ENVIRONMENTAL IMPACT ASSESSMENT

Johnsons Point Residential Development

Antigua, West Indies

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

E N V I R O N M E N T A L I M P A C T ASSESSMENT: FINAL

Johnsons Point Residential Development

Antigua, West Indies

Submitted to:
Top Bay Real Estate Corporation Ltd.

March 2025

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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: Dr. Shannon Gore, Geomorphologist; and Haldain Spencer, Ecologist.

ETC Ltd. is grateful for the input of the Department of Analytical Services.

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ABBREVIATIONS

EIA	Environmental Impact Assessment
DCA	Development Control Authority
DOE	Department of Environment
EAG	Environmental Awareness Group
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
MRP	Mill Reef Properties Limited
OICP	Offshore Island Conservation Programme
sq. ft	Square feet
ToR	Terms of Reference
CBMR	Cades Bay Marine Reserve
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

EXECUTIVE SUMMARY

Top Bay Real Estate Corporation Ltd. has submitted a plan to the DCA proposing to construct a vacation property in Johnsons Point, Antigua. The 3.7-acre property, which is designed to accommodate a large family, reflects the Client's longstanding appreciation for the island's natural environment. It was deemed that the project requires an Environmental Impact Assessment in order to inform final recommendation for its approval.

The Johnsons Point Residential Development project proposes the construction of a sustainable, Caribbean-inspired vacation retreat, incorporating the use of local materials and environmentally conscious design principles. It features a central Main House and four guest cottages spread across the property to maximise sea views and natural ventilation, with air conditioning used minimally. The project also includes a centrally located swimming pool, with an open air Gazebo that will serve as a design focal point.

Each cottage will be equipped with a water tank for rainwater harvesting, contributing to the property's self-sufficiency. Solar power will be generated by a concealed solar array, and a desalination plant will be installed to meet water demands. In addition, a sustainable sewage system, likely a Hydro-Action or similar, will be integrated into the site's infrastructure to minimise environmental impact.

Given the project's coastal location, an Environmental Impact Assessment (EIA) was conducted to assess potential environmental risks, propose mitigation measures, and ensure compliance with Antigua and Barbuda's regulatory requirements. The assessment included a detailed evaluation of ecological resources, water quality, coastal processes, and climate resilience.

Key Findings:

Coastal Stability & Setbacks

- The site exhibits a mix of erosion and accretion trends, with evidence of sediment accumulation in certain areas.
- Natural coastal barriers such as coral reefs provide protection against wave energy and coastal retreat.
- While a 100-foot setback is required by the Department of Environment (DOE), the proposed pool and gazebo fall within this zone. However, site-specific conditions suggest minimal erosion risk in that area. Mitigation strategies, including reinforced foundations, elevated construction, and the retention of vegetative buffers, will ensure their long-term resilience.

Hydrology & Wastewater Management

The project includes a rainwater harvesting system and a Hydro-Action wastewater treatment unit to minimise groundwater extraction and nutrient discharge. The lack of a permanent

freshwater source on-site confirms that the development must remain self-sufficient in water management.

Elevations

The Johnson's Point Residential Development has been designed with careful consideration of elevations and coastal resilience, ensuring that structures remain protected from storm surges, coastal flooding, and erosion risks. With site elevations ranging between 2.0–2.5m above sea level, mitigation strategies include pile foundations for stability, strategic site grading to improve drainage, and the preservation of natural vegetation buffers. The 100-ft setback serves as an additional protective measure, reducing direct exposure to wave energy. To further enhance resilience, all buildings will be elevated five feet above-ground, in addition to integrating stormwater management systems, erosion control measures, and hurricane-resistant materials into the development. Continuous shoreline monitoring and adaptive management strategies will be implemented to address long-term coastal changes, ensuring the project remains sustainable and well-integrated into its dynamic coastal environment.

Biodiversity & Ecological Sensitivities

- The site is adjacent to the Cades Bay Marine Reserve, a designated Marine Protected Area (MPA).
- Seagrass beds and fringing coral reefs provide critical habitat for marine life, including sea turtles and commercially valuable fish species.
- The coastal forest supports diverse flora and fauna, including native bird species.

Construction & Operational Risks

- Potential risks include coastal erosion, storm surge vulnerability, sediment transport, and localised flooding.
- During construction, erosion control measures and vegetative buffers will be implemented to minimise soil disturbance and runoff.
- Long-term operational risks will be mitigated through shoreline monitoring, adaptive building designs, and sustainable landscaping strategies.

Mitigation & Monitoring Strategies

The EIA outlines a comprehensive Environmental Monitoring and Management Plan (EMMP), which includes:

- *Coastal Protection Measures:* Strategic vegetation reinforcement, permeable surfaces, and erosion control barriers to support shoreline stability.
- *Stormwater & Wastewater Management:* Installation of sediment traps, permeable surfaces, and bi-annual water quality monitoring to prevent pollution.
- *Biodiversity Conservation:* Preservation of coastal vegetation, limited light pollution to protect sea turtle nesting areas, and sustainable landscaping practices.
- *Regulatory Compliance & Monitoring:* Regular inspections, compliance reporting, and adaptive management to ensure that environmental safeguards remain effective.

Conclusion

The Johnson's Point Residential Development is designed to balance environmental responsibility with sustainable coastal living. While the project's coastal location requires careful risk management, the integration of natural buffers, climate-adaptive features, and proactive monitoring ensures that it will maintain a low-risk profile while contributing to a responsible and well-integrated coastal development.

With the implementation of the proposed mitigation measures, the project is expected to comply with Antigua and Barbuda's environmental regulations and best practices for coastal resilience, setting a benchmark for sustainable residential development in the Caribbean.

1. INTRODUCTION

1.1. Project Proponent

ETC Ltd. was retained by the project proponents, Mr. & Mrs. Ray Stanton, directors of Top Bay Real Estate Corporation Ltd., to prepare this Environmental Impact Assessment (EIA) for a proposed vacation property development at Johnson's Point, Antigua.

Mr. & Mrs. Stanton, residents of Toronto, Canada, have been visiting Antigua for many years and have developed a strong appreciation for the island's natural beauty and coastal environment. Their vision for the project is to create a sustainable and well-integrated vacation home that respects the ecological sensitivity of the area while providing a retreat for their large family.

Contact Information:
Mr. & Mrs. Ray Stanton
Toronto, Canada

1.2. Purpose and Project Description

The purpose of this Environmental Impact Evaluation (EIE) is to assess the potential environmental impacts of the proposed vacation property development at Johnson's Point, Antigua, and to provide recommendations to mitigate risks while ensuring compliance with local environmental regulations and best practices. This report has been prepared in response to regulatory requirements set forth by the Government of Antigua and Barbuda (GOAB) and the Department of Environment (DOE), ensuring that the project aligns with sustainable coastal development principles.

The project involves the construction of a private vacation retreat designed to accommodate the needs of the proponent's extended family while maintaining sensitivity to the surrounding environment. The design concept prioritises natural ventilation, sustainability, and a minimal ecological footprint. Key project components include:

- *Main House:* The central structure of the development, housing shared living spaces such as the living room, library, study, kitchen, and outdoor dining area. Designed to be open to both the north and south to maximise cross-ventilation.
- *Guest Cottages:* Two primary guest cottages and two twin-bedroom cottages, each featuring verandahs to provide shade and enhance passive cooling.

- *Swimming Pool & Gazebo:* The pool is centrally located between the Main House and the sea, with a gazebo at the eastern end, which includes a pump room below. The gazebo will be an open air structure that will serve as a design focal point.
- *Rainwater Harvesting System:* Each cottage is equipped with an individual water tank for rainwater collection, with all tanks linked to a central storage tank located beside the swimming pool.
- *Solar Energy System:* A concealed solar array in the northwest corner of the site will provide sufficient power for the entire property, including water pumps and a desalination plant.
- *Sewage Treatment System:* A Hydro-Action or similar wastewater treatment system will be installed to ensure proper sewage management.
- *Landscaping and Coastal Protection:* Existing native vegetation along the shoreline will be retained and supplemented as needed to prevent erosion and maintain ecological integrity. A landscape architect with local expertise will be engaged during the detailed planning phase.

The design philosophy focuses on self-sufficiency, environmental responsibility, and integration with the natural landscape. Air conditioning will be used only occasionally, as the layout promotes natural cooling through strategic building orientation and shading elements. The overall approach balances the desire for a private, functional retreat with a commitment to preserving the coastal environment.

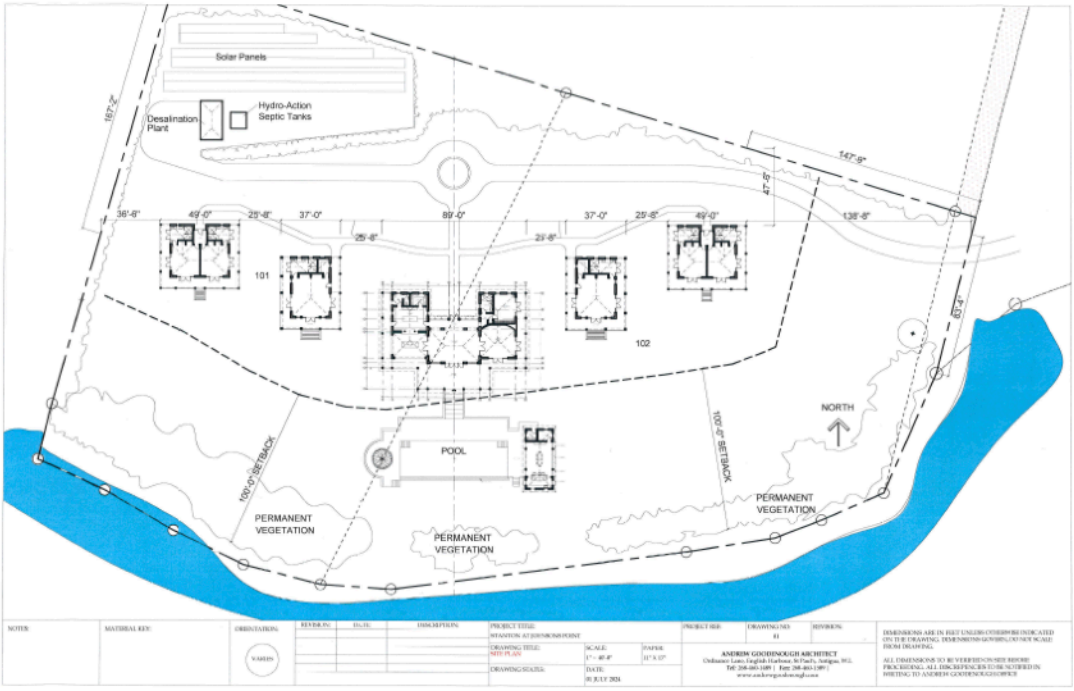

Figure 1: Johnsons Point Residential Development Masterplan

1.3. Sustainable Water Supply: AqSep Watermaker

Figure 2. AQSEP Watermaker WM11000E-340

A key feature of the Johnson's Point Vacation Property Development is the integration of an AqSep Watermaker, a compact, energy-efficient desalination system designed to provide a reliable and self-sufficient freshwater supply. This system eliminates dependence on municipal water infrastructure and reduces groundwater extraction, making it a sustainable solution for coastal developments.

The AqSep Watermaker operates on reverse osmosis (RO) technology, where seawater is pressurised through a semi-permeable membrane, separating freshwater from dissolved salts and other impurities. One of its standout advantages is its low power consumption, requiring significantly less energy than traditional desalination plants, making it ideal for off-grid or low-impact developments.

