The largest and healthiest seagrass beds were observed around Long Island, a known sea turtle nesting site (ECL, 2007). As such the benthic assessments highlighted in this report were carried out specifically to address the effects of proposed development in the defined area of interest.

IV. Beaches

Beaches are distributed throughout the NEMMA region and are important for recreation along with providing nesting habitats for marine turtles. Beach monitoring does occur within the NEMMA region to assess impacts of erosion. Extensive turtle monitoring has occurred on the Long Island for over 30 years, with over 200 nesting females tagged since the start of the program (Jackson, 2008).

5.1.5 Predicted Climate Change

I. Coastal Environment

As a Small Island Developing State, Antigua & Barbuda's vulnerability to the effects of climate change is well known, the 2017 Category 5 Hurricane which caused significant in Barbuda being a prime example. This was detrimental to the economy, as more intense storms result in greater losses and damages particularly in the tourism, business, and housing sectors (GOAB, 2021). **Table 2** outlines the projected climatic changes in Antigua & Barbuda as per the Draft State of the Environment Report, which draws on multiple scientific evidence to determine climate prediction (GOAB, 2021). Specifically, for the Jumby Bay Beach site, although all impacts are pertinent, Hurricanes, SLR, Coastal erosion and storm surge are significant threats to the livelihood within the NEMMA and Jumby Bay Island Resort.

According to the Meteorological Services, during the period 1998-2018, 11 hurricanes have affected the island. Philmore (2003) highlighted the detriment that hurricanes cause to areas such as the NEMMA - changes in beach profiles, damage to reefs, seagrass and wetlands. CEAS.Ltd (2021) addresses these extreme events and highlights that they can modify bathymetry and foreshore profile and if sufficient sediments are not available, erosion could occur. In such situations considerable land onshore may have to be lost before this natural stable profile is attained (CEAS.Ltd, 2021). It may not always be desirable or acceptable that the coastline be allowed to develop its own stable profile in which cases coastal engineering intervention may be required. Essentially, costal engineering intervention, such as dredging in this case is an attempt to not only provide or restore a stable beach/ shoreline or to manage the rate of erosion to acceptable limits, but to improve the water clarity and quality for recreational use (CEAS.Ltd, 2021). It is also noted that a stable shoreline could be subjected to erosion or accretion if the nearshore wave climate changes. Thus, changes in nearshore wave climate could result from either a change in offshore wave climate or a change in the physical boundary conditions within the bay.

Table 2: Summary of Climate Impacts and Mitigation measures on Coastal Environment in the context of Jumby Bay Beach

Impact	Brief Description	Risk Significance High/Medium/Low	Mitigation Measures
Extreme Rainfall Event	Extreme rainfall is only projected to occur during a tropical cyclone/ hurricane	Medium	Not applicable for this study
Extreme Drought	Reduction in rainfall is expected to result in more frequent “hot days”	Medium	Not applicable for this study
Extreme Atmospheric Temperatures	Increased Surface Temperatures are likely	Medium	Not applicable for this study
Hurricanes	Hurricane intensity in Atlantic is likely to increase, thus indicating stronger winds and increased rainfall which causes damage to ecosystems and coastal developments	High	Building resiliency at a national (Building Codes, adaptation policy) and community level
Sea Level Rise (SLR)	Climate change due to increased GHGs causes SLR	High	Coastal Defences

Other (Storm Surge/ Coastal Erosion)	Increased Hurricane activity results in Storm Surge and thus coastal erosion is likely for vulnerable and unhealthy coastlines	High	Dredging: Historically, Jumby Bay Beach presents as vulnerable to the effects of climate change and coastal erosion. The EIA in recognition proposes to rectify this.

II. Marine Environment

Climate Change, and its associated effects, such as increased frequency and intensity of tropical storm systems, is an ever-present threat for Antigua and Barbuda. While the NEMMA region is protected externally by coral reefs, and the coastlines are protected wetlands, the impacts of these storm systems are still felt, with previous assessments showing damage to marine ecosystems (Camacho, 2021).This proposed development will need to take into consideration the effect of such storm systems, particularly in the consideration to the movement of sediments, and possible impacts on the surrounding marine environment (Camacho, 2021).

The preferred option would be greater emphasis on the ecological importance of seagrass beds, the role that they play in the fight against climate change, and the loss of ecosystem services which can result from its removal. The seagrass beds in the bay are playing a crucial ecological role to the surrounding environment as a nursery and support for the coral reefs and is of tremendous ecological benefit to Long Island and its associated properties (Camacho, 2021). It is providing ecosystem services via reduction of turbidity/sedimentation, carbon sequestration and stabilization of the habitat. Dredging of the area may result in loss of native biodiversity and increased sedimentation in the bay area, which could result not only in a deteriorating ecological condition, but also a less attractive beach for recreational uses. Table 3 further expounds on this.

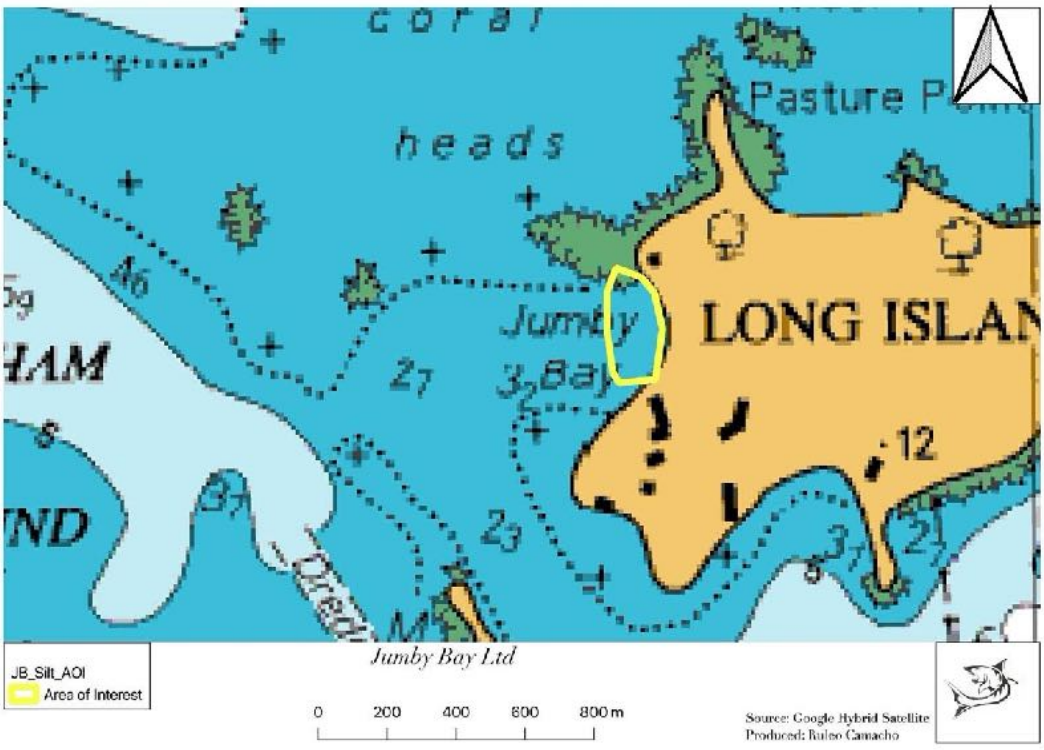
Table 3: Summary of Climate Impacts and Mitigation measures on Coastal Environment in the context of Jumby Bay Beach (Camacho, 2021)

Impact	Description	Risk	Mitigation
Hurricanes	Intense hurricanes, like Hurricane Irma 2017, can result in increased sedimentation, movement of sediment, and damage to surrounding ecosystems	Hig h	Ensure healthy seagrass beds will aid to stabilize sediment, the leaves will help to capture sedimentation and reduce turbidity in the water column. Healthy reefs have a greater chance of recovering following large scale physical degradation

Habitat Displacement	Dredging will displace ecological habitats.	High	If dredging cannot be avoided, then the footprint should be reduced as much as possible. Monitoring of the surrounding seagrass beds needs to be carried out to ascertain any damages. Long term monitoring of coral reefs to see changes. No anchoring should be allowed on the seagrass beds to reduce further physical degradation to the ecosystem. Boats should be maintained on mooring systems only. Coral reef restoration can be carried out to aid the restorations of the surrounding coral reef areas.

5.2 Jumby Bay Beach

The proposed development area, 'Jumby Bay Beach' is a sheltered bay on the Western end of Long Island. Long Island is one of the many offshore islands within the NEMMA and is home to the Jumby Bay Island Resort. It is enclosed within a swim line and is used primarily for recreational activity by the guests of Jumby Bay Island Resort. There is a swim platform midway in the bay, on the inner part of the swim line. The bay is shallow, with marine nautical charts such as Map 8 indicating a depth range less than 10ft (1.2 – 3.2m), and depths during the survey ranging from 3-6ft (1-2m). The following subsections provide an overview on the state of identified marine and coastal environment characteristics.



Map 8: Benthic Nautical Chart showing Area of Interest (Camacho, 2021)

5.2.1 Coastal Environment

I. Location & Nature of Beach

Jumby Bay Beach (also referred to as 'Jumby Bay') is the main beach on Long Island, measuring approximately 2000 ft. from the south-western headland to the north-eastern headland and is located along the central western coastline (CEAS. Ltd, 2021- Enclosure 2). The beach has a crenulate shape and is sheltered on the west from the mainland, and on the east by the island itself (CEAS.Ltd, 2021).Surrounding areas including Maiden and Guiana Islands and Crabbs Peninsula also provide some level of protection. Additionally, there is an offshore reef located northwest, seaward of the beach. This feature coupled with the flat bathymetry of the bay characterises its coastal processes such that a significant percentage of waves would break offshore before they are able to propagate to the beach (CEAS.Ltd, 2021). The above boundary conditions contribute to the tranquillity of the area and its seabed sedimentology composition containing mainly silt, that fosters the healthy development of seagrass (CEAS.Ltd, 2021).

II. Beach Profile

The foreshore which extends landwards from the water line to the vegetation lines elevates up to about 1 m above mean sea level (MSL). The width varies along the beach but is estimated at approximately 40m. From the shoreline, a narrow moderately sloping surf zone exists, and this area facilitates where most of the small waves break before running up onto the shore. The width of the surf zone is dependent on the prevailing wave direction which is approximately 5 m under normal sea conditions based on existing conditions on the day of site observations. Seaward of the surf zone, a mildly sloping nearshore area extends seawards which levels off as being relatively flat after approximately 200 m from

the shoreline. Thereafter, the seabed is irregular with undulations in the bathymetry. Some areas further than 200 m are essentially shallower than further inshore.
Based on the nature of the site as a tourist development for decades, it is understood that the beach has required previous manmade interventions geared towards its improvement, specifically this activity. Based on review of literature and on-site discussions with locals familiar with the offshore islands and the NEMMA region, the beach is naturally occurring. However, based on these historical sources of information, it is assumed the beach's profile and coastal processes have been influenced by these previous interventions.

III. Beach History

The beach is known as a naturally occurring sandy beach existing for decades and the northern and southern headlands provide its natural boundary and equally the indentation from the headlands indicates likely regression of the shoreline location over time. The coastal study therefore concluded that the beach has been naturally stable under normal circumstances, but the main driver of its reported erosion is due to extreme conditions from the severity of hurricanes over the years.
In Moffatt and Nichol (2013), it is understood that beach improvement works were performed at least twice in recent history specifically targeting the enhancement of beach quality regarding its characteristic "feel" and water clarity. According to past reports, the JBIC performed similar work in the early 1990s where a dredging contractor removed 1-2 feet of sediment within the defined swim area to improve the appearance and feel of the sea bottom. The methodology included using a suction dredger to pump the dredged material onshore after a sand dyke was constructed parallel to the beach to act as a retention pond. Further, it was established that fines in the slurry wash was allowed to flow back to the sea on the northern side, while the coarser sand collected was redistributed onto the beach and the nearshore area.