System Specifications and Advantages

- *Compact and Modular Design:* The system is small in size compared to industrial-scale desalination plants, making it easy to integrate into the site with minimal land disturbance.
- *Energy Efficiency:* Unlike large-scale desalination plants, the AqSep system is designed to run on low power, making it compatible with renewable energy sources like solar power.
- *High Water Purity:* The system produces high-quality potable water, suitable for domestic use and irrigation.
- *Automated Operation:* Features automatic flushing and low-maintenance components, reducing the need for constant monitoring and technical expertise.

1.4. Wastewater Treatment System

The development will incorporate an on-site wastewater treatment system utilising the Hydro-Action AN600, an aerobic treatment unit (ATU) designed to efficiently process domestic wastewater. Unlike conventional septic systems, which rely on passive anaerobic treatment, the Hydro-Action AN600 employs an extended aeration, activated sludge process to break down organic waste more effectively. This ensures a higher-quality effluent, reducing environmental impacts and supporting sustainable water management on-site.

The AN600 model has a treatment capacity of 600 gallons per day (gpd), making it well-suited for the scale of this development. The system consists of a fiberglass reinforced plastic (FRP) aeration tank, which houses an aeration chamber and a final clarification section. Wastewater enters the aeration zone, where oxygen is continuously supplied through fine-bubble diffusers, promoting microbial digestion of organic matter. The treated effluent then moves into the clarification zone, where solids settle before the clean water is discharged.

This system has been certified under NSF/ANSI Standard 245, demonstrating its efficiency in reducing nitrogen levels in treated wastewater. This is particularly important for coastal developments, as excess nitrogen can contribute to marine eutrophication, leading to harmful algal blooms and degradation of nearshore ecosystems.

By implementing the Hydro-Action AN600, the development will ensure that wastewater is treated to a high standard, with minimal impact on groundwater and surrounding marine habitats. The system's automated operation and low maintenance requirements further align with the project's sustainability goals.

1.5. Solar Array System

The Johnson's Point development will integrate a solar photovoltaic (PV) system as its primary energy source, ensuring a self-sufficient and environmentally friendly power supply. The solar array will be installed on a 4,150 sq. ft. area, designed to maximise solar energy capture while minimising visual and environmental impact.

The system will consist of 191 high-efficiency 400W solar panels with a 20% efficiency rating, providing a rated capacity of 76.4 kWp. Under optimal conditions, this system is expected to generate approximately 382 kWh per day, translating to an annual production of 140,000 kWh. Given that the development is off-grid, a battery storage system will be included to ensure energy reliability, particularly during low solar production periods.

Battery storage requirements will be tailored to the daily energy demand and backup needs. For a full backup of the system's maximum daily output, the development will require 382 kWh of battery storage capacity. If two days of backup are needed, storage capacity must be doubled to 764 kWh. Additionally, an appropriately sized inverter system will be installed to handle peak power demands efficiently.

By incorporating this solar array and battery storage solution, the development will significantly reduce its dependence on fossil fuels, aligning with sustainability objectives while ensuring a stable and renewable energy supply.

1.6. Project Benefits

The proposed vacation property development at Johnsons Point is designed with sustainability and community integration in mind, offering a range of economic, environmental, and social benefits:

- *Sustainable Design & Energy Efficiency:* The project prioritises eco-friendly construction, utilising passive cooling techniques, rainwater harvesting, and a solar energy system to minimise its environmental footprint.
- *Preservation of Natural Coastal Features:* The development maintains existing native vegetation along the shoreline, helping to prevent erosion and support coastal resilience. Additional landscaping will enhance the site's ecological value.
- *Local Economic Opportunities:* The construction phase will generate employment opportunities, with local contractors, artisans, and service providers engaged wherever possible.

- *Low-Impact Development:* The design approach minimises disruption to the natural environment, avoiding large-scale land alterations and ensuring responsible water and waste management.

- *Enhanced Tourism Appeal:* The project contributes to the broader tourism ecosystem by reinforcing Antigua's reputation as a sustainable and high-quality vacation destination, benefiting local businesses in hospitality, retail, and services.

- *Water and Energy Self-Sufficiency:* The integration of solar power, rainwater collection, and an efficient wastewater treatment system ensures that the property operates independently with minimal strain on public utilities.

By incorporating sustainable building practices and respecting the local environment, the project seeks to provide a model for responsible coastal development while offering a private, low-impact retreat for the proponent's family.

1.7. Limiting Conditions

As with any Environmental Impact Assessment (EIA), there are inherent limitations in the scope and content of this report. Environmental assessments rely on the best available data, scientific modelling, and past experiences in similar contexts to predict potential impacts. However, future environmental conditions are subject to variability, and absolute certainty cannot be guaranteed.

Key limitations of this assessment include:

- *Predictive Uncertainty:* While the evaluation is based on scientific literature, precedent cases, and site-specific observations, environmental changes—such as those driven by climate change, unforeseen weather events, or evolving ecological dynamics—may influence actual outcomes.

- *Assumptions on Mitigation Measures:* The effectiveness of mitigation strategies relies on the commitment of the project proponents to implement recommended measures and adhere to environmental management best practices. The success of these efforts depends on long-term monitoring and adaptive management.

- *Scope of Study Area:* The EIA focuses on the designated project site, as shown in Figure 1, while also considering potential indirect impacts on adjacent areas of environmental sensitivity. However, external factors beyond the project boundary, including broader coastal and ecological changes, are outside the direct scope of this assessment.

Despite these limitations, this EIA is designed to provide a well-informed analysis of potential environmental impacts and recommend appropriate mitigation strategies to support sustainable development at Johnson's Point.

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2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The Developers have received “Approval in Principle'' from the Development Control Authority. They also have received a letter of support from the Prime Minister, which states that the Cabinet has granted preliminary approval for the lease of five acres of seabed in addition to its willingness to grant all the permits and other licenses required to operate the planned marina; all of which however, is subject to a satisfactory EIA.

There are several laws that are relevant to the Johnsons Point Residential Development Project; these are as follows:

- Physical Planning Act 2003
- The Fisheries Act 2006
- Environmental Protection and Management Act 2019
- The Sustainable Island Resource Management Plan (SIRMZP)
- National Solid Waste Management Authority Act 1995 and (Amendment) 2005
- Noise Abatement Act 1996

Physical Planning Act 2003

This act provides the main legal framework for orderly and progressive development as it outlines the conditions for the control of the use of the land as well as the regulates building construction and other related matters. Schedule 3 of the legislation outlines those projects for which Environmental Impact Assessments are required. These include:

- An airport, port or harbour including a yacht marina
- A wastewater treatment, desalination or water purification plant.
- An industrial estate development project; and
- A hotel or resort complex
- A power plant
- A crude oil or refinery facility or a petroleum and natural gas storage and pipeline installation;
- An incinerator, sanitary landfill operation, solid waste disposal site, sludge disposal site, toxic waste disposal site or other similar site;
- An industrial estate development project;
- An installation for the manufacture, storage or industrial use of cement, paints, chemical products or hazardous materials,
- A drilling, quarrying, sand mining and other mining operation;

Environmental Protection and Management Act 2019

The Environmental Protection and Management Act (2015) is an act created to the protection of 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. These have implications for the Runaway Bay Development Project because of the fragile ecosystem in which the development is taking place.

The act also covers financial provisions, compliance and enforcement, environment information, research and education as well as offences and penalties.

The Sustainable Island Resource Management Plan (SIRMZP)

The Sustainable Island Resource Management Zoning Plan (SIRMZP) was prepared by GENIVAR Trinidad and Tobago along with local consultants in Antigua namely Ivor Jackson and Associates as well as Kingdome Consultants. The main goal of the SIRMZP was to approach land development from a strategic and national perspective. It therefore addresses current development issues and provides a platform for private and public partnerships and development initiatives over the next 20 years. The document meets the criteria for the Physical Planning Act (2003) and serves as a revised Draft National Physical Development Plan (NPDP).

The Fisheries Act 2006

Fisheries Act, 2006 (Act No. 22 of 2006) 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. The principal authority for purposes of this Act shall be the Minister. The Minister shall appoint a Fisheries Advisory Committee and may designate local fisheries management areas and appoint an authority for each area.

Cades Bay Marine Reserve (CBMR)

The Cades Bay Marine Reserve (CBMR), established in April 1999, extends along Antigua's southwestern coast from Johnson's Point to Old Road, encompassing an integrated ecosystem of wetlands, beaches, coral reefs, and seagrass beds. The Fisheries Division is responsible for managing the reserve, which plays a crucial role in supporting globally significant plant and animal species, sustaining fisheries, and contributing to the tourism industry.

The reserve's boundaries are designed to protect critical habitats, including Cades Reef, which serves as a natural barrier against coastal erosion while providing essential nursery areas for

marine life. Over time, changes in coastal dynamics and human activity have influenced the reef and surrounding ecosystems, highlighting the need for continued conservation efforts. Protecting this marine reserve also provides opportunities for research on marine ecosystem resilience and best practices for sustainable coastal management.

National Solid Waste Management Authority Act 1995 and (Amendment) 2005

This act is an amendment of the Solid Waste Management Authority Act No. 10 of 1995. It is cited as the Solid Waste Management (Amendment) Act 2005. It establishes the National Solid Waste Management Authority with the responsibility for solid waste , storage, collection, treatment and disposal, and for matters incidental or otherwise.

The act outlines the main responsibilities and duties of the Solid Waste Management Authority which are as follows:

- To provide storage facilities for solid waste
- To provide collection and storage facilities at ports , harbours and anchorages
- To convert dumps into sanitary landfills
- To provide treatment and disposal for hazardous and medical waste
- To develop and manage sanitary landfill sites and other disposal methods
- To introduce measures to encourage recovery of recyclable items
- To introduce cost recovery methods for services provided by the Authority

Noise Abatement Act 1996

The Noise Abatement Act of Antigua and Barbuda makes provisions concerning the control of noise. In the case of this project the noise on construction sites will include but are not limited to erection, alteration or repairs to buildings, demolition work and any engineering construction. Under this act the Project Manager and contractor would have to apply for consent with the Ministry stating work to be carried out and efforts made to minimise noise.

International Conventions and Protocols

As it is necessary to consider the international arena and compliance on an international level, the following international agreements have bearing:

- United Nations Framework Convention on Climate Change (UNFCCC)
- Vienna Convention for the Protection of the Ozone Layer and Montreal Protocol on substances that deplete the Ozone Layer
- Convention on Biological Diversity (CBD), Nairobi 1992
- Convention on the Prevention of Marine Pollution (MARPOL) by dumping of wastes and other matter, 1972, and
- International Union for the Conservation of Nature (IUCN) which Antigua and Barbuda are member of.
- Kyoto Protocol to the UN Framework Convention on Climate Change December 11th 1997 Kyoto October 28th 1998
- UN Convention on Biological Diversity and its protocols. June 5th 1992
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity 2000

- Protocol Concerning Specially Protected Areas and Wildlife (SPAW Protocol to the Cartagena Convention) January 18th 1990 Jamaica
- Montreal Protocol on Substances that Deplete the Ozone Layer and its protocols. September 16th 1987 final accession Copenhagen 1993
- The Stockholm Convention on Persistent Organic Pollutants February 2004

3. APPROACH AND METHODOLOGY

3.1. Marine Surveys

Surveys of the near shore marine environment, shown in Figure 3 below, were done as a variation of the Atlantic Gulf Rapid Reef Assessment (AGGRA), desktop review/research and drone imagery/GIS mapping variation. The variation of the AGGRA survey was done while snorkelling instead of scuba diving due to the shallow nature of the marine area in front of the site.

Figure 3. Photo of the marine environment

3.2. Terrestrial Surveys

This ecological survey was completed using a several popular techniques that were combined for this particular project. The terrestrial survey was done using drone imagery, walk-through observations and bird survey methods adopted from the Environmental Awareness Group (EAG). For the walk-through observations, a rope was used to establish a 30m central line at

random locations throughout the site. Following the line, every ecologically significant plant and animal species were recorded. Examples of the vegetation are shown in Figures 4 and 5 below.

Figures 4 and 5. Mangrove cuckoo perched on branches and dense vegetation consisting of Manchineel and Seagrape

3.3. Informal Community Surveys

Local community members in Johnson's Point and surrounding areas were approached casually and asked questions about the proposed development site and the broader Cades Bay Marine Reserve (CBMR) in an informal manner. This approach to data collection has proven more effective in small coastal villages, where individuals are generally more comfortable engaging in conversational-style discussions rather than filling out structured questionnaires.

The survey process aimed to gather local perspectives on the marine environment, fishing activities, tourism, and potential impacts of development in the area. Residents were responsive, with all but one person out of ten participants providing useful insights. This information was used to contextualise environmental, social, and economic considerations for the proposed project.

3.4. Desk-Based Analysis

A comprehensive desk-based analysis was conducted to assess baseline conditions, environmental trends, and socioeconomic dynamics in the CBMR region. This analysis involved

reviewing maps, charts, historic technical studies, and unpublished reports relevant to the Cades Bay Marine Reserve and Johnson's Point area.

To further strengthen the assessment, national and regional demographic and socioeconomic data were referenced, including:

- The CIA World Factbook (2024) for current national demographic indicators such as population structure, employment trends, and migration rates.
- The 2007 Socioeconomic Assessment of CBMR, conducted under the SocMon protocol, which provided insights into local livelihoods, stakeholder perceptions, and economic activities in the fishing and tourism sectors.
- The Cades Bay Marine Reserve Management Plan (2012), which outlined key ecological and socioeconomic considerations, including resource use patterns, conservation challenges, and management strategies.
- Additional literature and professional expertise to interpret historical and environmental trends impacting the CBMR region.

This combined desk-based and field survey approach ensures that the EIA incorporates both scientific research and local knowledge, offering a holistic perspective on the environmental, economic, and social factors influencing the Johnson's Point Residential Development.

3.5. Water Quality Checks

The Department of Analytical Services within the Ministry of Agriculture, Lands and Barbuda Affairs was commissioned to perform water quality sampling within the site area to establish a baseline of existing marine quality conditions. Snapshot samples (Figure 6) were taken at five (5) points, three in the near shore coastal zone and two in shallow pools found inland on the property; shown in Figure 3. The results from the sampling process were recorded in Section 5 and will be reviewed in the future to measure the effects of the proposed development upon the water quality of the surrounding area.

During the actual 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:

- Enterococci
- E. Coli
- Dissolve Oxygen
- Nitrate - Nitrogen
- Temperature (C)
- pH
- Turbidity (NTU)

- Salinity (%)
- Phosphate (ppm)

Figure 6. Water Quality Sampling Points

3.6. Analysis of Coastal Processes

To assess coastal processes and shoreline changes along the Stanton property coastline (figure 7), a comparative analysis was conducted by overlaying historical imagery from 1968 with contemporary imagery from 2024. The 1968 imagery was then georeferenced in ArcGIS Pro by aligning it with the 2024 Google Earth imagery using identifiable landmarks such as coastal headlands, roads, and settlements, with control points selected to ensure accurate spatial alignment and minimise distortion. Next, the historical shoreline from the 1968 imagery was manually digitised to create a shapefile along the prominent boundary between beach sediments and the vegetation line, a commonly used visual proxy shoreline indicator (Morton, 1991) at a scale of 1:1000. Although this proved difficult since this particular shoreline indicator is not always easy to detect on black and white photos and the old image had a low resolution with blurring but provides the visual difference needed to see the coastal change over time. The digitised image was used for visual and quantitative comparison. The analysis was validated by cross-checking with topographic features like the cliffs at Johnson's Point and Curtain Bluff, roads, reef features. The results were interpreted as evidence of ongoing coastal erosion, potentially driven by wave action, sediment transport, or the loss of natural barriers such as coral reefs or mangroves, identified within the baseline descriptions, revealing a net landward movement of the shoreline and a westward shift over the 56-year period, indicative of erosion in the southern part of the property.

Figure 7. Drone photo showing seaward view of the site.

3.7. Depth Analysis

The depth of the marine area surrounding Johnson's Point is a critical factor in understanding the coastal and nearshore environmental conditions. The Cades Bay Marine Reserve Management Plan (2012) provides depth contours at five-meter gradients, allowing for an interpretation of the seabed profile around the site. Based on the extracted depth map (Figure 8), the area immediately offshore from Johnson's Point exhibits depths ranging from approximately 2 to 10 feet (0.6 to 3 meters) in nearshore zones, with progressively deeper waters extending further westward into Cades Bay and the broader marine reserve.

These depth variations suggest that Johnson's Point is characterised by relatively shallow waters close to shore, which may influence coastal hydrodynamics, sediment transport, and ecosystem interactions. The presence of gradual depth transitions indicates a relatively gentle slope, reducing the likelihood of abrupt underwater drop-offs. Understanding these bathymetric conditions is essential for evaluating potential hydrological and marine ecological impacts related to the project, particularly concerning wave action, sediment movement, and marine habitat sensitivity. The inclusion of this depth map within the methodology section ensures that baseline marine conditions are well-documented for further analysis in the environmental assessment.

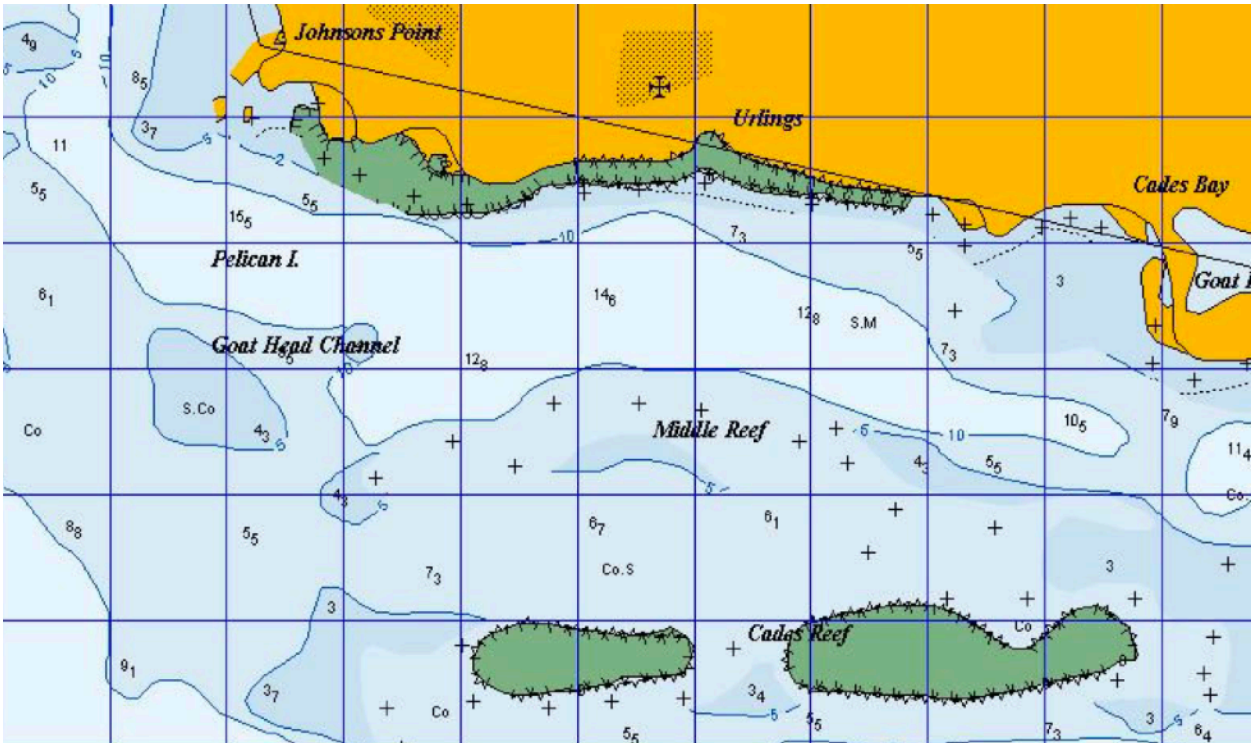


Figure 8. Map showing depths close to project site

4. ANALYSIS OF ALTERNATIVES

The Analysis of Alternatives section evaluates different approaches to the proposed Johnson's Point Residential Development, considering potential environmental, social, and economic impacts. During the design phase, the project underwent a significant revision, with the most notable change being the removal of the planned pond on the eastern side of the property. This revision was made in response to concerns that the pond could alter natural hydrological processes occurring on and around the site, potentially leading to unintended near-shore marine impacts.

The following alternatives are assessed:

1. Option 1 – Original Design (With Pond)
2. Option 2 – Revised Design (Without Pond) [Preferred Alternative]
3. Option 3 – No-Action Alternative

Each alternative is discussed below.

4.1 No-Action Alternative

Under the no-action alternative, the Johnson's Point Residential Development would not proceed, and the site would remain in its current natural state.

- The site's natural hydrology, coastal vegetation, and ecological balance would remain undisturbed. Risks associated with land alteration, such as changes to surface water flow, potential erosion, and marine habitat disturbance, would be completely avoided.
- The opportunity to develop a sustainably designed private residence that aligns with best environmental practices would be lost.
- Local employment opportunities during both the construction and operational phases would not materialise.
- The local economy would not benefit from investments in construction and related services.

Rationale: While this option avoids all environmental risks, it does not provide any economic or social benefits. The project proponent's vision for a self-sufficient, environmentally responsible retreat would not be realised.

4.2 Alternative 1 – Original Design (With Pond)

The original project concept included a man-made pond located on the eastern side of the property. Shown in Figure 9 below. This feature was envisioned as a focal point for the development, designed to enhance the site's aesthetics and provide a habitat for local bird species.

However, environmental concerns arose regarding the potential disruption of natural hydrological processes on and around the site, including:

- Possible alteration of surface water drainage patterns, affecting the way water flows through the landscape.
- Increased risk of water retention and flooding in unexpected areas.
- Potential for impacts to near-shore marine ecosystems due to changes in water movement.

Rationale: While the pond was originally intended as a design enhancement, the risks associated with altering the natural hydrology outweighed the benefits. This led to the development of Alternative 2.