Beach nourishment has been a regular occurrence for the JBIC, and its last reported activity was in 2013 when sand from offshore was pumped hydraulically onto the shore where a similar dyke was constructed to retain the material. The coarse particle sizes were again retained and distributed along the beach. The fines were then left to flow back into the water through the overflow pipes and may have contributed to the excessive fine present within the nearshore. This methodology in 2013, was critiqued as flawed, as it allowed significant number of fines to return within the bay. From this, an assumption can be made that the little consideration was given to the sand particle size which resulted in using material that was simply available rather than one that would build the resilience of the beach by replacing with larger particle size. Thus, in this process, the methodology outlined in Section 3.0 seeks to rectify this as much as possible to fulfil the aesthetics required of the beach in terms of its water clarity and its suitability for recreational use

Sand is reported to accrete on the southern side of the Guest Arrival Jetty. This sand accretion is likely due to the partial blockage due to the jetty. JBIC has indicated that in the past a backhoe was used to remove the accreted sand from the shoreline and nearshore and place it on the other side (referred to in Coastal Engineering as "bypass" (CEAS. Ltd, 2021). The sand removal serves to maintain the water depth along the jetty. Currently the are on the south of the jetty is significantly shallower than the north side and is therefore only able to accommodate vessels with a very small draught.

IV. Present Conditions

Having inspected the Beach (foreshore and shore area), the beach comprises of creamish to white medium grain sand. To validate this, laboratory analysis of samples taken from a representative area indicate a D_{50} particle size of between 0.3 to 0.36 mm shown in Table 3 extracted from (CEAS. Ltd, 2021- Appendix 1 & 4). It was found the D_{50} is the median particle size. A dive through the Bay on the 14th & 19th August indicated the surf zone comprised of medium grain sand with D_{50} particle size slightly coarser than the sand onshore. This material extended from the swash zone, just beyond the wet sand line to approximately 20 feet into the water. Prospectively, the material was likely generated from the sorting of the foreshore material where the coarser material was dispersed along the surf zone and the finer particle sizes transported to the more tranquil nearshore (wading) area.

Past 20 ft into the water, although the bottom bathymetry possessed a mild slope downwards, it had an irregular shape comprising small undulations along the seabed with small 1 ft peaks and low depressions 0.5ft above and below surrounding levels (CEAS. Ltd, 2021- Enclosures 3D & E). The surface sedimentology consists of a silty fine sandy with moderately dense seagrass. This is detailed below based on the findings from the Benthic Marine Assessment. The bottom surface may be described as mushy/ slimy with a sense on compression of the surface as one walked along the nearshore area. (CEAS. Ltd, 2021- Appendix 1) shows the sieve analysis for 2 samples taken within the nearshore area. Further seaward the bathymetry is relatively flat with only a mild downwards slope seawards. The seabed lithology consisted of a similar fine sandy silt as encountered in the nearshore area but appeared in some areas to be finer than the material encountered further shoreward. There was however a marked reduction in the density of the seagrass (CEAS. Ltd, 2021- Enclosure 3H).
The bay is generally calm and at the time of the site visits there were no appreciable waves. This is expected based on the nature and location of the beach. The undisturbed water appears to be very clear but readily becomes murky whenever disturbed as occurs when one walks on the seabed or even slightly disturbs the seabed while diving. (CEAS. Ltd, 2021- Enclosure 3F).

There were no signs of any significant erosion on the beach and the fact that the sediment found was extremely fine suggest that there is not much sediment transport capacity within the bay, thus the sediment particle size would be significantly larger. This relationship between wave and current strength with beach particle size is clearly seen on the south and southwestern side of the island where the sediment particle sizes is much coarser on account of the greater wave and current climate on the southern side. Table 4 summarises the sediments found based on the 8 samples in (CEAS. Ltd, 2021- Enclosure 4).

Sand is reported to accrete on the southern side of the Guest Arrival Jetty. This sand accretion is likely due to the partial blockage due to the jetty. JBIC has indicated that in the past a backhoe was used to remove the accreted sand from the shoreline and nearshore and place it on the other side (referred to in Coastal Engineering as “bypass” . The sand removal serves to maintain the water depth along the jetty. Currently the area on the south of the jetty is significantly shallower than the north side and is therefore only able to accommodate vessels with a very small draught.

Table 4: Summary of Sediment Type found at Jumby Bay Beach

SAMPLE NO	LOCATION	SAMPLE DESCRIPTION	D_{50} (MM)
A1	Shoreline 100m from jetty	Creamish white medium sand	0.30
1B	25m offshore 100m N of Jetty	Whitish grey silty fine sand	0.18
2A	Shoreline 200m N of jetty	Creamish white medium sand no silt	0.36
2B	25 m offshore 200m from jetty	Greyish white silty sand	0.24
3	300m from shoreline	Greyish white silty fine sand	<0.074
4	500 m from shoreline	Greyish white silty fine sand	0.08
5	Runaway shore (control)	Creamish white medium sand	0.35
6	Near Reef	Greyish white silty fine sand	0.1

V. Coastal Analysis

(i) Coastal Dynamics and Coastal Erosion

Coastal Erosion is nature's way of trying to redevelop a stable coastline capable of resisting the prevailing wave conditions which incident the coastline. This is achieved by redistributing the sediment (silt, sand, gravel, cobbles etc.) in the near-shore and onshore areas to a stable profile capable of resisting the prevailing wave conditions (water level, wave height/ direction). To develop this stable profile sufficient sediment must be available in the near-shore areas for redistribution. If sufficient sediment is not available in the near-shore area, any available sand onshore is generally mobilized into the system. This process will tend to continue until a stable profile is reached. This process is indeed what we refer to as erosion/ accretion. A stable beach profile is therefore specific to a particular set of boundary conditions. Consequently, whenever one of these boundary conditions changes, the beach profile must adjust accordingly. This accounts for the seasonal beach changes where section of the beach become smaller at a particular time then rebuild at another.

If extreme events (such as hurricanes) modify the bathymetry and foreshore profile, then if sufficient sediments are not available erosion could occur. In such situations considerable land onshore may have to be lost before this natural stable profile is attained. It may not always be desirable or acceptable that the coastline be allowed to develop its own stable profile in which cases coastal engineering intervention may be required. Essentially the costal engineering intervention is an attempt to provide or restore a stable beach/ shoreline or to manage the rate of erosion to acceptable limits. A stable shoreline could be subjected to erosion or accretion if the nearshore wave climate changes. Changes in nearshore wave climate could result from either a change in offshore wave climate or a change in the physical boundary conditions within the bay.

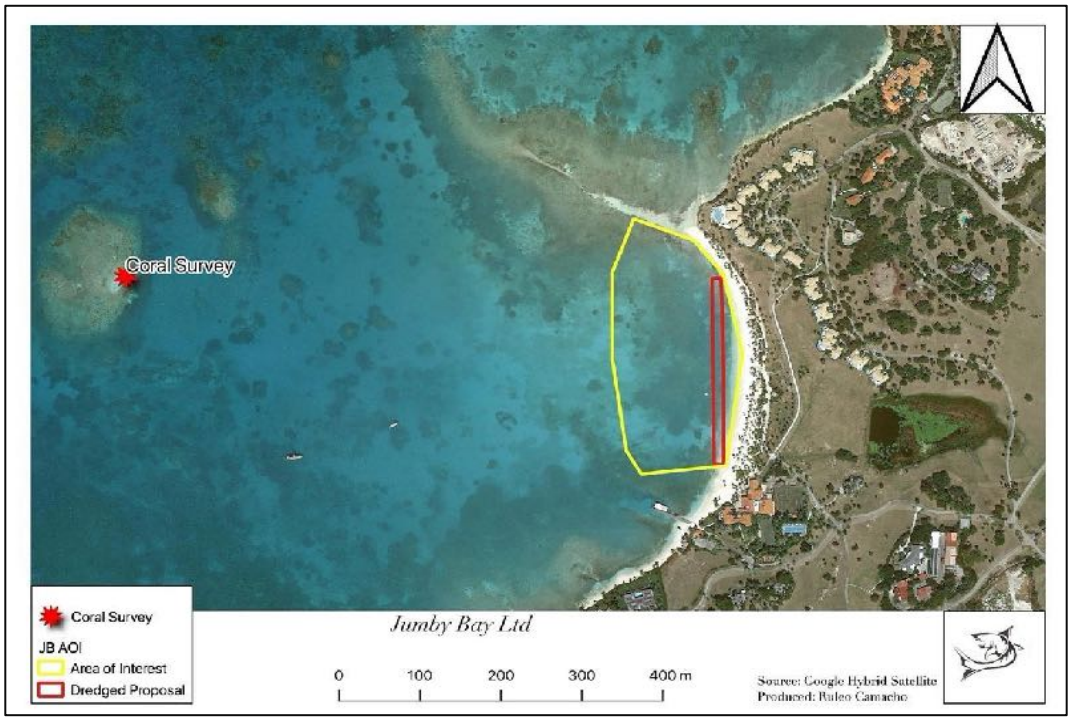
(ii) Existing Stability

As previously indicated the beach is sheltered on the west from the mainland and on the east by the island itself and partially on the south by Maiden Island, Crabbs Peninsula and Guiana Island. Consequently, under normal conditions the bay is generally very calm and there is very little sediment transport capacity. This is borne out in our observations and reports from various individuals. The fact that the sediment type is very fine is further evidence that there is very little sediment movement and that the Beach is stable (CEAS. Ltd, 2021). The subject coastline appears to be a relatively stable coastline under normal conditions and although erosion is possible under extreme conditions, the level of erosion anticipated to be small based on the extensive flat and shallow bottom bathymetry of the bay and the relatively sheltered nature of the bay (CEAS. Ltd, 2021). Previous studies corroborate these findings.

5.2.2 Marine Environment

I. Coral Reefs in Jumby Bay Beach

Coral surveys were carried out at the point specified "Coral Survey" below in Map 9. This would ascertain the baseline ecological conditions of this coral reef site.



Map 9: Coral Reef Survey Site (Camacho, 2021)

T1 was carried out on the southern part of the point. The t area here is algal dominated as seen in Photo 3, with Dead Coral with algae (49.24%) and Macroalgae (28.90%) accounting for most of the benthic cover. Based on observations, live coral accounted for 0.38% represented in Figure 2.

Photo 4: Coral Present in T1 Transect (Camacho, 2021)

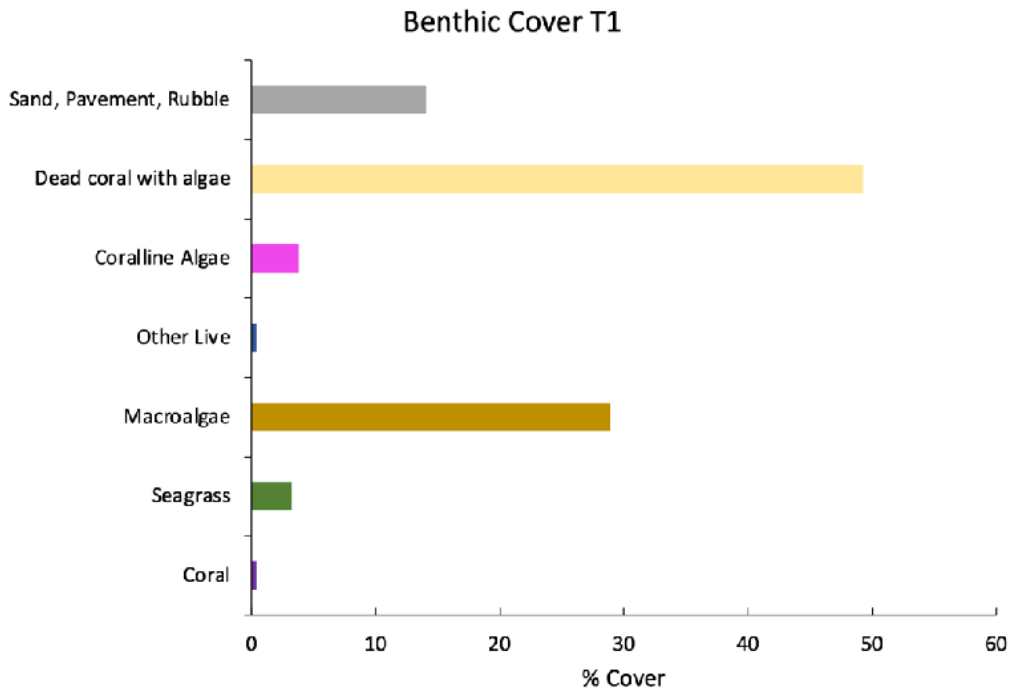


Figure 2: Transect 1 Benthic Cover (Camacho, 2021)

T2 was carried out to the northern part of the “Coral Survey” point. The dominant substrate here was live coral, accounting for 47.36% of the benthic cover (Photo 4). Dead coral with algae accounted for 28.41% while macroalgae and seagrass each accounted for 8.15% (Figure 3).