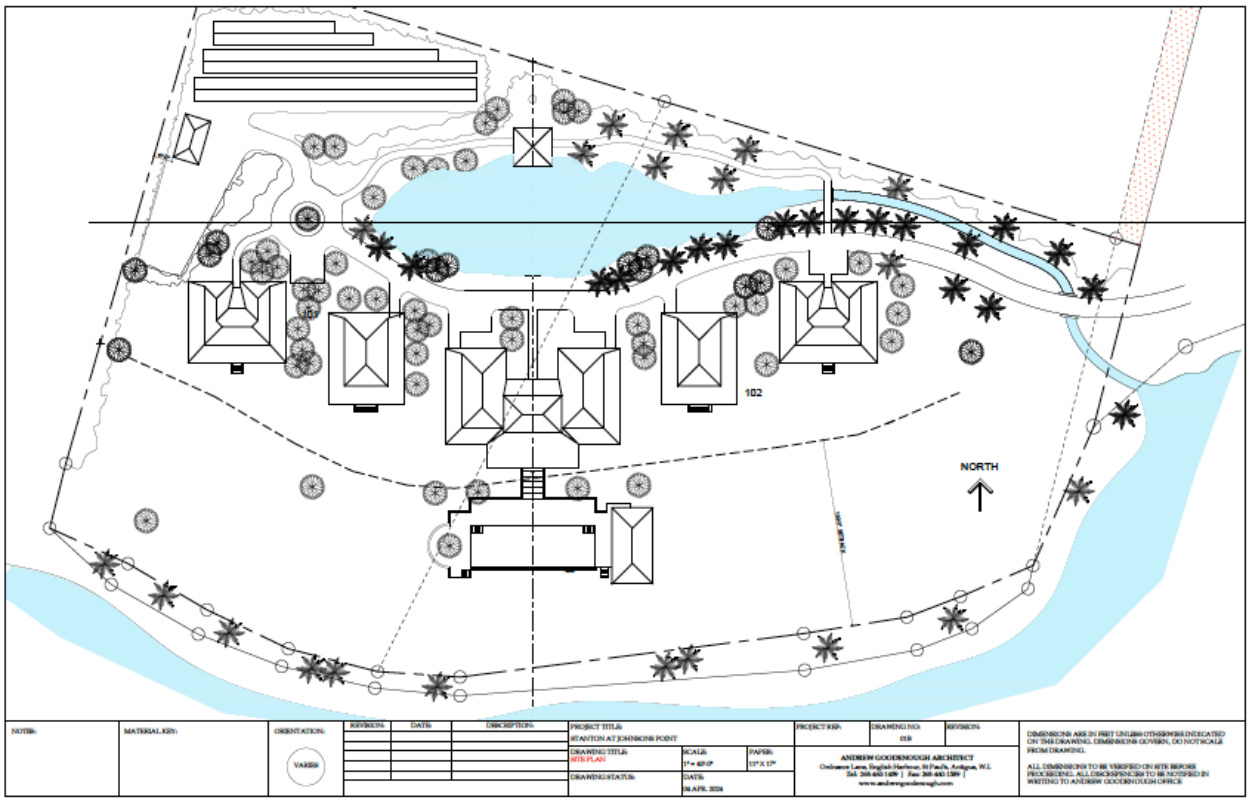


Figure 9. Stanton Site Plan version 1

4.3 Alternative 2 – Revised Design (Without Pond) [Preferred Alternative]

In response to the identified environmental risks, the project proponent revised the site plan to eliminate the pond, thereby preserving the site's existing natural drainage patterns. Show in Figure 10 below.

Key adjustments in this preferred alternative:

- Removal of the pond, ensuring minimal alteration to the natural flow of surface and groundwater.
- Retention of existing coastal vegetation, which acts as a natural buffer against erosion.
- Continued focus on sustainability measures, including rainwater harvesting, solar energy integration, and a low-impact development approach.
- Prevents disruption to the site's natural hydrology.
- Reduces potential near-shore marine impacts.
- Maintains existing ecological balance, allowing native flora and fauna to thrive.
- The project remains viable while reducing environmental concerns.
- Local employment and economic activity will still be supported during construction and maintenance phases.

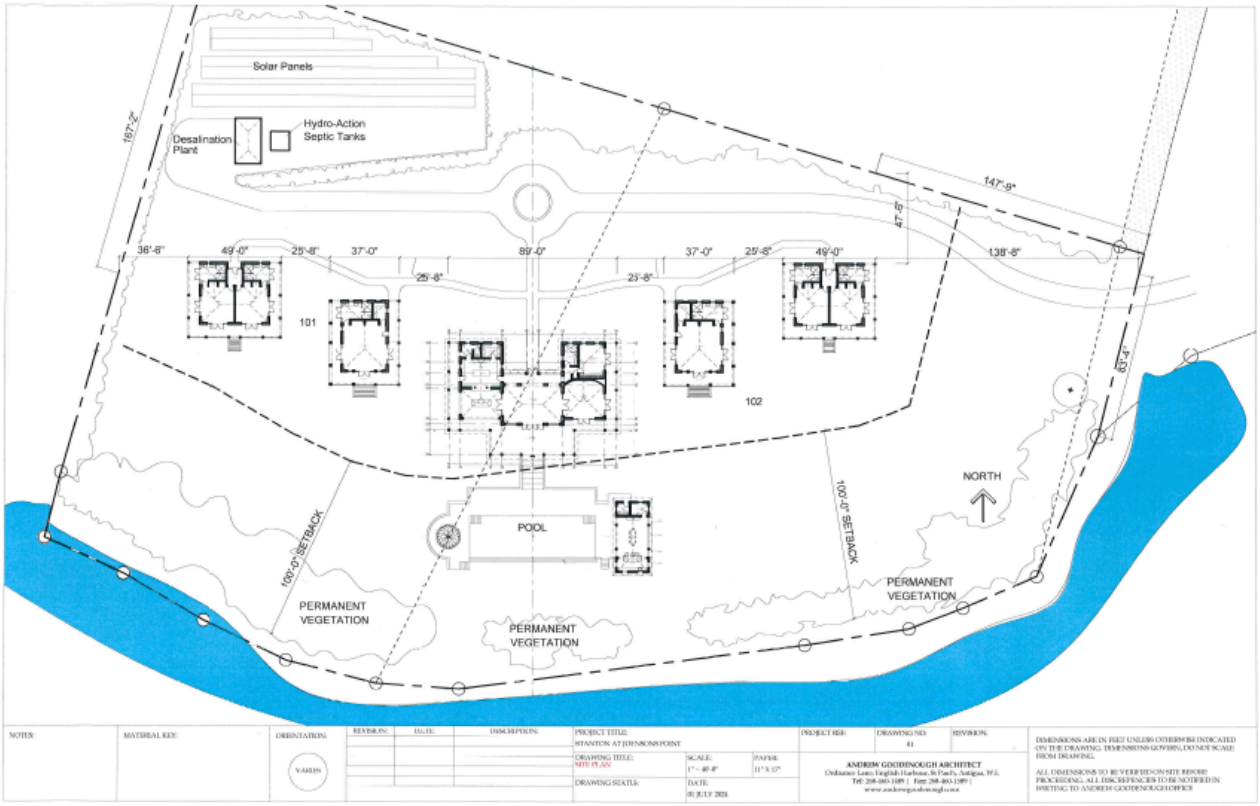


Figure 10. Stanton Site Plan version 2 (preferred)

Rationale: This alternative balances environmental responsibility with the project's goals, making it the preferred option. By removing the pond, the project avoids potential hydrological and marine ecosystem disturbances while retaining the core vision of a self-sufficient, sustainable private retreat.

4.4 Preferred Alternative

The preferred alternative is Alternative 2 – The Revised Design (Without Pond), which integrates sustainable development principles while avoiding significant environmental risks.

- No major modifications to natural hydrological processes.
- Native vegetation and coastal features are preserved.
- Rainwater harvesting and solar power support self-sufficiency.
- Provides employment opportunities during construction.
- Contributes to local economic activity in construction, landscaping, and maintenance services.

Rationale: The revised design achieves the best balance between environmental conservation and project feasibility, ensuring the Johnson's Point Residential Development proceeds in a responsible and sustainable manner.

5. BASELINE ENVIRONMENTAL AND SOCIO-ECONOMIC ASSESSMENT

Antigua and Barbuda currently have four declared Marine Protected Areas (MPAs), established to support fisheries conservation, biodiversity protection, and sustainable resource management. Among these, the Cades Bay Marine Reserve (CBMR) was gazetted in 1999 under the Fisheries Act, encompassing coastal and marine ecosystems critical to the ecological health of the southwestern coast of Antigua. The CBMR includes Cades Reef, a significant offshore barrier reef, and extends landward to encompass mangrove forests, seagrass beds, wetlands, and other critical nursery areas that support marine biodiversity. The Fisheries Division serves as the primary managing authority, with responsibilities including resource protection, monitoring, and stakeholder engagement.

The CBMR plays an essential role in the local economy, supporting fisheries, tourism, and recreational activities. The area is regularly used for snorkelling, diving, kayaking, and small-scale fishing, while its mangrove-lined coastal wetlands provide habitat for commercially important fish species. However, like many marine reserves, CBMR faces pressures from human activities, including coastal development, overfishing, pollution, and climate-related changes. The boundaries of the CBMR extend from Johnson's Point to Old Road and Carlisle Bay (see Figure 11 below), ensuring the protection of a range of interconnected habitats. This section will examine the project site within the broader context of the CBMR and assess the existing environmental and socioeconomic conditions influencing the proposed Johnson's Point Residential Development.

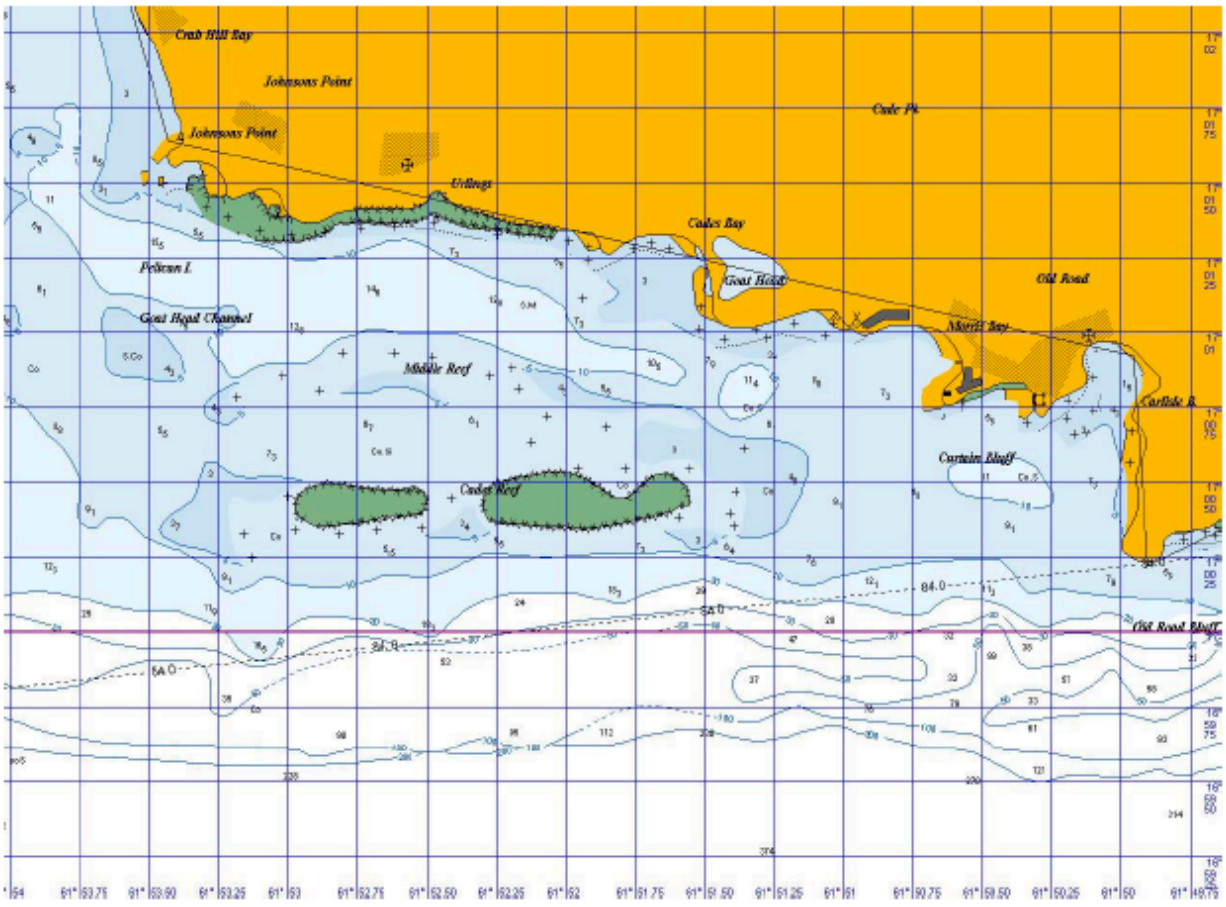


Figure 11. Map detailing Cades Bay Area in the Southwestern coastal region of Antigua. Green areas represent shallow reef zones, with blue contours at 5m depth gradients. Yellow land mass is mainland Antigua.