Photo 5: Live coral identified in Coral Transect 2 (Camacho, 2021)

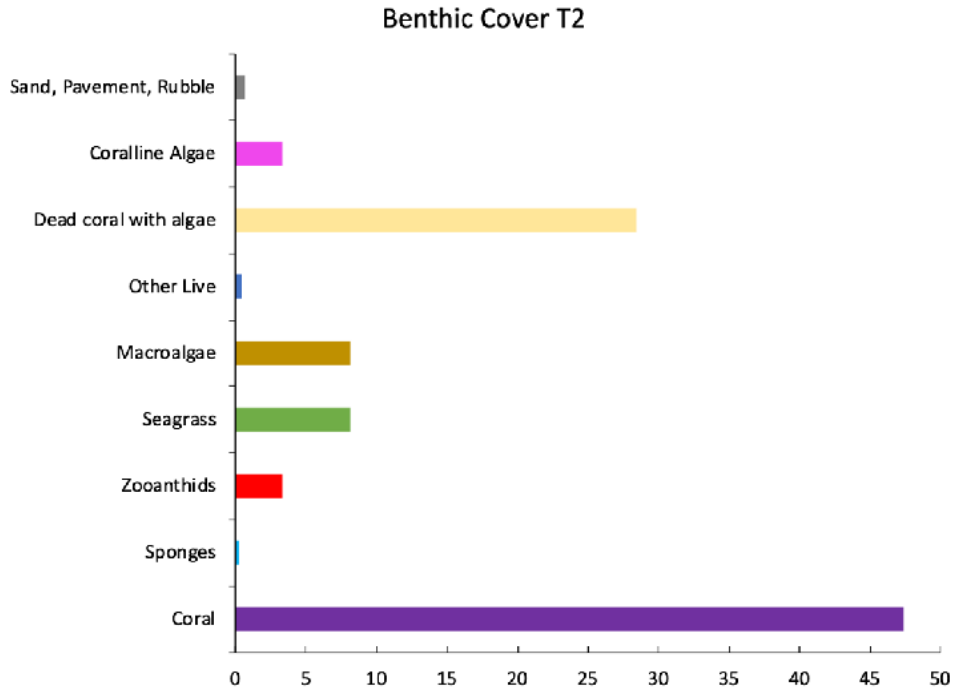
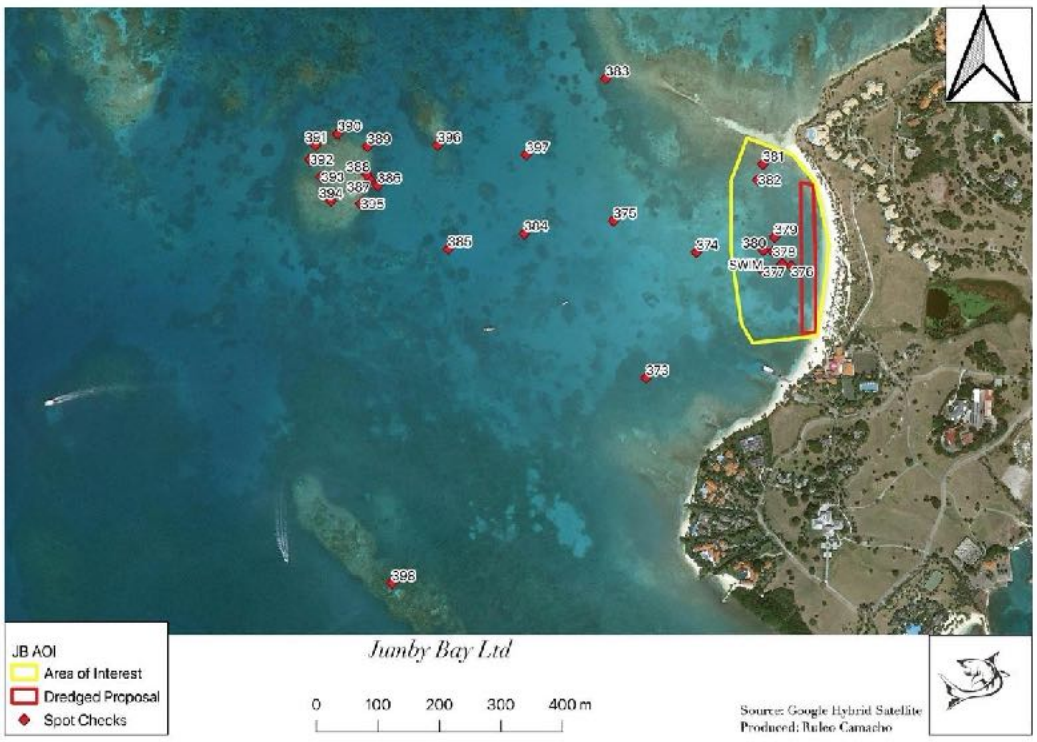


Figure 3: Transect 2 Benthic Cover (Camacho, 2021)

On average, the Live Coral accounted for 23.87% cover, Dead Coral with algae 38.83% and macroalgae accounted for 18.53% (Photo 5).

Photo 6: Coral Reef Area (Camacho, 2021)

Although not explicitly surveyed, a variety of fish species were noted at the coral reef sites, and family names are given in Table 5. Additionally, several spot-checks were carried out to better understand the distribution of benthic marine ecosystem displayed in Map 10 utilising the under-water data collection method of Section 3.0.



Map 10: Marine Spot Check Locations (Camacho, 2021)

These spot checks were useful in identifying three notable biodiversity characteristics and their influences on the marine environment. This includes the presence of Broad-Leaf or *Halophila stipulacea* seagrass, which is an invasive species, *Halimeda* or Halimeda sp. which is a seagrass species that contributes to sand-making and cyanobacteria which could be an indicator of high nutrient levels in the marine environment. Tables 6 & 6 below summarises the spot check findings and provides information on the species observed.

Table 5: Spot Check Observations (Camacho, 2021)

LOCATION NUMBER	LOCATION NOTES	OBSERVATIONS	FAUNAL OBSERVATIONS	DEPTH (FT)
373		Seagrass: TG, MG, HA, BL		
374		Seagrass area: TG, MG, BL		
375		Seagrass/Sand: BL, TG	Sea Star	
376	Floating swim platform within swim line adjacent to beach	Seagrass area: TG, MG, BL, CYAN. Floral coverage 80%. Average canopy height 17cm. Sedimentation on blades		6ft

376-a	Inward 30ft from 376	Seagrass area: TG, MG, HA, BL, CYAN. Floral coverage 70%. Canopy height is 17cm. Sedimentation on blades	Sea Star, Juvenile Nassau Grouper	6ft
376-b	Inward 30ft from 376-a	Seagrass area: TG, MG, HA. Floral coverage 90%. Canopy height 19cm. Sedimentation on blades		5ft
376-c	Inward 30ft from 376-b	Seagrass area: MG, HA, TG, BL. Floral Coverage 70%. Canopy Height 16cm. Sedimentation on blades	Sea Star, Juvenile Parrotfish	4ft
376-d	Inward 30ft from 376-c. Transition from seagrass to sandy area.	Seagrass area: MG, HA, TG. Floral coverage 80%. Canopy height of 12cm. Sedimentation on blades		4ft
377		Seagrass area: TG, MG, HA, CYAN, BL. Floral coverage 80%. Floral canopy height 16cm. Sedimentation on blades	Sea Star, Juvenile Snapper, Juvenile Grunt	6ft
SWIM	Swim Lane	Seagrass area: TG, HA, MG, CYAN. Floral coverage 70%. Canopy Height 17cm. Sedimentation on blades		6ft
378		Seagrass Area: MG, TG, BL, HA. Floral Coverage 65%. Canopy Height 17cm. Sedimentation on blades		6ft
379		Seagrass Area: TG, HA, MG, BL. Floral Coverage 80%. Canopy Height 19cm. Sedimentation on blades		6ft.
380		Seagrass area: BL, MG, TG, HA. Floral coverage 80%. Canopy height 12cm.		6ft
381	Approaching and along seagrass bank.	Seagrass Area: TG, HA. Canopy Height 19cm. Isolated PAST in seagrass	Juvenile Queen Conch	<3ft
382		Seagrass area: MG, BL, HA. Floral coverage 95%. Canopy Height 14cm.		4ft
383		Mixed substrate area. Seagrass: TG, GORG, HA. Scruffy Bottom: APRO, MILL, PDIV, PPOR, PPOR Skeleton, DIAD, Red Urchin, OANN, MAUR.	Juvenile snappers & grunts, squirrel fish, jacks	3-6ft
384		Seagrass Area: CYAN, TG, TG, HA, BL. Floral coverage 80%. Canopy Height 10c		13ft
385		Sand and BL. Canopy Height 7cm		14ft

386	Seagrass area which transitions to reef bank	Seagrass dominated by TG. Reef bank is PPOR and APAL skeleton. Southern side of reef bank dead. Northern side: APRO, MILL, PPOR, OANN, PCLI, DLAB, PSTR, PAST	Parrotfish, Grunt, Snapper, Doctorfish,	10ft – 2 ft
387	Transect was conducted here	Seagrass (TG), few coral (APRO, MILL)	Juvenile Fish	7ft
388	Transect was conducted here	Coral thicket (more defined point than 386)	Juvenile fish (Snappers, grunts, squirrel fish, Doctorfish, et al)	7ft
389		Reduction in coral density. Isolated colonies of APRO, OANN, PPOR.		
390		Mixed reef (increased diversity of corals) with large fish biomass. APRO, OANN, SSID, PAST, PPOR, DLAB, PSTR, PCLI, MILL,	Large schools of grunts, parrotfish, doctorfish	
391		APRO Thicket		
392		Greater dead zone, heavy macroalgae		
393		Sea Grass (TG), APRO, PDIV, PFUR		
394		APAL		
395		Seagrass (TG) and isolated HC (APRO, MILL, PFUR,		
396		High Coral diversity (APRO, PAST, SSID, PPOR, OANN	Juvenile fish, DIAD	
397		BL, TG, CYAN, SAND		
398		TG, MG, HA, PDIV, PFUR	Conch	

Table 6: Abbreviations and Species List (Camacho, 2021)

ABBREVIATION	COMMON NAME	SPECIES NAME	NOTES
TG	Turtle Grass	*Thalassia testudinum*	
MG	Manatee Grass	*Syringodium filiforme*	

BL	Broad-Leaf	*Halophila stipulacea*	Invasive seagrass
HA	Halimeda	*Halimeda sp.*	Group of seagrass species which contribute towards sand making
CYAN	Cyanobacteria		Can be an indicator of high nutrient levels in the marine environment
	Upside-down Jellyfish	*Cassiopea xamachana*	
PAST	Mustard Hill Coral	*Porites Astreoides*	
APRO	Fused Staghorn	*Acropora prolifera*	
PDIV	Thin Finger Coral	*Porites divarcata*	
MILL	Fire Coral	*Millepora sp.*	
PPOR	Finger Coral	*Porites porites*	
DIAD	Black Sea Urchin	*Diadema antillarum*	
OANN	Lobed Star Coral	*Orbicella annularis*	
DCLI	Knobby Brain Coral	*Diploria clivosa*	
PFUR	Branched Finger Coral	*Porites furcata*	
	Groupers	*Serranidae*	
	Snappers	*Lutjanidae*	
	Grunts	*Haemulidae*	
	Parrotfish	*Scaridae*	
	Jacks	*Carangidae*	

II. Seagrass in Jumby Bay Beach

Within section 3.0 Methodology, the seagrass assessment area is highlighted and compartmentalised into three transects. Based on the assessment, the benthic substrate was dominated by Turtle Grass (*Thalassia testudinum),* Manatee Grass (*Syringodium filiforme*) and *Halimeda sp*.. The invasive Broad-leaf Seagrass (*Halophilia stipulacea*) shown below in Photo 6 was also noted in the transects, with the dominant benthic substrate being a mud/silt material. The following observations were found in each Transect outlined in Map 11.