5.1. Cades Bay Marine Reserve (CBMR)

The Cades Bay Marine Reserve (CBMR) is a designated Marine Protected Area (MPA) situated along the southwestern coast of Antigua, spanning from Johnson's Point to Old Road and Carlisle Bay. Established in 1999 under the Fisheries Act, the CBMR was created to protect critical marine habitats, promote sustainable fisheries management, and support biodiversity conservation. The reserve is an integral component of Antigua and Barbuda's marine ecosystem, encompassing Cades Reef, extensive seagrass beds, mangrove forests, and coastal wetlands, all of which play a crucial role in maintaining marine biodiversity and coastal resilience.

A management plan for the CBMR was developed to outline conservation priorities and ensure the sustainable use of its resources. The reserve serves as a key ecological and economic asset, supporting both fisheries and tourism-based activities. The offshore coral reefs, particularly Cades Reef, are one of the most well-known snorkeling and diving sites in Antigua, attracting visitors and researchers alike. The mangrove forests and seagrass beds act as vital nursery

grounds for commercially important fish species, contributing to the productivity of local fisheries. Additionally, the reserve provides a buffer against coastal erosion, helping to stabilise the coastline and mitigate the impacts of storm surges.

The CBMR has historically supported multiple uses, ranging from small-scale fishing and recreational boating to marine ecotourism activities. The area is frequently visited by charter boats, kayakers, and scuba diving tours, making it a critical component of the marine tourism industry in Antigua. However, like many coastal and marine protected areas, the CBMR faces pressures from human activities, including coastal development, pollution, and resource extraction. Effective management and enforcement remain essential to ensure that economic benefits are balanced with long-term conservation goals.

From a scientific and ecological perspective, the CBMR serves as a living laboratory, offering valuable insights into climate resilience, coral reef health, and habitat connectivity. By maintaining strict conservation measures and sustainable management strategies, the CBMR continues to play a pivotal role in Antigua and Barbuda's broader marine conservation efforts.

5.2. Demographics and Livelihoods

5.2.1.Population and Communities

As of the most recent national estimates, the population of Antigua and Barbuda stands at approximately 102,634 people (2024 est.). The communities surrounding the Cades Bay Marine Reserve (CBMR) include Johnson's Point, Urlings, Crab Hill, and Old Road, which are small coastal settlements where livelihoods are closely tied to fishing, tourism, and marine-based industries.

A 2007 socioeconomic assessment conducted under the 'SocMon' protocol identified fishing and tourism as the primary economic activities within the CBMR region. Despite their importance to the local economy, concerns have been raised about limited local involvement in decision-making regarding the reserve's management. While some stakeholders perceive marine conservation efforts as beneficial to long-term fisheries sustainability, others have expressed the need for designated storage areas for fishing equipment during adverse weather conditions.

5.2.2. Economic Activities and Livelihoods

The CBMR region supports a mix of livelihoods, including:

- Fishing: Small-scale fisheries remain an important source of income for local communities, particularly in Urlings and Old Road. The mangroves, seagrass beds, and coral reefs within CBMR serve as essential nursery habitats for commercially important species.

- Tourism and Marine-Based Recreation: Cades Reef is a popular snorkelling and diving site, attracting both local and international visitors. Charter boats, kayak tours, and yachting excursions contribute significantly to employment and revenue generation in the area.
- Small Business and Commercial Trade: Some communities within the CBMR region engage in local trade, craft production, and small-scale retail to supplement their income. However, economic diversification remains limited, with many residents still reliant on seasonal tourism employment.

5.2.3. Socioeconomic Challenges and Management Considerations

While the CBMR management plan highlights broad stakeholder support for conservation, there is a recognition that greater community involvement in decision-making is needed. Socioeconomic monitoring is recommended on a two-year cycle to assess public perception and ensure that coastal resource management remains inclusive. Additionally, outreach programs and alternative livelihood training have been proposed as strategies to support local resilience in response to environmental and economic changes .

5.3. Resource Uses

The Cades Bay Marine Reserve (CBMR) supports a variety of resource uses that are integral to the local economy and community livelihoods. The primary activities within the reserve include tourism, fishing, and industrial operations.

5.3.1.Tourism

Tourism is a major driver of economic activity within the CBMR, attracting visitors to its pristine waters, vibrant marine life, and scenic coastal landscapes. The coral reefs, particularly Cades Reef, are among the most popular snorkelling and diving sites in Antigua, drawing both recreational visitors and researchers interested in studying reef ecosystems. The calm, sheltered waters of Cades Bay also make it a favoured destination for boat tours, yachting, and kayaking. Local tour operators offer excursions that showcase the area's marine biodiversity, while hotels and resorts in nearby Jolly Harbour and Old Road integrate CBMR into their eco-tourism experiences. The reserve's aesthetic appeal is central to its tourism value, reinforcing the broader role of Antigua's natural environment as a cornerstone of the tourism industry.

5.3.2. Fishing

Fishing has long been an important livelihood for residents of Johnson's Point, Urlings, Crab Hill, and Old Road, with many fishers relying on the coastal waters and mangrove nurseries within the CBMR for their catch. The primary fishing methods used in the area are small-scale and artisanal, targeting species such as snapper, grouper, and lobster. Landing sites, particularly in Urlings and Crab Hill, serve as key points where fishers bring in their catch, which is then sold in local markets or supplied directly to hotels and restaurants. While fishing remains a vital source of income, environmental changes and increasing pressures on marine resources have raised concerns about sustainability. Over the years, shifting fish populations and habitat degradation

have led to discussions on balancing conservation efforts with the needs of the fishing community, ensuring that marine resources remain viable for future generations.

5.3.3. Industrial

Although the CBMR is primarily designated as a conservation area, some industrial activities are present in the broader region, particularly those related to water and energy infrastructure. A desalination plant operates near the CBMR, providing potable water to surrounding communities. Power generation facilities, including both traditional and renewable energy sources, contribute to the area's infrastructure, ensuring the reliability of essential services. Additionally, harbour facilities and small industrial estates exist on the outskirts of the reserve, supporting local businesses while being subject to environmental regulations aimed at mitigating impacts on marine ecosystems.

5.3.4. Land Use and Zoning

Land use within the CBMR region reflects a balance between conservation, community development, and economic activities. The Sustainable Island Resource Management Zoning Plan for Antigua & Barbuda (SIRMZP, 2011) classifies the area for environmental protection, tourism, and small-scale commercial activities, with an emphasis on preserving the integrity of coastal and marine ecosystems. While settlements and agricultural areas exist within the vicinity of the reserve, the zoning framework ensures that development remains compatible with conservation goals, minimising conflicts between economic activities and ecological preservation. See Figures 12 and 13 below.