Photo 7: Broad-Leaf Seagrass showing sedimentation on Leaves (Camacho, 2021)

In Transect 1, the native seagrass species (Turtle Grass) shown below in Photo 7, accounted for 85% of benthic cover, while the invasive broadleaf species accounts for 3.5% and the remaining 11.5% made up by mud/silt.

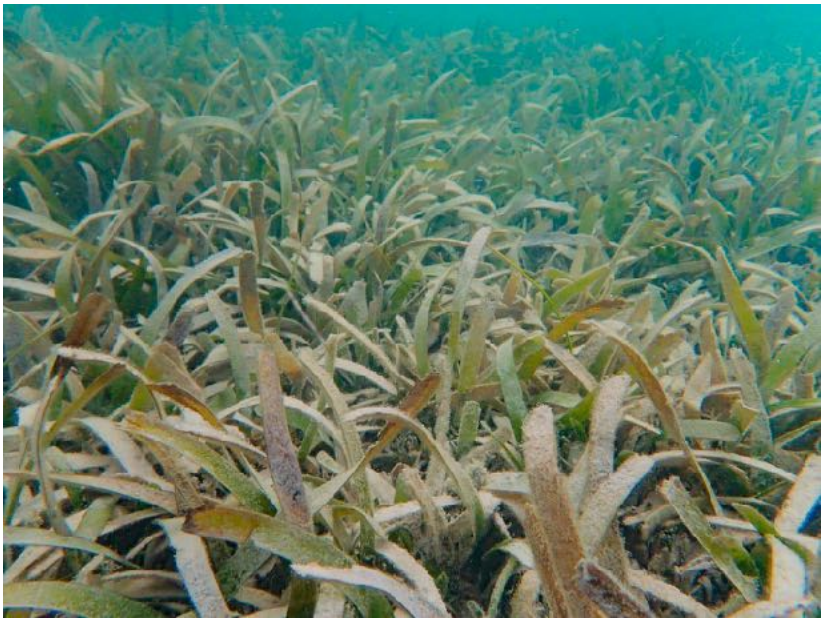


Photo 8: Turtle Grass Found in Transect 1 (Camacho, 2021)

Transect 2 consisted of 58.5% of the benthic cover, with the invasive broadleaf species (Figure 4) accounting for 11% and the remaining 30.5% mud/silt.

Transect 3 comprised of 54.5% native seagrass cover, 22% invasive seagrass cover and 23.5% silt/mud. Figure 5 provides a synopsis on the overall percentage cover of the benthic substrate with native seagrass species accounting for 66% of the benthic coverage in the area of interest (AOI), followed by mud/silt (21.83%) and invasive seagrass (12.17%).

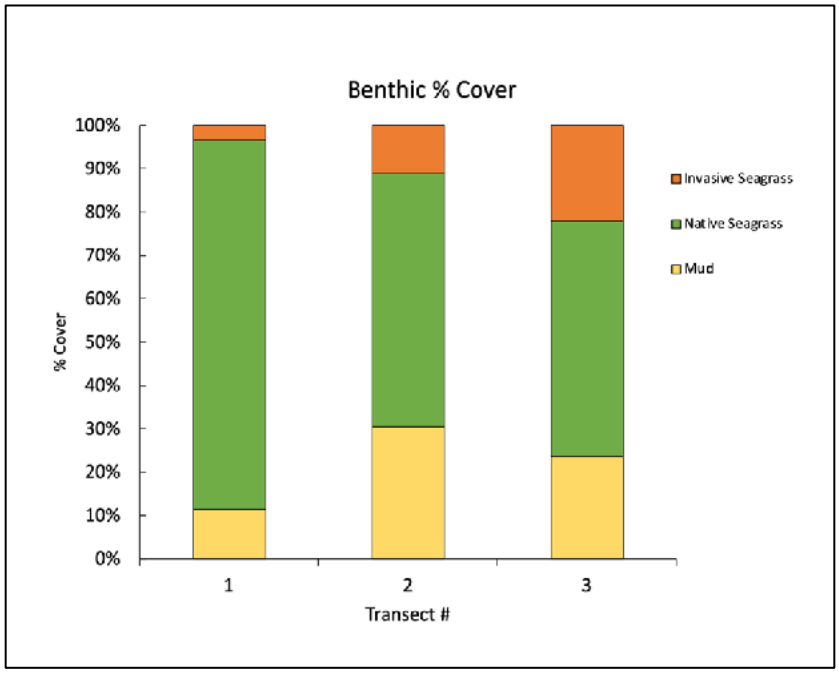


Figure 4: Percentage Cover of Benthic Substrate (Camacho, 2021*)*

In all transects, seagrass blades, particularly the native species, were heavily inundated by sediment shown in Photo 8.

Photo 9: Turtle Grass showing significant presence of sedimentation *(Camacho, 2021)*

Floral Canopy height showed variation between transects, with transects having a higher proportion of the invasive broadleaf species showing a reduction in canopy height in Figure 4. Transect 1 and Transect 2 were similar, measuring 164mm and 160mm respectively. This dropped to 141.5mm in Transect 3, where the coverage of the invasive broadleaf species increased to 22%. Average canopy height throughout the area of interest is 155.17mm. Floral species richness varied, with Transect 1 measuring 4.5 species/m2, while Transect 2 and Transect 3 both measured 3.5 species/m2. Overall average species richness in 3.7 species/m2.

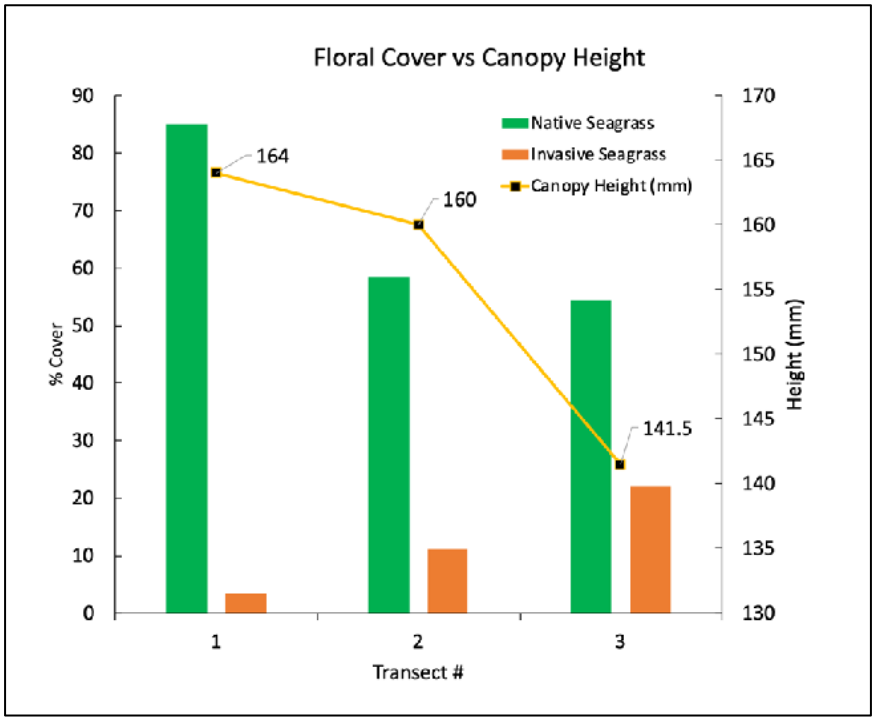


Figure 5: Percentage Cover (%) of Seagrass and Canopy Height (mm) (Camacho, 2021)

Macro-invertebrates were also observed and varied across transects, with the Upside-down jellyfish (*Cassiopea frondosa* and *Cassiopea xamachana*) *in* Photo 9 being the most dominant but only seen in Transect 2 (26/100m^2) and Transect 3 (5/100m^2).

Photo 10: Upside-down Jellyfish in Seagrass *(Camacho, 2021)*

A single Queen Conch (*Aliger gigas*) in Photo 10 was seen in Transect 2, while 6 Cushion Sea Star (*Oreaster reticulatus*) *in* Photo 11 observed in Transect 6. Figure 5 displays the distribution where macro-invertebrates were observed in Transect 1.

Photo 11: Queen Conch
(Camacho, 2021)

Photo 12: Cushion Sea Star
(Camacho, 2021)

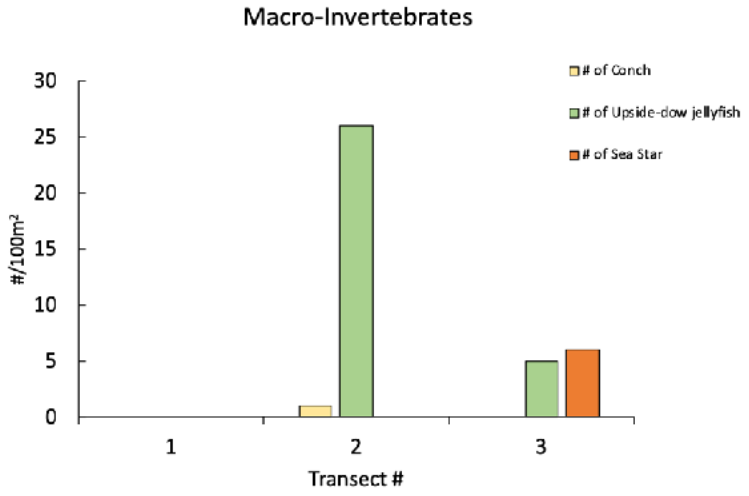


Figure 6: Macro-invertebrates per 100m² (Camacho, 2021)

III. Water Quality

Except for observed phosphates, the water quality levels for turbidity, temperature, salinity, pH were found to be within nationally accepted levels. Figure 6 outlines these results. While these results do not show high turbidity, the ecology in the area point to a trend of high sedimentation. It should be noted that the water quality sampling was limited to only one sample day.

Department of Analytical Services
Friars Hill
St. John's
Antigua
T: 462-9437/462-6281
E: linroy.christian@ab.gov.ag

Certificate of Analysis

Date of Issue : 2021-08-20
Client : Environmental Tourism Consulting
Report # : ETC002
Sample Submission Date : 2021-08-18
Temperature on Arrival (°C) : <10
Sample Type : Water

Lab ID	Sample Description	Temperature °C	Turbidity NTU	pH (6.5-8.5)	Salinity %	Phosphate ppm
ETC-202108-01	Site 5	29.2	0.60	7.45	2.92	0.27
ETC-202108-02	Site 4	29.3	0.63	8.04	3.04	0.14
ETC-202108-03	Site 3	30.0	1.33	8.03	3.06	0.22
ETC-202108-04	Site 2	30.3	4.37	8.12	3.16	0.26
ETC-202108-05	Site 1	30.8	1.43	8.20	3.13	0.22

Approved by:

Dr Linroy Christian
Director

Figure 7: Certificate of Analysis for 5 Water Quality Sampling Sites at Jumby Bay Beach (DOAS, 2021)

6.0 Potential Impacts and Mitigation Measures

6.1 Dredging Activities

6.1.1 Coastline Environment

Dredging activities can have physical, biological, and socioeconomic impacts in the area of concern. Given that the intention is for the equivalent volume of material to be replaced with more stable material most of the negative physical impact at the beach site will be limited temporally to the period in which the dreading activity is being conducted.

- The coastal analysis conducted did not support the sourcing of sand from the site identified by the developer. Material from the proposed site will not achieve the aesthetic results due to small grain size. Therefore, alternative sources, such as Barbuda are recommended for sourcing sand.

- Dispersion of any outwash plume resulting from overflow can also occur at the site and along the transportation route to the disposal site. The sides of the hopper will need to be adequately secured and the level of material monitored to avoid spillage.

- Transport and settlement of the material suspended by the dredging activity is likely. Water quality will be negatively impacted through increases in the amount of fine material in suspension, potentially producing effects leeward of the borrow area into the bay. The baseline water quality analysis conducted on 5 points in the study area did not reveal high turbidity levels. However, the ecological assessment conducted in the area pointed to a trend of high sedimentation. This is evidenced by the sediment present on seagrass at the site. This impact is likely to be short term and limited to the time of the dredging activity. It is anticipated that the issue will resolve when the project is complete. No specific mitigation is required.

- Since the replacement of material is expected to be immediate, bottom bathymetry of the seabed will not be modified and therefore will have no significant influence on the nearshore wave or tidal conditions.

- The effects of the disposal of dredging waste at the approved disposal site are not expected to have any new impacts.

- No dredging is expected during the operational phase; therefore, no impacts are anticipated. However, the measures outlined regarding ecological monitoring are required to ensure that there is no recolonisation by invasive species of sea grass (Halophila stipulacea).

6.1.2 Sand Bypassing

- The presence of the guest arrival jetty may be altering the natural movement of sand along the beach thus encouraging the accretion of sand close to the said jetty. Hence, the periodic redistribution of the sand back towards the North may be required to maintain the water depth.
- Periodically in the future when the sand gets either close to or reaches 1 m in depth another redistribution of the accumulated sand would be triggered.

6.1.3 Marine Environment

The principle biological impacts of dredging include disturbance, removal, and alteration of the substrate

upon which establishment of features such as Coral Reef and Seagrass beds depend. This action affects the suitability of the seabed as a food resource for fish, turtles, and other marine organisms or as habitat. This activity will result in significant disruption to the seagrass ecosystem in the area. Seagrass surveys indicated that the Area of Interest is a seagrass bed ecosystem dominated by native seagrass species including: Turtle Grass (*Thalassia testudinum),* Manatee Grass (*Syringodium filiforme*) and *Halimeda sp*.. It was also noted that there exists the presence of the Invasive Broad-leaf seagrass (*Halophilia stipulacea)* (Camacho, 2021).

The following are anticipated biological impacts and the mitigations:

- Seagrass will be lost in the dredging activity. However, while the area over which the seagrass was encountered was extensive it is significantly greater that the area that it is to be removed by dredging. It is estimated that less 5% of the area identified for dredging is covered by seagrass. Therefore, while any removal of seagrass is ecologically significant, the overall national and regional impact of the removal of this small area of native seagrass is expected to be minimal. However, the following measures should be considered.
    - The area of seagrass removed should be minimized. The dredging footprint of 800ft by 40ft should be reduced as much as possible and not exceed that area. This requires on site monitoring during the dredging exercise. as well as the placement of limit markers to prevent accidental drifting from the desired dredge area.
    - Fauna observed within the area earmarked for the improvement work should be removed by a team of Divers and be relocated outside of the affected zone prior to dredging.
    - A long-term seagrass and coral reef monitoring program should be developed and implemented by Jumby Bay Resort. Coral reef restoration programs should be considered.
    - No anchoring should be allowed on the seagrass beds to reduce further physical degradation to the ecosystem.
    - Boats should be maintained on mooring systems only

    (CEAS Ltd., 2021)

6.1.4 Socio-Economic Environment

There is expected to be an overall positive impact on the viability of the hotel because of the improved aesthetic conditions of the beach. The following are anticipated socio-economic impacts and the mitigation:

- As the hotel will be closed, dredging activities are not expected to interfere with its recreational activities and the operations
- The dredging activities may impact shipping and navigation approach routes to and from the potential extraction area

All relevant authorities, such as Antigua and Barbuda Department of Marine Services, The Antigua and Barbuda Port Authority and the Coast Guard should be notified of the planned dredging activity and alerted when the start date is determined.

7.0 Risk Analysis

Section 6.0 identified the impacts of the development likely to pose risks to water quality, fisheries resources, livelihoods, benthic ecology, and coastal morphology. Table 7 aims to measure the extent of these impacts and the magnitude of risk absorbed by these key environmental and socio-economic components. Using qualitative ratings from low to high, the impacts on the project site were assessed based on combining parameters such as:

- Nature and Spatial Extent of Potential Impact
- Duration and Direction of Impact
- Permanence

Table 7: Summary of Assessment of Risks, Benefits and Potential Impacts

IMPACTS	MAGNITUDE	NATURE OF POTENTIAL IMPACT	SPATIAL EXTENT	DURATION	DIRECTION OF IMPACT	PERMANENCE
DREDGING PHASE						
Water Quality	Medium-High	Increased sediment suspension in water column	Crabbs Channel	Short term	Negative	Reversible
Fisheries Resources	Low	No significant impact on fisheries	Crabbs Channel	Short term	Negative	Reversible
Livelihoods	Low	Some disturbance of boat traffic at during dredging	Crabbs Channel	Short term	Negative	Reversible
Benthic Ecology	High	Destruction of benthic seagrass in dredged area	Dredge Site	Long term	Negative	Permanent
Coastal Morphology	Low	Larger sand particle size will increase beach stability	Beach	Long term	Positive	Permanent

8.0 Environmental Monitoring and Management Plan (EMMP)

The Environmental Monitoring and Management Plan outlines the responsibilities of those responsible for its implementation. It is a framework for environmental monitoring on the project site.

8.1 EMMP Objectives

- Ensure that preventative measures are in place before and during dredge and fill works
- Ensure any environmental issues are addressed if they arise and the chain of command is adhered to ensure materials are recycled or properly disposed

Monitoring of the marine environment will be conducted visually combined with water quality testing. The monitoring framework reflected below in Table 8, outlines suitable monitoring activity that will be implemented based on the identified impacts to the Marine Environment, Water Quality, and Benthic Ecology in Section 6.0. Monitoring components are designed to quickly identify potential environmental issues to provide prompt recommendations for remedial actions that reduce further negative impacts.

Table 8. Proposed Environmental Monitoring Framework

Impacts	Objective	Priority EIA Recommendations	Monitoring Activity	Monitoring Frequency	Indicators of Change	Potential Impacts
Marine Environ.	Minimize impact on marine ecosystems - seagrass beds and coral reefs	Remaining ecosystems should be preserved Limit dredging area as much as possible.	Seagrass and coral reef surveys	Biennial	Advancement of invasive seagrass and reduction of the native species. Change in species abundance, diversity, quality	Loss of native plants and species habitats Loss of natural vegetation cover High turbidity
Water Quality	Maintain water quality levels	Sedimentation from dredging activity should be limited in scale and time.	Take turbidity and nutrient measurements From a human safety perspective, bacterial checks (Enterococci) should also be executed	immediately after dredging	Diminished water quality	Increased turbidity and bacterial nutrient load

Benthic Ecology	Ensure effectiveness of threatened species monitoring measures		Collaborate with Project Management Team in monitoring the Threatened Species Monitoring Programme. ETC's wildlife experts review implementation of the Threatened Species Monitoring Programme. (avifauna and marine turtles)	Bi-monthly Environment Team Meetings	Changes in distribution and population of threatened species	Decrease in distribution or population size of threatened species
Coastal Morphology	Maintain required water depth around the guest services jetty	Redistribute sand northwards up the beach	Monitor depth of sand along the jetty	Annually	Changes in sand depth	Decrease in water depth

9.0 SUMMARY & CONCLUSION

This study examines the possible impacts the planned dredging works in the nearshore area of Jumby Bay Beach as well as spreading the accumulated sand near the guest dock will have upon the coastal and marine environments. There are a number of components within this project that could potentially affect its effectiveness:

IV. The removal of native seagrass could result in the loss of feeding grounds and habitat for fish, turtles, and other marine organisms. Mitigation measures will involve:
    - IV.I. Reducing the dredging footprint of 800ft by 40ft as much as possible and not exceed that area. This requires on site monitoring during the dredging exercise. as well as the placement of limit markers to prevent accidental drifting from the desired dredge area.
    - IV.II. Fauna observed within the area earmarked for the improvement work should be removed by a team of Divers and be relocated outside of the affected zone prior to dredging.
    - IV.III. A long-term seagrass and coral reef monitoring program should be developed and implemented by Jumby Bay Resort. Coral reef restoration programs should be considered.
    - IV.IV. No anchoring should be allowed on the seagrass beds to reduce further physical degradation to the ecosystem.
    - IV.V. Boats should be maintained on mooring systems only.

II. The site 1000 ft offshore, which was identified for sourcing the sand to replace the silty material did not contain the required particle size that would. Hence, its ability to remain within the swim area could not be guaranteed. Other sites within the vicinity were also examined and were found to not contain suitable material either. Hence, it was decided that the sand for replacing the silt will be sourced from Barbuda.

III. The redistribution of the accreted sand from alongside the guest arrivals jetty is advisable in order to maintain the necessary water depth and to accommodate the docking of vessels.

10.0 Bibliography

Baldwin, J. (2000). Tourism Development, Wetland Degradation and Beach Erosion in Antigua, West Indies. Unpublished

Brodersen KE, Lichtenberg M, Paz L, Kühl M. (2015) Epiphyte-cover on seagrass (Zostera marina L .) leaves impedes plant performance and radial O 2 loss from the below-ground tissue. 1-11. https://doi.org/10.3389/fmars.2015.00058

Camacho R. (2019). NDNP Biological Assessment Report - Seagrass. Unpublished

Camacho R, Steele S, Challenger S, Archibald M. (2020). Status of coral reefs in Antigua & Barbuda: using data to inform management. PeerJ.(6):1-20. https://doi.org/10.7717/peerj.9236

Camacho R, Hay B. (2020). Mangrove Wetland Surveys of the Nelson Dockyard National Park. Available at: https://www.nationalparksantigua.com/eco-wetlands/

Camacho, R. (2021). Jumby Bay Silt Removal: Benthic Marine Assessment Report. Unpublished

Canari, (2017). Snapshot of the North-East Marine Management Area. Available at: https://canari.org/wp-content/uploads/2018/08/profile-north-east-marine-management-area-anu.pdf

CEAS Limited (Ltd) (2021). Jumby Bay Island Resort Coastal Assessment of Proposed Beach Enhancement by Blue Ocean. Unpublished

Cooper, Brian; Bowen, Vincent (2001). Integrating Management of Wetlands and Coastal Areas in Small Island Developing States of the Caribbean. National Report for Antigua and Barbuda. Ministry of Tourism and Environment, Environment Division.

de Boer WF. (2007) Seagrass–sediment interactions, positive feedbacks and critical thresholds for occurrence: a review. Hydrobiologia.;591:5-24. https://doi.org/10.1007/s10750-007-0780-9

Department of Analytical Services, DOAS. (2021).

ECL. (2007). North East Marine Management Area (NEMMA), Antigua Site Report. Available at:

Encircle, (2021). Stingray City at Mercer's Creek Bay, Seatons Village Antgua. Available at: https://www.encirclephotos.com/image/stingray-city-at-mercer-creek-bay-in-seatons-village-antigua/

Environmental Awareness Group, EAG. (1997). The Offshore Islands of Antigua. *Unpublished*

Espeut, P. (2006). Opportunities for Sustainable Livelihoods on One Protected Area in each of the Six Independent OECS Territories, for the OECS Protected Areas and Sustainable Livelihoods (OPAAL) Project. *Unpublished*

Florida Fish and Wildlife Conservation Commission, FWC (2021) Importance of Sea Grass. Available at: https://myfwc.com/research/habitat/seagrasses/information/importance/

Fourqurean JW, Muth MF, Boyer JN, Keys F. (2010) Epiphyte loads on seagrasses and microphytobenthos abundance are not reliable indicators of nutrient availability in oligotrophic coastal ecosystems. Mar Pollut Bull. ;60(7):971-983. Available at: https://doi.org/:10.1016/j.marpolbul.2010.03.003

Fourqurean JW, Duarte CM, Kennedy H, et al. (2012) Seagrass ecosystems as a globally significant carbon stock. Nat Geosci.;5:505-509. https://doi.org/10.1038/ngeo1477

Gilbert HJ. Receiver functions in the western United States, with implications for upper mantle structure and dynamics. J Geophys Res. 2003;108(B5). https://doi.org/10.1029/2001JB001194

Grossman AR, Schaefer MR, Chiang GG, Collier JL. The Responses of Cyanobacteria to Environmental Conditions: Light and Nutrients. In: Bryant DA, ed. The Molecular Biology of Cyanobacteria. Springer, Dordrecht; 1994:641-675. Available at: https://doi.org/10.1007/978-94-011-0227-8_21

Heck Jr KL, Nadeau DA, Thomas R.(1997). The Nursery Role of Seagrass Beds. Gulf Mex Sci. 1997;15(1):1. https://doi.org10.18785/goms.1501.08

Heck Jr KL, Hays G, Orth RJ. (2003). Critical evaluation of the nursery role hypothesis for seagrass meadows. Mar Ecol Prog Ser.253:123-136. Available at: https://www.disl.edu/assets/uploads/publications/2003_heck_etal_meps_v253.pdf.