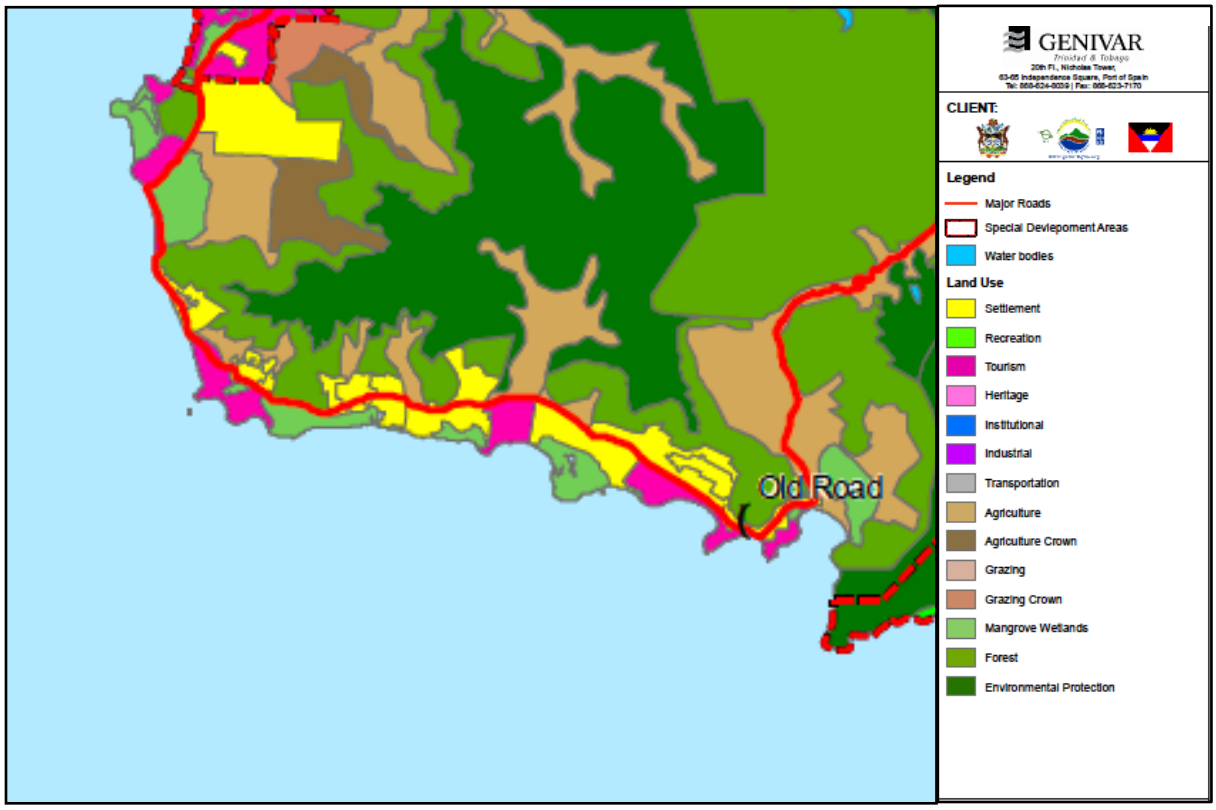


Figure 12. SIRMM Zoning

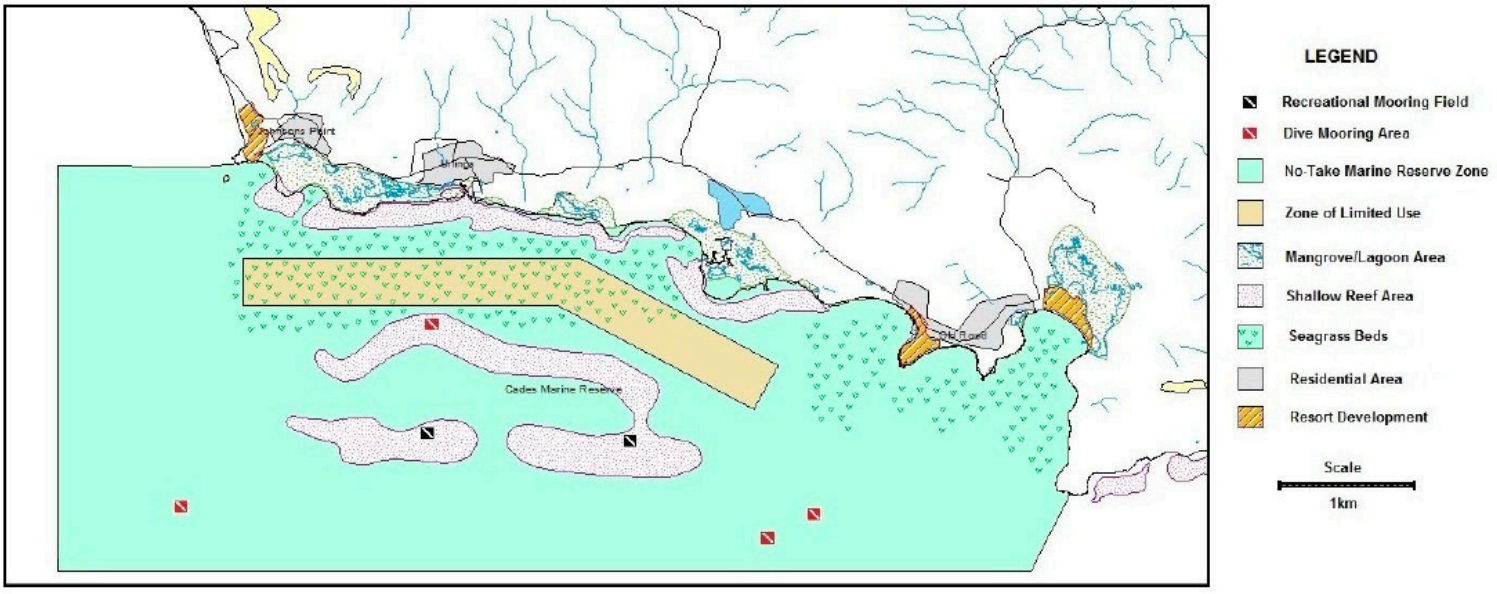


Figure 13. CBMR Zoning

5.4. Biological Resources

5.4.1. Regional Overview

The Cades Bay Marine Reserve (CBMR) encompasses diverse coastal and marine ecosystems, including mangrove wetlands, seagrass beds, and coral reefs, which provide critical habitat for marine and terrestrial species. These habitats play an essential role in coastal protection, fisheries sustainability, and biodiversity conservation.

The CBMR is home to three dominant coastal ecosystems:

1. Mangrove Wetlands – These provide nursery habitats for fish and crustaceans, stabilize the shoreline, and help protect against coastal erosion.
2. Seagrass Beds – Essential for marine biodiversity, these habitats act as carbon sinks and feeding grounds for sea turtles and other species.
3. Coral Reefs – Fringing reefs along the CBMR coastline support fish populations and reduce wave energy, helping protect the shoreline.

The proposed development site at Johnson's Point is located within this broader ecological framework. The vegetation across the study site predominantly aligns with the ecological characteristics of a tropical coastal forest. This biome is marked by a diverse array of flora and fauna adapted to saline conditions and coastal influences. The distribution of plant communities varies spatially, reflecting microenvironmental gradients in exposure to wind, salt spray, and soil moisture levels.

5.5.2. Terrestrial Flora

The seaward section of the site supports dense growth of sea grape (Coccoloba uvifera), a species well-known for its salt tolerance and sturdy growth habit. Its broad, leathery leaves form an effective windbreak and offer a critical protective barrier against storm surges and soil erosion along the coastline. This natural buffer contributes to coastal stability and serves as a vital habitat for local fauna.

Moving further inland, the vegetation transitions to a zone dominated by an abundance of manchineel trees (Hippomane mancinella) and cassie trees (Acacia spp.). As seen in Figure 14 below. The manchineel, despite its highly toxic properties, plays an essential ecological role in stabilising sandy soils and providing structural diversity within the forest. Cassie trees contribute to nitrogen fixation and support pollinators with their vibrant yellow flowers.

Additionally, a distinct patch reminiscent of a savannah ecosystem is present within the site. This area is characterised by an assemblage of grasses and sedges, whose fibrous root systems are well-adapted to withstand fluctuations in water availability. The presence of such graminoid-dominated patches underscores the site's ecological heterogeneity and provides habitat for various invertebrates.

Figure 14. Drone photos showing vegetation on the site and the marine space directly in front

This combination of plant communities exemplifies the resilience and adaptability of tropical coastal forests and highlights their ecological importance in maintaining biodiversity and mitigating coastal erosion.

5.5.3. Terrestrial Fauna

The terrestrial mammal population in Antigua is characterised by a dominance of invasive species, most notably the Indian mongoose (Herpestes auropunctatus) and the brown rat (Rattus rattus). These species have established themselves as key components of the island's mammalian fauna due to the absence of larger native terrestrial mammals, a typical trait of small island ecosystems. Their presence has significant ecological implications, particularly concerning predation on native fauna and competition for resources.

Of greater ecological and geographic significance, however, are the reptilian species, which display high levels of adaptation to Antigua's environment. During the terrestrial assessment of the study site, two notable native lizard species were observed:

- Watts Anole (Anolis wattsi): A small, agile lizard endemic to Antigua and Barbuda, characterised by its vibrant green to brown coloration and territorial behaviour.
- Antigua Bank Tree Lizard (Anolis leachii): Larger than the Watts Anole, this species exhibits a more robust build and is commonly found in arboreal habitats. Its presence is indicative of relatively undisturbed vegetative areas.

Given the site's coastal nature, avian biodiversity is particularly dynamic, featuring a mixture of both seabirds and inland bird species. The presence of these birds underscores the ecological importance of the site as a habitat for foraging, nesting, and resting. Species recorded during the assessment include the following:

1. Eurasian Collared-Dove (Streptopelia decaocto): A medium-sized dove identifiable by its distinctive black collar. This species has successfully adapted to human-altered landscapes.
2. Common Ground Dove (Columbina passerina): One of the smallest dove species, recognised for its scaled plumage and preference for open, grassy habitats.
3. Western Cattle Egret (Bubulcus ibis): Frequently seen near grazing livestock, these egrets are known for their mutualistic relationship with herbivores, feeding on insects stirred up by their movement.
4. Great Egret (Ardea alba): A large, elegant heron often seen wading in shallow coastal waters and wetlands, an important indicator of wetland health.
5. Zenaida Dove (Zenaida aurita): This medium-sized dove is characterised by a soft, plaintive cooing call and is often observed foraging on the ground.
6. Laughing Gull (Leucophaeus atricilla): Identified by its black head during the breeding season and distinctive laughing call, this gull is commonly seen along the coast.
7. Carib Grackle (Quiscalus lugubris): A highly adaptable blackbird known for its sociable nature and glossy plumage.
8. Blue Heron (Ardea herodias): One of the larger herons, typically found along the shoreline or in mangroves, where it forages for fish and amphibians.

9. Green Heron (Butorides virescens): A smaller heron species, often seen skulking in dense vegetation near water.
10. Mangrove Cuckoo (Coccyzus minor): A secretive bird that inhabits mangrove swamps and coastal forests, recognized by its distinctive call.
11. Caribbean Elaenia (Elaenia martinica): A small, active flycatcher commonly found in wooded habitats.
12. Yellow Warbler (Setophaga petechia): Known for its bright yellow plumage, this warbler frequents coastal and mangrove environments.
13. Gray Kingbird (Tyrannus dominicensis): A bold, aggressive flycatcher often seen perched conspicuously as it hunts for flying insects.
14. Brown Pelican (Pelecanus occidentalis): A large seabird recognized by its impressive plunge-diving behavior.
15. Least Sandpiper (Calidris minutilla): The smallest shorebird, often seen foraging along mudflats and sandy beaches.
16. Bananaquit (Coereba flaveola): A nectar-feeding bird with striking black, white, and yellow plumage.
17. Lesser Caribbean Bullfinch (Loxigilla noctis): An adaptable seed-eater with robust features, frequently seen in open habitats.
18. Green-throated Carib (Eulampis holosericeus): A hummingbird species known for its shimmering green throat and agile flight.
19. Antillean Crested Hummingbird (Orthorhyncus cristatus): Distinguished by its diminutive size and iridescent crest, this hummingbird is often observed hovering near flowering plants.

The rich diversity of bird species highlights the site's ecological significance as a vital habitat for both resident and migratory avifauna. The dynamic interactions between terrestrial and coastal environments contribute to the site's role in supporting biodiversity and maintaining ecological balance.

5.5.4. Marine Ecology

The marine environment adjacent to Johnson's Point is characterized by a complex and dynamic ecosystem comprising fringing coral reefs and extensive seagrass beds. Fringing reefs are the most common type of coral reef formation and are typically found along coastlines, forming a barrier that extends from the shallow nearshore waters into deeper zones. These reefs are ecologically significant due to their role in coastal protection, biodiversity conservation, and nutrient cycling.

Coral Reefs

At Johnson's Point, the fringing reefs display a diverse assemblage of hard corals (Scleractinia) and soft corals (Octocorallia), which create a structurally complex habitat. This complexity provides shelter, breeding grounds, and foraging sites for a myriad of marine species. The coral matrix also plays a vital role in dissipating wave energy, thereby reducing coastal erosion and enhancing the stability of nearby sandy beaches. However, the most recent ecological

assessment indicates that most of the reef structure is now composed of dead coral and coral rubble, likely due to past storm events, bleaching, and sedimentation impacts. While some coral remnants remain standing, much of the area has transitioned to a limestone pavement with loose coral fragments.

Seagrass Beds

Complementing the coral reefs are extensive seagrass beds (Figure 15), primarily composed of species such as Thalassia testudinum (*turtle grass*) and Syringodium filiforme (*manatee grass*). These submerged flowering plants form dense underwater meadows that act as critical carbon sinks, sequestering significant amounts of carbon dioxide and contributing to blue-carbon ecosystems. Seagrass beds are also essential for nutrient cycling, sediment stabilisation, and providing nursery habitats for numerous juvenile marine organisms. No invasive species of seagrass were noted during the marine survey. The seagrass meadows around the site seem to be doing exceptionally well and are so lush and healthy that they have grown over much of the dead reef structure as a mat.