Jackson I. (2008). North East Marine Management Area (NEMMA). Available at: https://parkscaribbean.net/wp-content/uploads/2013/11/North-East%20Marine%20Management%20Area%20(Antigua)%20Management%20Plan%202007-2010.pdf

Jackson JBC, Donovan MK, Cramer KL, Lam W. (2014). Status and Trends of Caribbean Coral Reefs: 1970-2012. Unpublished

Kohler KE, Gill SM. Coral Point Count with Excel extensions (CPCe) (2006).: A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. Comput Geosci. ;32(9):1259-1269.

Kramer P, Roth L, Constantine S, et al. (2016). Antigua & Barbuda's Coral Reef Report. *Unpublished*

Ministry of Health, Wellness, and the Environment, MHWE (2020). Health & Climate Change Country Profile 2020: Small Island Developing States Initiative Available at: https://cdn.who.int/media/docs/default-source/climate-change/who-unfccc-cch-country-profile-antigua-barbuda.pdf?Sfvrsn=b73692e7_2&download=true

Nagelkerken I, van der Velde G, Gorissen MW, Meijer GJ, Van't Hof T, den Hartog C.(2000). Importance of Mangroves, Seagrass Beds and the Shallow Coral Reef as a Nursery for Important Coral Reef Fishes, Using a Visual Census Technique. Estuar Coast Shelf Sci.51(1):31-44. https://doi.org/10.1006/ecss.2000.0617

Palmer SE (UWI/MONA). AGRRA REEF ASSESSMENT & TEAM SUPPORT , NEMMA , ANTIGUA. *Unpublished*

Philmore, J. (2003). Analysis of Beach Changes in Antigua and Barbuda 1996-2001. Volume 1 – Assessment Report. Unpublished

Visitantiguabarbuda, (2021). Stingray City Operations located in the NEMMA. Available at: https://visitantiguabarbuda.com/destinations/stingray-city/

Winters G, Beer S, Willette DA, et al. (2020). The tropical seagrass halophila stipulacea: Reviewing what we know from its native and invasive habitats, alongside identifying knowledge gaps. Front Mar Sci;7(May):1-28. https://doi.org/10.3389/fmars.2020.00300

Willette DA, Ambrose RF(2012). Effects of the invasive seagrass Halophila stipulacea on the native seagrass, Syringodium filiforme, and associated fish and epibiota communities in the Eastern Caribbean. Aquat Bot.103:74-82. https://doi.org/10.1016/j.aquabot.2012.06.007

APPENDICES

Appendix 1: EIA Outline

Executive Summary

This section allows for a clear understanding of the project proposal and summarize the significant results of the EIA study, e.g. positive and negative environmental, social and economic impacts, options considered, reasons for selection of the proposed options for design and density, and the measures to be implemented to prevent or mitigate negative impacts or capitalize on positive impacts.

1.0 Introduction

This chapter should will cover the following:

- Profile of the project proponent, name and contact address, implementing organization, organizational chart, project consultants etc., should be mentioned clearly.
- Purpose of the project, brief description of the project- name, nature, size, location of the project, its importance to the country.
- Description of national and local regulations and standards applicable to area development projects should be discussed.

2.0 Project Description

This chapter covers the broader details of the basic activities, location, zoning plan and specific site plan for the hotel as well as implementation schedule of the project.

2.2 Project Benefits

This section details the improvements in physical infrastructure and social infrastructure if any. Also, it details any employment potential and other benefits that are accrued if the project is taken up.

2.3 Analysis of alternatives (Technology & Sites)

The EIA may find that there is a need to develop alternatives to the original intent of the developer. A clear description of each alternative, summary of the impact – adverse and positive – within the site as well as the cumulative impact when considering other inputs into the environment. ***Selection of alternatives are detailed out.***

3.0 Methodology

The EIA outlines the process used to collect information and data.

4.0 Environmental Baseline

Collect environmental data to establish a reference point as to the quality of environmental features prior to the execution of the project. Specific areas to be reported on:

4.4 Biological Environment

An inventory, inclusive of lists and maps of ecosystems and species within the general zone of the project site, is to be prepared along with a description of the vegetation. If there are any rare and endangered species in the study area they are to be clearly mentioned. Details for fauna and flora to be included are:

- General type and dominant species
- Densities and distributions
- Habitat value

- Historically /commercially important species
- Rare and Endangered species (location, distribution, conditions etc.)
- Specimen of scientific or aesthetic interest
- Presence of invasive flora and fauna documented.

4.5 Socio Economic & Health Environment

Baseline data should include the demography, nearest settlements, and, existing infrastructure facilities in the proposed area. Present employment and livelihood of these populations and awareness of the population about the proposed activity should also be included.

5.0 Anticipated Environmental Impacts and Mitigation Measures:

5.1 Prediction of Impacts:

This describes the likely impact of the project on each of the environmental parameters, methods adopted for assessing the impact such as model studies, empirical methods, reference to existing similar situations, details of mitigation, methods proposed to reduce adverse effects of the project, best environmental practices, conservation of natural resources; environmental management plan; as well as post project environmental monitoring programme including budgeting for the expenditure proposed in the project

Given the nature of the proposed development and the sensitive environment in which it is to be located, the investment is exposed to projected impacts of climate change. To ensure that the development is climate-resilient, potential impacts are to be assessed and mitigation measures proposed in the planning and assessment stage (See table 3 below as a guide).

Table 3: Summary of risks associated to climate change impacts and mitigation measures

Impact	**Brief Description**	**Risk Significance High/Medium/Low**	**Mitigation Measures**
Extreme rainfall event			
Extreme drought			
Extreme atmospheric temperatures			
Hurricanes			
Sea Level Rise			
Other			

Discuss emergency plans for any environmental risks such as earthquakes, hurricanes, surges, flooding, etc.

7.0 Environmental Monitoring and Management Plan (EMMP)

A draft environmental monitoring and management plan is included which will detail the monitoring requirements for during- and post dredge and fill works. This will include recommendations to ensure the documented

implementation of mitigation measures and long-term minimization of negative impacts and maximization of positive impacts.

8.0 Summary & Conclusion

This section summarizes the significant findings of the EIA report. The summary must describe each significant environmental issue and its resolution in sufficient detail so that its importance and scope, as well as the appropriateness of the approach taken to resolve it are well understood.

ANNEX 1 Disclosure of consultants engaged

This chapter shall include the names of the consultants engaged with their brief resume and nature of consultancy rendered.

ANNEX 2 Declaration of Completeness and authenticity

This section is to be in the form of a letter from the EIA consultant containing an indication of the completeness of the work and the authenticity of the information reported.

ANNEX 3 Enclosures

Conceptual plan / Questionnaire / Photos/ Maps/ Full Technical studies

ANNEX 1 Disclosure of consultants engaged

C . E A . S
CIVIL ENGINEERING
& Associated Services Ltd.
#43 High Street, St. Johns Antigua Tel 764-2327
or 562-2327

Civil Engineering and Associated Services Limited (CEAS Ltd.) is a totally locally owned Engineering and Construction Company. The Company was established by three directors: Reuben Everon Zachariah (Engineer), Steve Graham (Architect) and Bertrand Joseph (Engineer) in 2005 to provide a wide range of services in the Engineering, Architecture and Construction Field. Mr. Graham and Mr. Joseph although still part of the company have migrated to Canada and Africa, where they currently work. CEAS ltd. is currently managed by its Principal R. Everon Zachariah.

CEAS Ltd. has been an integral part of the Antiguan Landscape in the field of Engineering, Architecture and Construction. More recently the concentration has been on Engineering and Construction with less on Architecture. We have also been involved in the field of Valuation and Estimating and have built significant experience in this field and in Damage Assessments and Cost Estimating for remedial works.

In addition to Mr. Zachariah who is the Owner and Principal, the company employs another full time engineer, and a draughtsman and architect as needed. We have also collaborated with other in the field to supplement areas that we may not be strong in or to address projects for which we may be too small on our own. We have collaborated extensively with KNYKO Studios an architectural firm, on several projects and also with Ivor Jackson & Associates in carrying out Environmental Impact Assessments.

Civil Engineering & Associates Services boasts that it has the resources to undertake most types of development which normally occurs in Antigua and Barbuda from inception to finish. Be it a simple modification, or a complex Development we are have the experience and desire to have the project completed expeditiously.

We have been involved in the soil investigation/ geotechnical analysis and foundation design for several buildings and structures including the V.C. Bird International Airport and the Newly Proposed Callaloo Cay Development at Morris Bay; We have also been involved in the preparation of a Development Plans for Housing Development along with the architectural and structural designs for several single, two, three and four storey buildings;

The company has also been involved in the supervision of several engineering works including the dredging of the Deep Water Harbour, the stage valuations for Citizenship by

Investment CIP Dieppe Bay Condominium Development. It principal also has significant experience while working with another company in road construction and infrastructural development.

Civil Engineering and Associated Services Ltd. have undertaken and completed the construction of several buildings including the complete renovation and remodeling of the CIBC First Caribbean Bank on Old Parham Road, The Top Ranking Store & Top Ranking Inn on Old Parham Road; The Video Makers Studio in Clarehall along with several other Private Residences

The company has carried out the Structural Design for private dwelling, commercial or industrial development including the Condominium Units for Non Such Bay Development, and several high end commercial dwelling properties.

Our Office is located on the upper floor of the Zachariah's Building, at #43 High Street opposite Deluxe Cinema. We can also be reached by telephone or email as follows:.

Office: 562-CEAS (2327)
Mobile: 764-CEAS (2327)
Email: ceas@candw.ag
Or ceaseveron @hotmail.com

Mailing address: CEAS ltd.
P.O. Box 2101
St. John's, Antigua

The following are but a few of the services the Company provides:

a) Structural Design
b) Architectural Design and Project Development
c) Construction
d) Project Management and Engineering Supervision
e) Land & Infrastructure Development
f) Construction or Design & Supervision of Road and Drainage Infrastructure
g) Property Valuations
h) Structural Evaluation of Buildings
i) Damage Assessment and Estimates
j) Coastal Engineering Consultancy & Design
k) Coastal Erosion Assessment and Design of Remedial works
l) Coastal zone management

Our firm offers a one stop shop where a wide variety services from project inception, development and design, to costing and finally construction are available. Being both an engineering and construction firm, we offer a high level and quality of construction which is difficult to surpass. We offer that additional level of comfort that one will be getting top quality for the monies being invested.

Civil Engineering & Associated Services Ltd.- Engineering is our Name

RESUMÉ: LUCIA MINGS

PROFESSIONAL EXPERIENCE

5/2007 – present **Environment Tourism Consulting Ltd.**: *Founder & Managing Director*

ENVIRONMENTAL COMPLIANCE RELATED

- Led team of professionals to carry out a Scoping and Baseline Assessment of Valley Church Beach for a proposed hotel development.
- Led team of professionals to carry out an Environmental Impact Assessment for a proposed Courtyard by Marriot Hotel at the VC Bird International Airport, Antigua
- Led team of professionals to carry out an Environmental Impact Assessment for Falmouth Harbour Restaurant and Jetty.
- Led team of professionals to conduct an Environmental Impact Statement for Barbuda Belle Hotel Development, Cedar Tree Point Barbuda.
- Environmental compliance monitoring for a proposed Autograph/Marriott Resort in Yeptons, Antigua.

- Carried out an environmental audit of the Gilberts Agricultural and Rural Development Center (GARD)
- Environmental compliance monitoring for a proposed Callaloo Cay Resort development on Morris Bay, Antigua and engaging the adjacent community of Old Road along with relevant government agencies to address existing storm water runoff, erosion and beach access issues.
- Assisted Ivor Jackson and Associates with implementing Environmental Impact Assessments by assessing project impacts on wildlife and habitats; assessing socio-economic and cultural impacts and advising on best practices for solid waste, wastewater, energy supply, land use and stakeholder involvement.
- Stakeholder outreach in St. Kitts and Nevis to find solutions to biodiversity loss and diminished ecosystem functions within its terrestrial national parks under a UNDP-managed project to carry out an ecological survey of its protected areas.
- Monitored EIA compliance of major hotel and other developments on Antigua on behalf of the Environment Division, Ministry of Agriculture and Environment.
- Assisted the GEF SGP with carrying out Vulnerability Risk Assessments in several communities in Antigua & Barbuda and wrote corresponding Disaster Risk Reduction grant proposals to Australian AID and UNDP.

OTHER

- National Project Coordinator of FAO's CC4Fish climate adaptation in the fisheries sector project in Antigua and Barbuda.
- Led consultancy team to prepare an "Updated Ecosystem Assessment and Land Use Zoning Plan for the Body Ponds Watershed" under the UNDP full size project - Sustainable Island Resource Management Mechanism (SIRMM) where GIS maps, biodiversity and natural resources inventory, social impact assessment, cost-benefit analysis, land use management plan and an environmental impact assessment were developed.
- From 2013 – 2014 facilitated negotiations between The Nature Conservancy (TNC) and the Government for establishing a National Protected Areas Trust Fund under the World Bank implemented project - Sustainable Financing and Management of the Eastern Caribbean Marine Ecosystem Project in Antigua and Barbuda.

- Developed Communities Adapting to Climate Change Training Programme and worked with four Antiguan communities to develop projects aimed at building their resilience to the effects of climate change.
- Project Manager for the Environmental Awareness Group's "Protection of Watershed Functions and Sustainable Use of Plant Biodiversity in Antigua and Barbuda" project.
- Led consultancy to zone and GIS map the newly formed Codrington Lagoon National Park in Barbuda.
- As a senior consultant for the Island Resources Foundation (IRF) conducted socio-economic research and prepared environmental, socio-economic and livelihoods assessments for Grenada and St. Kitts for the OECS' Protected Areas and Associated Livelihoods Project. Developed creative mechanisms to enhance livelihoods through creation of new forest reserves.
- As a senior consultant for IRF facilitated surrounding communities' inputs in developing natural resource maps for the "Assessing and Mapping the Southwest Region of Antigua" under the SIRMM's Ridge to Reef Demonstration Project.
- Assisted Antigua and Barbuda GEF SGP with carrying out Vulnerability Risk Assessments in several communities; wrote corresponding Disaster Risk Reduction grant proposals to Australian AID and UNDP and facilitated GEF OP6 National Consultation where priorities, targets, indicators and project ideas were developed.
- As National Researcher for the International Union for the Conservation of Nature (IUCN) conducted an assessment of Antigua and Barbuda's National Biodiversity Strategy and Action Plan development and review processes and prepared a monograph for presentation at the Convention on Biological Diversity's COP12.
- Advised the Development Control Authority on the establishment of regulations for its Physical Planning Act 2003. Conferred with relevant stakeholders to understand their challenges, discuss possible solutions and made recommendations to the Authority on how these could be remedied within the Regulations.
- Country-based Researcher in support of UNHABITAT and OECS project to develop a "Country Level Land Policy Issues Paper". Information and documents relevant to developing land policy were collected and collated from public and civil society sectors for further use in developing the Land Issues Policy Paper for Antigua and Barbuda.
- As primary trainer for Global Water Partnership trained water management technicians across Antigua on Water Use Efficiency in the tourism and water sectors.
- Prepared Communications Strategy for the SIRMM.

1/2005 – 6/2007 **Antigua LOC, ICC Cricket World Cup West Indies 2007:** *National Hosting Programme Coordinator (Communications)*

- Developed key priorities, strategies and budgets on the event's execution in collaboration with the CEO and ICC Cricket World Cup West Indies 2007 (CWC 2007) in areas such as airport renovations and visitor experience, licensing, merchandising and volunteer management.
- Worked closely with the Government's Tourism, Aviation and Information departments to coordinate the country's visitor experience, accommodations, marketing and public information preparations for CWC 2007 by either chairing or participating on executive committees.
- Worked with various stakeholder groups such as vendors, crafts people and merchants to explain the benefits of the event to them and provided guidance for their involvement
- Spearheaded and participated in the LOC and Ministry of Tourism's tour of the United States, Canada and Britain to promote the Country's hosting of ICC CWC 2007.
- Managed 5 technical and 1 administrative staff.

1/2004- 12/2004 **Environmental Awareness Group:** *Executive Director*

- Managed this NGO day to day, including accounting, public relations, contracting

consultants, liaising with governing executive council. Represented the organization at national and regional consultations to establish and strengthen partnerships.

- Facilitated strategic planning and financial reviews for the organization.
- Designed Antigua and Barbuda's CREP project for over EC$360,000 (€100,000), for the development and implementation of a management plan for the Codrington lagoon, Barbuda; trained community members in stakeholder identification and analysis; and coordinated the island's Stakeholder Management Board.
- Implemented a EC$123,500 (€34,000) ecotourism project, funded by the European Union, which facilitated ecotourism training, sustainable livelihoods and protected areas management workshops for tour operators and community groups.
- In close collaboration with the writer produced a Wildlife Guide for the organization.
- Acquired a grant for EC$94,000 (US$35,000) from the Caribbean Natural Resources to improve civil society organizations' participation in governance and national decision-making.
- Coordinated the organization's implementation of other environmental education, management and conservation projects funded by the GEF, Organization of American States, Fauna and Flora International, International Fund for Animal Welfare among others.
- Editor of the organization's newsletter, the EAG'er.

10/2002-12/2003 **Environmental Awareness Group:** *Assistant and Acting Executive Directors*

- Responsibilities as above.

EDUCATION

2016 **Institute of Environmental Management and Assessment**

- ISO 14001:2015 Lead Environmental Auditor Course

2015 **Cousera.org: University of Geneva**

- Statement of Accomplishment in Pathways to Climate Change Adaptation: The Case of Small Island Developing States

2003 – 2015 **Certificates in the following areas:**

- Traditional Knowledge and Customary Sustainable Use under the Convention on Biological Diversity
- Proposal writing for OECS and GEF grants; Caribbean bird conservation (developing national policies, public awareness and monitoring); Communications and Crisis Management; Protected Areas planning and Management; Participatory Planning and Collaborative Management; Environmental Management; Data Collection Protocols and Participatory Research Techniques.

2008 **University of Bath, Bath, England**

- Continuing Professional Development Certificate in Environmental Impact Assessment.

1999-2000 **Canterbury Christ Church University, England**

- MSc in Tourism and Environmental Management. Course work included GIS, tourism marketing, human resource management, tourism management in developing countries and issues in tourism and environmental management.

1996-1999 **University of the West Indies, Cave Hill Campus, Barbados**

- BA (Hons) in History. Course work included Caribbean political economy, business law, economic history of West Africa since 1880, women and gender in the history of the English speaking Caribbean, society and economy in the British Caribbean 1830-1870 and West Indian literature 1.

ADDITIONAL INFORMATION

- Amateur bird watcher;
- Past board member of the EAG;

Ruleo Camacho

Marine Ecologist (MSC: Marine Biology, MSC: Marine Policy)

Skill Sets:

UAS operation:

- Extensive experience in the operation of Unmanned Aerial Systems (drones) in biodiversity and ecosystem assessments. The use of drones allows for an aerial overview of ecosystems, which allows for a unique perspective of the pressures facing these ecosystems while reducing the impact footprint of the investigation and assessment.

Marine Surveys:

- Trained in the assessment of marine ecosystems to assess health, biodiversity and to determine pressures facing them. Trained in Atlantic Gulf Rapid Reef Assessment (AGRRA) survey methodologies. The following ecosystems can be assessed: Coral Reefs, Rocky Reefs, Seagrass Beds, and Mud Flats. Assessments can be carried out via snorkel/ scuba methods, or from the surface.
- Assessment of Mangrove Wetlands to determine status of the wetland ecosystem, including: Identification of Mangrove types and distribution, general health of the mangrove wetlands, identification of point sources of pollution and other pressures facing the mangroves, impacts of development on the wetland ecosystem.
- Pollution Sources: Experience in assessing marine ecosystems to determine the point sources of pollution and/or potential point sources of pollution and trained in the collection of water samples to determine water quality.
- Experience in assessing beaches for turtle nest and turtle nesting potential, impact of development on nesting beaches, and mitigation measures.
- Knowledge of ecosystem habitats in Antigua & Barbuda, and the pressures they face from anthropogenic and natural systems.
- Interview of marine resource users and stakeholders, and analysis and write-up of data.

Terrestrial Surveys

- Experience in assessing species richness of terrestrial fauna, inclusive of endangered reptiles and bird counts.
- Experience in calculating density of forest cover.
- Experience in following methodologies to establish terrestrial ecosystem habitat assessment. I have assisted and conducted

Writing

- Skilled in drafting, editing and reviewing peer-reviewed literature. I’m experienced in conducting background research on various ecological issues and impacts, while determining mitigation suggestion for various development and environmental pressures.Experience in review of development applications, using an understanding of the environmental conditions and regulations in Antigua & Barbuda to determine potential outcomes and best-practices.
- Scientific reports and data and statistical analysis.
- Media reports to help to explain science in everyday terms. Experience in writing science articles for newspapers, teaching science, and explaining scientific outputs to the public.

ANNEX 2 Declaration of Completeness and authenticity

Declaration of Completeness and Authenticity

I, Lucia Mings, Managing Director of Environment Tourism Consulting limited (ETC ltd.), hereby declare that the report entitled " ENVIRONMENTAL IMPACT ASSESSMENT JUMBY BAY BEACH: Silt Removal and Replacement" submitted to the Development Control Authority, is true and complete.

Ms. lucia Mings
Managing Director
ETC ltd.

Appendix 2

BLUE OCEAN MARINE LTD.
P.O. Box W653, Unit No. 22
Mandolin Place, Friars Hill
Road St. John's,
Antigua
Phone +1 268 562 6192
Fax +1 284 494 7136

a. General liability insurance with limits of liability not less than US $1,000,000.00 per occurrence and US $2,000,000.00 in aggregate
b. Vessel pollution coverage U.S. $1,000,000.00 each occurrence and U.S $1,000,000.00 aggregate; and
c. Completed products insurance of U.S. $2,500,000.00 per occurrence and U.S. $4,000,000.00 in aggregate.
d. Marine and construction equipment insurance including hull, machinery, and third party liabilities. Client agrees that Contractor's current terms and levels of insurance are acceptable. Client acknowledges its responsibility for builder's risk and shall insure builder's risk as Client deems prudent, at Client's expense. Client acknowledges that Contractor has no responsibility for builder's risk. Additional insurance is not quoted or included.

12. Stoppage for reasons outside the control of Contractor such as but not limited to: authorities, conflicts with other contractors, environmentalists, fishermen, or other third parties will be charged at daily rates.
13. Client or Contractor may terminate the Contract of Change of Conditions or Force Majeure. In the event of termination, Client will pay Contractor for Contractor's work to date, within 5 days.
14. The pricing quoted is valid for 10 days. The equipment needed to perform this work is also required for other outstanding quotations. Projects will be accepted on a "first come, first served" basis.