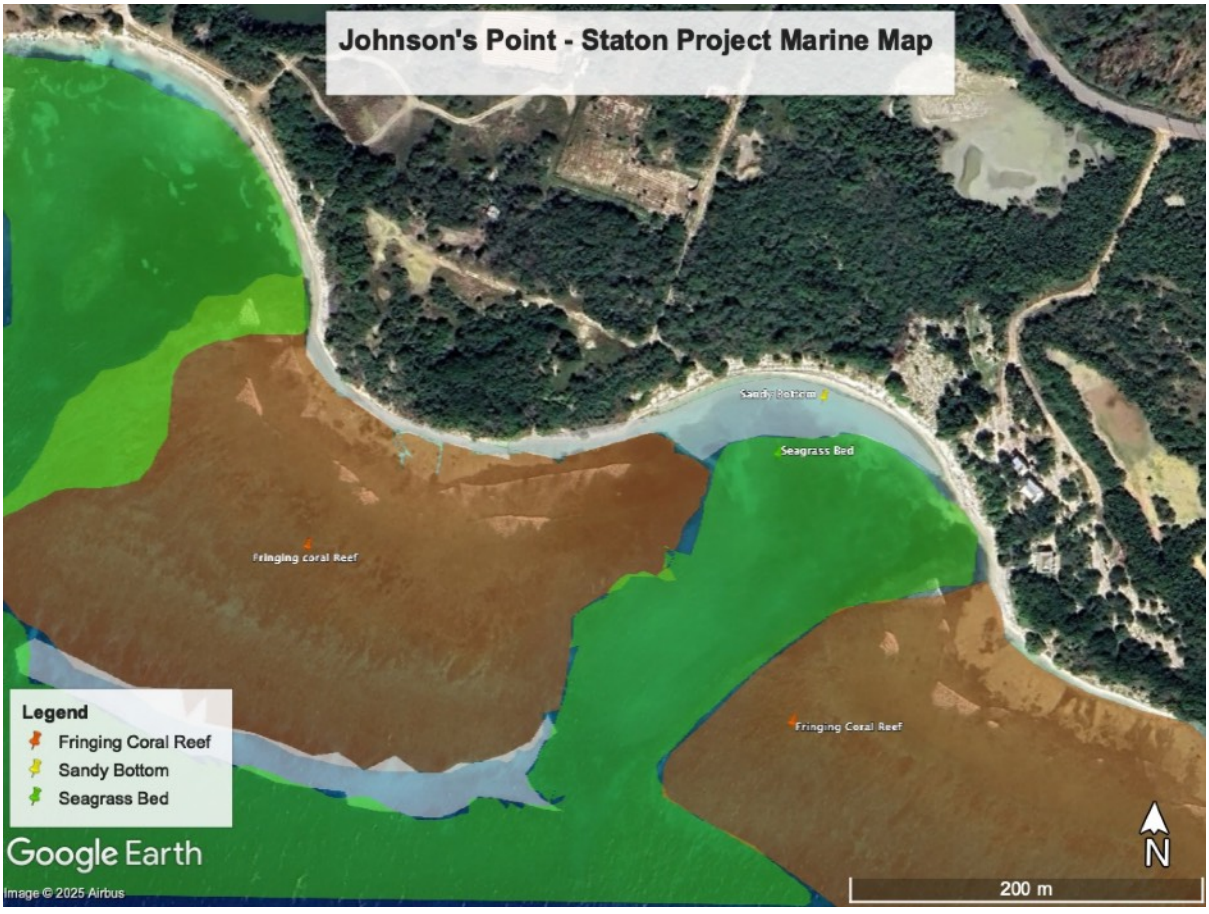


Figure 15. Map showing the marine ecosystem and substrate type in the area surrounding the site.

Marine Fauna

The biodiversity within the fringing reefs and seagrass habitats at Johnson's Point is remarkable, encompassing a wide range of vertebrate and invertebrate species. Common fish species observed include:

- Parrotfish (Scaridae family): Known for their vibrant colours and key role in coral reef health through their grazing activities, which prevent algal overgrowth.
- Angelfish (Pomacanthidae family): Recognised for their striking patterns and importance in maintaining reef ecosystem balance by feeding on sponges and algae.
- Damselfish (Pomacentridae family): Small territorial species that contribute to algal control and serve as prey for larger predators.

Various invertebrates also thrive in these habitats, including spiny lobsters (*Panulirus argus*), sea urchins (*Diadema antillarum**),*** and a variety of mollusks. These species contribute to the intricate food web dynamics and ecological balance of the marine environment. Lobsters are known to regulate the coral reef ecosystem by controlling the population of reef grazers and algae. Sea urchins also promote healthier reefs by controlling the overgrowth of algae that can smother coral reefs.

The fringing reefs and seagrass beds also provide crucial foraging and nesting habitats for sea turtles. Studies have confirmed the presence of species such as:

- Green sea turtle (*Chelonia mydas):* Preferring seagrass beds for foraging, this species plays a crucial role in maintaining the health of seagrass ecosystems.
- Hawksbill sea turtle (*Eretmochelys imbricata*): Often associated with coral reefs, where they forage on sponges and contribute to maintaining coral diversity.

During nesting season, sandy beaches around Johnson's Point, including the two beaches on either end of the development site serve as vital nesting grounds where these sea turtles lay their eggs. This process underscores the area's ecological importance as a site for the life cycles of these critically endangered marine reptiles.

5.5.5. Ecological Importance and Conservation Considerations

The coastal and marine ecosystems surrounding Johnson’s Point form a highly interconnected natural system that contributes to fisheries productivity, tourism appeal, and climate resilience. The seagrass beds and fringing reefs, despite degradation, continue to provide valuable ecosystem services. Additionally, the terrestrial vegetation acts as a natural buffer against storm surge and coastal erosion.

Given the development’s location within the Cades Bay Marine Reserve, key conservation considerations include:

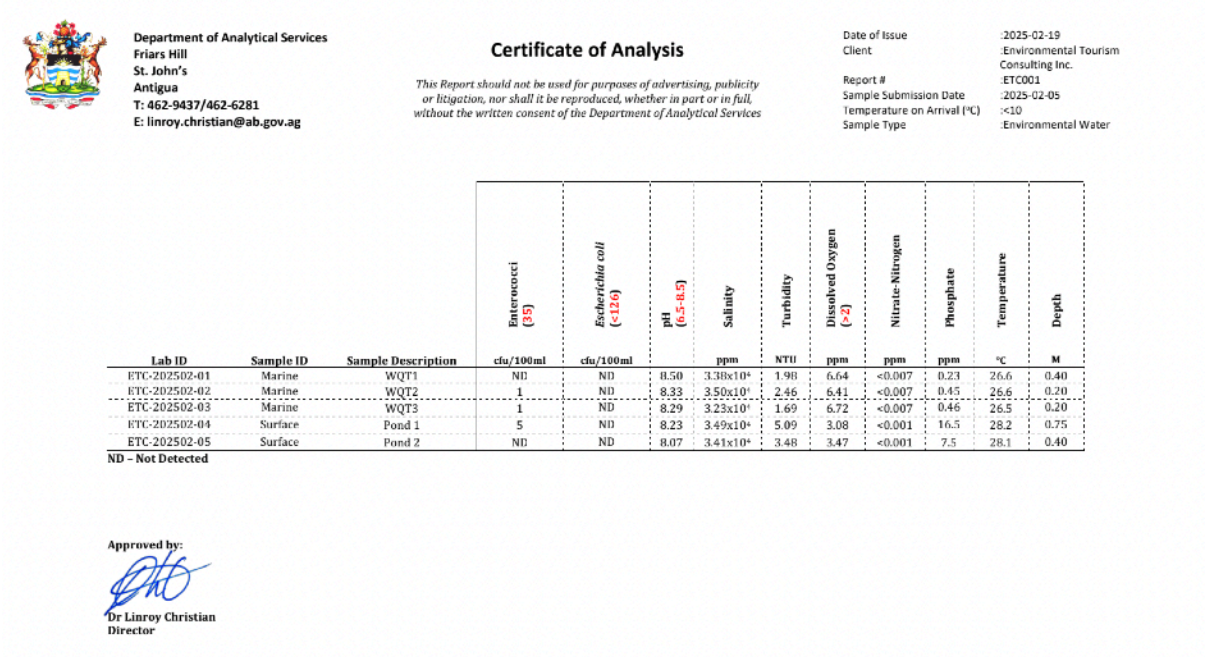
- Preserving the natural coastal vegetation, particularly the sea grape stands, which help mitigate erosion.

- Monitoring water quality and stormwater runoff, ensuring that pollutants do not impact the remaining reef structure or seagrass beds.
- Implementing best practices for coastal construction, including low-impact development strategies to protect nearshore ecosystems.

The integration of habitat conservation strategies and sustainable land management practices will be crucial in maintaining the ecological health of Johnson's Point while allowing for responsible development within the CBMR.

5.6. Water quality

A team from the Department of Analytical services visited the site with a YSI Water Quality Assessment probe and conducted analyses from marine and any terrestrial sources of water. Test results are shown in Figure 16 below. Three points were chosen in the marine space directly in front of the development site, and two small ponds on the site were also tested. The parameters tested include Enterococci, E. Coli, pH, salinity, turbidity, dissolved oxygen, Nitrate-nitrogen, phosphate and temperature. Interestingly, the terrestrial water is just as saline as the water in the marine space. It can be inferred from these results that the terrestrial water also originates from the sea, and there is no permanent source of freshwater on the land. All other testing parameters were within their normal ranges.



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Certificate of Analysis

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Date of Issue :2025-02-19
Client :Environmental Tourism Consulting Inc.
Report # :ETC001
Sample Submission Date :2025-02-05
Temperature on Arrival (°C) :<10
Sample Type :Environmental Water

Lab ID	Sample ID	Sample Description	Enterococci (35) cfu/100ml	*Escherichia coli* (<126) cfu/100ml	pH (6.5-8.5)	Salinity ppm	Turbidity NTU	Dissolved Oxygen (>2) ppm	Nitrate-Nitrogen ppm	Phosphate ppm	Temperature °C	Depth M
ETC-202502-01	Marine	WQT1	ND	ND	8.50	3.38x10⁴	1.98	6.64	<0.007	0.23	26.6	0.40
ETC-202502-02	Marine	WQT2	1	ND	8.33	3.50x10⁴	2.46	6.41	<0.007	0.45	26.6	0.20
ETC-202502-03	Marine	WQT3	1	ND	8.29	3.23x10⁴	1.69	6.72	<0.007	0.46	26.5	0.20
ETC-202502-04	Surface	Pond 1	5	ND	8.23	3.49x10⁴	5.09	3.08	<0.001	16.5	28.2	0.75
ETC-202502-05	Surface	Pond 2	ND	ND	8.07	3.41x10⁴	3.48	3.47	<0.001	7.5	28.1	0.40

ND – Not Detected

Approved by:

Dr Linroy Christian
Director

Figure 16. Certificate of water quality analysis.

5.7. Community Dynamics

The Johnson's Point community, though relatively small, is tremendously active and functional. The people are relational and close-knit, yet also welcoming to visitors who are interested in the area. The community exhibits a strong environmental stewardship attribute which can be seen in their conservation efforts and public engagement. The locals are also very active in the marine space whether it be for recreation or livelihoods.

5.7.1. Coastal Stewardship Initiatives

Recent efforts led by community organisations, supported by the Sandals Foundation and the GEF Small Grants Program, have contributed to the area's environmental recovery. Achievements include; the removal of over 1,770 kilograms of waste, including derelict vehicles and a boat. Additionally, the community has planted over 100 indigenous trees to stabilise the shoreline and enhance biodiversity.

The community has also organised workshops on up-cycling, swimming lessons, and environmental education campaigns that have fostered a sense of community responsibility towards protecting Johnson's Point. Beach and Marine Protection Efforts to install designated waste disposal areas and promote eco-friendly recreational activities have also contributed to a healthier coastal environment.

5.7.2. Livelihoods and lifestyle

The community surveys revealed that fishing has been a tradition in the Johnson's Point community since its inception. Fish is a main staple and source of protein for many households with most of them getting their fish from fishermen in the community. Persons went on to share that the proposed project site is not in the direct area of the fishing grounds nor the landing site, however, the neighbouring beaches to the site are popular with recreational activities and relaxation.

5.8. Coastal Processes

5.8.1. Geomorphology

The geology of southwestern Antigua is primarily shaped by the Basal Volcanic group, identified by Christman (1972) and van der Looij (2019) as igneous rock from the late Eocene to early Oligocene (40-36 Ma). In contrast, the northeastern Antigua Formation consists of younger limestone, reflecting the island's complex volcanic and sedimentary history. Though Antigua itself is no longer volcanically active, the Lesser Antilles remain seismically dynamic due to active tectonic plate interactions, with recent earthquakes near Antigua in November 2024 recorded at magnitudes 4.6 and 5.0 by the USGS (earthquake.usgs.gov). the Pan-American Institute of Geography and History (PAIGH) Antigua and Barbuda Vulnerability Assessment (OAS,

1998), which indicated peak ground accelerations between 500 gals and 800 gals for a 10% probability of excedance in 50 years, and recent earthquake data from the USGS Earthquake Hazards Program, noting magnitudes of 4.6 and 5.0 in November 2024.