Payment Terms:

15. 25%, i.e. US $93,750.00, of quoted amount shall be payable in advance. Progress payments shall be processed weekly, with payment 5 days after submission of pay application. Final payment shall occur within 10 days of project completion.
16. Client will notify Contractor in writing within five (5) days of submission of progress payment of any dispute or refusal to recommend payment in full. Contractor shall have opportunity to cure.
17. Client shall pay costs of collections, including costs of travel, reasonable attorney fees, and interest on past due amounts at 1.5% per month
18. Payments will be made wire transfer to Contractor's account as directed.
19. There shall be no retention on this project.
20. All currency figures in the contract are in U.S Dollars

BLUE OCEAN MARINE LTD.
P.O.Box W653, Unit No.22
Mandolin Place, Friars Hill Road
St. John's, Antigua
Phone + 1 268 562 6192

BLUE OCEAN MARINE LTD.
P.O. Box W653, Unit No. 22
Mandolin Place, Friars Hill
Road St. John's,
Antigua
Phone +1 268 562 6192
Fax +1 284 494 7136

ACCEPTED:	CONFIRMED:
The above prices, specifications and conditions are satisfactory and are hereby accepted. By signing, I certify that I have authority to bind Client to the terms of this Contract, and sufficient funds are approved and dedicated to pay for this Contract. **Client:** Jumby Bay Island Ltd. **Authorized Signature:** _____ **Print Name & Title:** Ian Steele, VP Operations & Infrastructure	**CONTRACTOR:** Blue Ocean Marine Ltd. **Authorized Signature:** **Print Name & Title:** Conley Browne, General Manager

BLUE OCEAN MARINE LTD.
P.O.Box W653, Unit No.22
Mandolin Place, Friars Hill Road
St. John's, Antigua
Phone + 1 268 562 6192

GOVERNMENT OF ANTIGUA AND BARBUDA

July 14, 2021

Department of Environment
Ministry of Health and the Environment
#1 Victoria Park, Botanical Garden
P.O, Box W693
St. John's
Antigua, W.I.
Tel: (268) 462-6265
Fax: (268) 462-4625
Email: antiguaenvironmentdivision@gmail.com

Chief Town and Country Planner,
Development Control Authority
Transport Board Head Quarters
Herbert's Estate
P.O. Box 895
St. John's
Antigua

REF #D.o.E 9/6 F6

Review of Plan Application #G13-2021 – Sand Removal

Dear Mr. Southwell,

The Department of Environment (DoE) has conducted a review of Plan Application #G13-2021 for the removal of buildup of sand from alongside the guest dock on Jumby Bay Island. The site was assessed with officers from the Development Control Authority (DCA) and the DoE, on May 14, 2021.

In completion of the review, the DoE reminds the DCA that such activities are considered dredging and as such, trigger a mandatory requirement for Environmental Impact Assessments (EIAs) under the Physical Planning Act (PPA) No.6 of 2003. To this end, the DoE cannot recommend approval for this activity without the commissioning of an EIA. To guide the preparation of the EIA, the Terms of Reference (ToR) can be obtained from the DoE.

Best Regards,

.....

Director
Department of Environment

Development Application: Location:	G13-2021, Jumby Bay Island Company Jumby Bay Island
Proposal Concept:	Sand Removal
Date Received:	May 10, 2021
Site Visit:	May 14, 2021
Report Submitted:	July 14, 2021
Recommendation:	EIA required
EIA Request	EIA - Dredging
Legislative/ Policy Considerations:	EPMA PPA Fisheries Act
Environmental Risks/Concerns:	Dredging
Lead Author Reviewed by: Approved by:	Arry Simon, Climate Assessment Officer Ato Lewis, Senior Environmental Officer Jenniael Flermius, Apprentice Diann Black-Layne, Director

Initials of Dir

INTRODUCTION

The Department of Environment (DoE) has conducted a review of Plan Application #G13-2021 for the removal of sand buildup from alongside the guest dock on Jumby Bay Island. A site inspection was conducted with officers from the Development Control Authority (DCA) and the DoE, on May 14, 2021. Note that a final report with recommendations from the Fisheries Division on this issue is necessary since the site is located within the NEMMA.

LOCATION & DESCRIPTION OF PROJECT

The proposed site is located on the western coastline of the island. There was no information presented with the application relating to how the scope of work will be executed.

RISKS IDENTIFIED

Dredging

The DoE is concerned about the impacts the planned activities will have on marine life and sediment transport. The Department would remind the DCA that dredging of sand, under the Physical Planning Act, requires an EIA. The developer is therefore required to address this issues.

RECOMMENDATIONS

In completion of the review, the DoE reminds the DCA that such activities are considered dredging and as such, trigger a mandatory requirement for Environmental Impact Assessments (EIAs) under the Physical Planning Act (PPA) No.6 of 2003. To this end, the DoE cannot recommend approval for this activity without the commissioning of an EIA. To guide the preparation of the EIA, the Terms of Reference (ToR) can be obtained from the DoE.

.....

Initials of Dir

Appendix 3

GOVERNMENT OF ANTIGUA AND BARBUDA

July 14, 2021

Department of Environment
Ministry of Health and the Environment
#1 Victoria Park, Botanical Garden
P.O, Box W693
St. John's
Antigua, W.I.
Tel: (268) 462-6265
Fax: (268) 462-4625
Email: antiguaenvironmentdivision@gmail.com

Chief Town and Country Planner,
Development Control Authority
Transport Board Head Quarters
Herbert's Estate
P.O. Box 895
St. John's
Antigua

REF #D.o.E 9/6 F6

Review of Plan Application #G13-2021 – Sand Removal

Dear Mr. Southwell,

The Department of Environment (DoE) has conducted a review of Plan Application #G13-2021 for the removal of buildup of sand from alongside the guest dock on Jumby Bay Island. The site was assessed with officers from the Development Control Authority (DCA) and the DoE, on May 14, 2021.

In completion of the review, the DoE reminds the DCA that such activities are considered dredging and as such, trigger a mandatory requirement for Environmental Impact Assessments (EIAs) under the Physical Planning Act (PPA) No.6 of 2003. To this end, the DoE cannot recommend approval for this activity without the commissioning of an EIA. To guide the preparation of the EIA, the Terms of Reference (ToR) can be obtained from the DoE.

Best Regards,

Director
Department of Environment

Development Application: Location:	Jumby Bay Island Company Jumby Bay Island
Proposal Concept:	Silt removal
Date Received:	May 10, 2021
Site Visit:	May 14, 2021
Report Submitted:	July 14, 2021
Recommendation:	More information required: Benthic & Coastal Studies
EIA Request	EIA - Dredging
Legislative/ Policy Considerations:	EPMA PPA Fisheries Act
Environmental Risks/Concerns:	Seagrass destruction and dredging
Lead Author Reviewed by: Approved by:	Arry Simon, Climate Assessment Officer Ato Lewis, Senior Environmental Officer Jenniael Flermius, Apprentice Diann Black-Layne, Director

Initials of Dir

INTRODUCTION

The Department of Environment (DoE) has conducted a review of request for the removal of silt on Jumby Bay Island. A site inspection was conducted with officers from the Development Control Authority (DCA) and the DoE, on May 14, 2021. The concerns and recommendations of the DoE are listed below. Note that a final report with recommendations from the Fisheries Division on this issue is necessary since the site is located within the NEMMA.

LOCATION & DESCRIPTION OF PROJECT

The proposed project site is located on the western coastline of Jumby Bay Island and encompasses the entire section currently cordoned off for sea bathers. Jumby Bay Island Company proposes to excavates silt from this area which contained seagrass and other living organisms.

The proposal entails excavating silt approximately 800ft x 40ft x 16 ft inches deep, disposal of silt, then replacement with suitable sand from about 1,000 ft offshore.

RISKS IDENTIFIED

Seagrass destruction and dredging

The proposed location contains seagrass meadows. Meadows are essential for the marine ecosystem as it provides a home or feeding area for more than 1,000 species of fish and sea turtles. Seagrass holds underwater soil (known as sediment) together, which helps to protect the coasts from the impacts of storms and large waves, by preventing coastal erosion.

The DoE is concerned about the impacts the planned activities will have on marine life and sediment transport. The Department would remind the DCA that dredging of sand, under the Physical Planning Act, requires an EIA. The developer is therefore required to address these issues.

Finally, Jumby Bay Island Company is recommended to seek guidance on the removal of flora and fauna from the seafloor, as well as any dredging and/or extraction activities from the Fisheries Division before the DoE can make any proper recommendations.

RECOMMENDATIONS

In completion of the review, the DoE cannot recommend approval for activities relating to seagrass removal. More information is required, and as such, recommend that a benthic and coastal study be conducted to provide the best recommendations for the project site.

Also, given the area is located within the NEMMA, and proposed activities; the Fisheries Division should be informed of this application and be able to provide recommendations as well.

Initials of Dir

Appendix 4: Blue Ocean Marine Ltd Proposal for the Removal of Silt to be Replaced with suitable sand, May 7, 2021

BLUE OCEAN MARINE LTD.

P.O. Box W653, Unit No. 22
Mandolin Place, Friars Hill
Road St. John's,
Antigua
Phone +1 268 562 6192
Fax +1 284 494 7136

Mr Ian Steele
Jumby Bay Island Ltd.
P.O. Box 423
St John's, Antigua
Office - 268 5624022
Mobile-268 764 0422

May 7, 2021

Dear Sir:

RE: Proposal for the Removal of silt and to be replaced with suitable sand

We hereby submit our proposal for the following scope of works.

1. Excavate silt from swimming area and load onto Barge.
2. Off load Barge and stockpile silt in designated area with trucks.
3. Excavate suitable sand onto Barge.
4. Place suitable sand back in swimming area.

This proposal is based on Excavating silt approximately 800ft x 40ft x 16 inches deep, disposal of silt, then replace with suitable sand from about 1,000 feet offshore.

We hereby submit a price of US $375,000.00.

Included in the price are the following:

- Mobilization and Demobilization of Equipment, in Antigua.
- Excavating silt and sand only.
- Transporting and offloading Barge.
- Trucking silt from barge to disposal site.
- Supervision and coordination of the work with owner
- The price is based on quantities within the swimming area.

Terms and Conditions:

1. Contractor will provide operated and fueled usage of its mechanical dredging equipment's, operations are restricted to daylight hours. Barge movements are subject to maneuverability and

BLUE OCEAN MARINE LTD.
P.O.Box W653, Unit No.22
Mandolin Place, Friars Hill Road
St. John's, Antigua
Phone + 1 268 562 6192

P.O. Box W653, Unit No. 22
Mandolin Place, Friars Hill
Road St. John's,
Antigua
Phone +1 268 562 6192
Fax +1 284 494 7136

draft limitations. Contractor barge requires 6ft draft when loaded in order to execute this particular job. Contractor will provide the following equipment:

a. Spud barge 2502 with bin wall, ramp, and winch (200ft x 54ft x 12ft)
b. 100 ton Hitachi ZX750 long stick excavator
c. Cat 330 excavator
d. Push boat abby

2. The following drawing is incorporated into this proposal as Exhibit A:
   a. Shot of Jumby bay beach from google earth outlining work areas.
3. This is a lump sum contract for a maximum of 10 working days at 10hrs per day.
4. Client shall clearly mark all pipelines or utility crossings and specify depth. Contractor shall bypass pipelines and utility crossings. Contractor is not liable for damage to unmarked or incorrectly marked or incorrectly specified utility crossing or interruptions of associated service.
5. No allowance is made for import duties, stamp tax, equipment deposit, brokerage fees, temporary importation bonds, port dues, wharfage fees, pilotage, navigation fees, or similar costs. These will be billable to the Client at cost plus 10% if incurred. Client will arrange pre-clearance authorization for Contractor equipment's prior to Contractor's equipment mobilizing.
6. No allowance has been made for:
   - Environmental issues
   - Handling, removing hazardous material, coral relocation or special reef work
   - Rock excavation beyond that economically removable by Contractor's equipment
   - Special handling
7. Client represents and warrants it shall obtain all required and appropriate permits in connection with the Work. Client shall only direct and allow Contractor to operate only within the scope of Client's permits. Client is responsible to provide advanced notification to Contractor of any limitations of conditions of Client's permits. Client will indemnify and defend Contractor for work within Client's permits and/or instructions.
8. Client to provide specific directions for excavations near any bulkhead, pier or marine structures to avoid any potential conflict or damage.
9. Contractor shall coordinate construction and marine access to the site with the Port Authority on a day to day basis. Client and contractor shall coorcinate requirements relating to the Work with the understanding that these requirements and coordination shall consider Contractor's operational requirements in connection with the Work.
10. Client acknowledges that Contractor is not the architect, engineer, or designer of the works. Client does not rely on Contractor for architectural, engineering or design advice. Statements made by Contractor's employees constitute opinions and are not architectural, engineering, or design advice.
11. Contractor, at Contractor's expense, will carry:

BLUE OCEAN MARINE LTD.
P.O.Box W653, Unit No.22
Mandolin Place, Friars Hill Road
St. John's, Antigua
Phone + 1 268 562 6192