Crabbe Hill, the Shekerley Mountains, and Cade Peak form the backdrop to the 5km shoreline that is framed by the rugged volcanic rock cliffs, particularly at Johnson's Point (elevation 8m/ 26.2ft), west of the proposed Stanton development and Curtain Bluff (elevation ~8m/26.2ft), east of the proposed development (Figure 17). The coastal geomorphology along this shore is an intricate balance of the underlying volcanic bedrock overlaid with carbonate sediments produced by fronting coral reefs. These reefs have also acted as natural barriers, dissipating wave energy and influencing the morphology of the shoreline by protecting the beaches from excessive erosion (Weiss, 1994) and have allowed for the formation of several pocket beaches. Additionally, this protection has allowed for the development of mangrove wetlands.

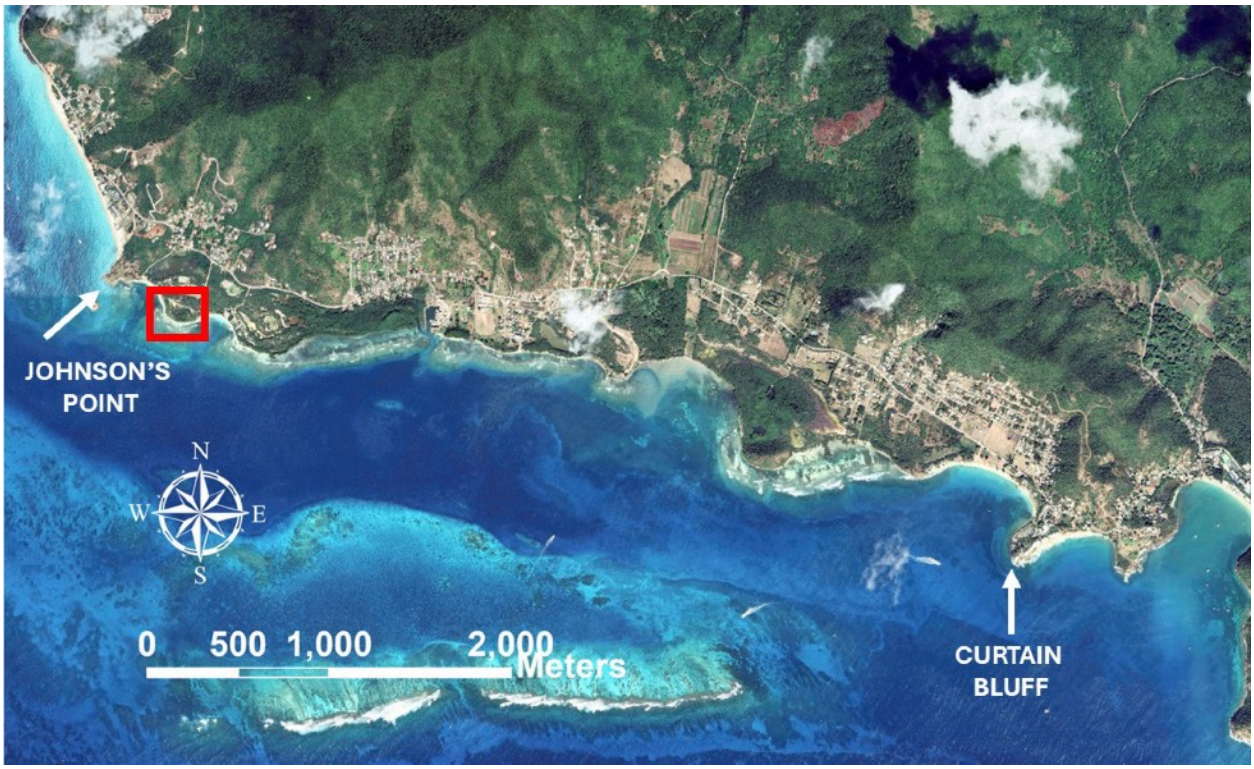

Figure 17. Proposed development (red box) framed within volcanic bedrock at Johnson's Point and Curtain Bluff.

5.8.2 Oceanographic and Coastal Processes Affecting Development

The dominant oceanographic forces affecting coastal processes between Johnson's Point and Curtain Bluff are drivers of climate, prevailing winds, tidal and wave dynamics, currents, and storm impacts, highlighting their role in shaping the coastal zone by its location and orientation in the Caribbean Sea.

Climate Setting

Antigua's semi-arid tropical climate is characterised by a mean annual temperature of approximately 27.3°C, based on recent climate data from 1991-2020 (World Bank, 2021). The average annual rainfall is 1110 mm, with variations by elevation; the karst belt, the driest region, receives less than 900 mm annually (CCA, 1991). The dry season (January–April) aligns with peak evapotranspiration at 143 mm/month in March, while the wet season (August–November) sees reduced rates at 87 mm/month in November (McMillan, 1985). The precipitation-to-evapotranspiration ratio is 0.57, indicating water stress (UNCCD, 2005). As of December 2024, a moderate meteorological drought was recorded, with only 41.7 mm of rainfall, the seventh driest December since 1928, highlighting ongoing climate challenges (Safety Steps, 2025).

Climate Change Projections

Future climate scenarios project substantial impacts on coastal processes (Simpson *et al.*, 2012):

- *Temperature Rise:* Mean annual temperatures are expected to increase by 2.4°C to 3.2°C by the 2080s, affecting thermal stress on coastal ecosystems.
- *Rainfall Variability:* Projections indicate monthly shifts between -31 to +13 mm, with an 18% annual decrease, exacerbating drought risks.
- *Sea Surface Temperature (SST) Increase*: SSTs may rise by 0.7°C to 2.8°C, increasing coral bleaching risks that could result in the loss of coral reefs (Hoegh-Guldberg, 1999).
- *Storm Intensity:* More intense hurricanes are anticipated due to higher SSTs, though frequency projections remain uncertain, with the potential for increased coastal flooding.
- *Sea Level Rise (SLR):* Current trends show a global mean rise of 3 mm/year (IPCC, 2013), with projections of 0.28 to 1.01 meters by 2100 under varying emissions scenarios (IPCC AR6, 2021).

Prevailing Winds

Easterly trade winds dominate, with an average speed of approximately 8 knots (9.2 mph), based on wind statistics for V. C. Bird International Airport (Windfinder, 2025). Peak speeds reach 13.6 knots in July, with calmer periods at 9.2 knots in October. Winds rarely exceed 21 knots (24 mph), but open waters and elevated areas experience gusts up to 25 knots, particularly during storms. The southwest coast, lacking topographic shelter, is highly exposed to wind-driven wave energy, intensifying coastal dynamics and erosion risks.

Coastal Hydrodynamics

The southwest coast exhibits a semi-diurnal tidal regime with a mean range of 0.3 to 0.32 meters, based on tide charts for St. John's, Antigua, as of March 2025 (tide-forecast.com). Significant wave heights range from 1 to 2 meters, with long-period swells exceeding 2.5 meters during winter and spring, driven by North Atlantic extra-tropical cyclones. During the hurricane season (June–November, peaking August–September), storm-generated waves may reach 1.8

meters under a 100-year return period, as per historical data (USAID, 2001). These dynamics can contribute to sediment transport and coastal erosion and accretion.

Ocean Currents

Ocean currents along the southwest coast are predominantly wind-driven, flowing northwest to west under the influence of easterly trade winds, consistent with Caribbean Current patterns (MYROMS, no date). Local bathymetry and coastal alignment create nearshore eddies and countercurrents, affecting sediment distribution. Storm events disrupt these patterns, leading to unpredictable shoreline changes through erosion and deposition, highlighting the relationship between wind, currents, and coastal morphology.

Hurricane and Storm Influences: Historical and Projected Impacts

Tropical cyclones generate high waves, storm surges up to 1.5 meters for a 100-year return period (GFDRR, 2017), and heavy rainfall can reshape the coastline. Historical events, such as Hurricane Irma in 2017, caused significant coastal changes, with surges breaching low-lying areas and altering beach morphology (GFDRR, 2017). Recent storms, like Tropical Storm Ernesto in August 2024, brought tropical-storm-force winds and potential surges, emphasising ongoing vulnerability (Antigua Observer, 2024).

5.8.3. Historical Coastal Change

The methodology for identifying coastal change is described in section 3.6 Analysis of Coastal Processes.

Although the 1968 image is blurred, the alignment of the images was recognised in ArcGIS Pro and identified a residual error of less than 2m, indicating the overlaid images were within 2m of the exact location as the other image. Despite some errors, digitising the shoreline in 1968, where vegetation meets the sand, and overlaying on the 2024 image provides a clear indication of at least 10m erosion on the southern edge since 1968 (Figure 19). However, some accretion can be seen on the eastern and western sides of the sandy peninsula in which the proposed development is located. This is caused by variable coastal processes in which littoral drift can cause sediments to move westerly along this shore. Figure 20 provides an aerial view of the property overlaid with the renderings.

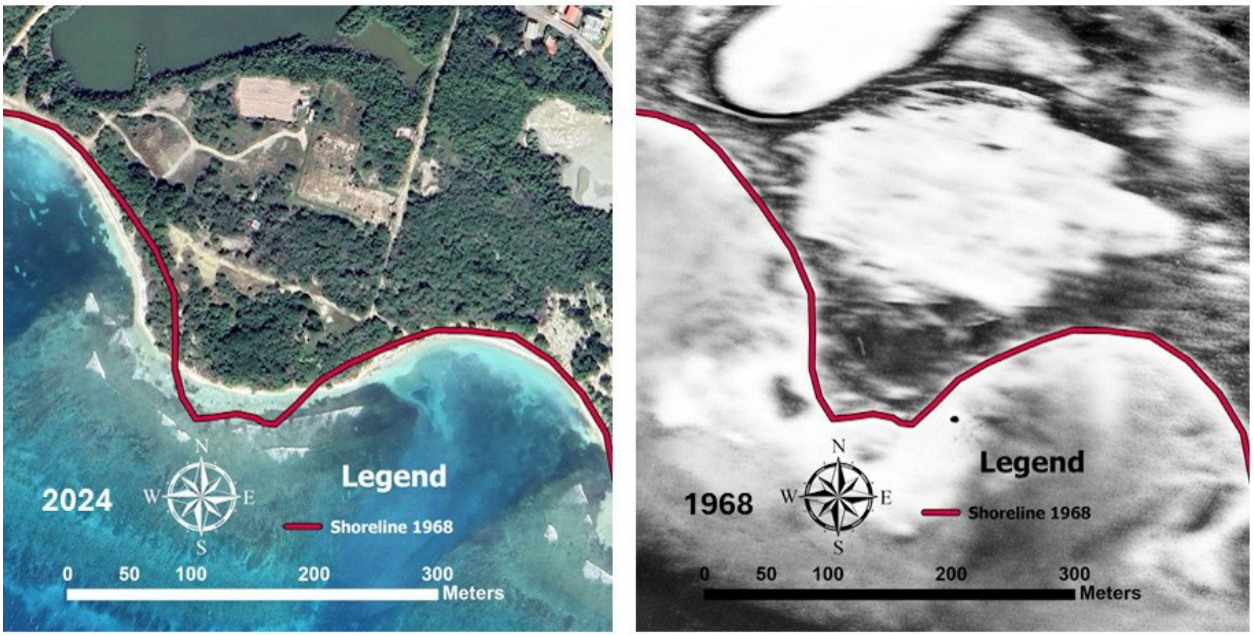

Figure 18. Red line indicates the shoreline as it was in 1968.

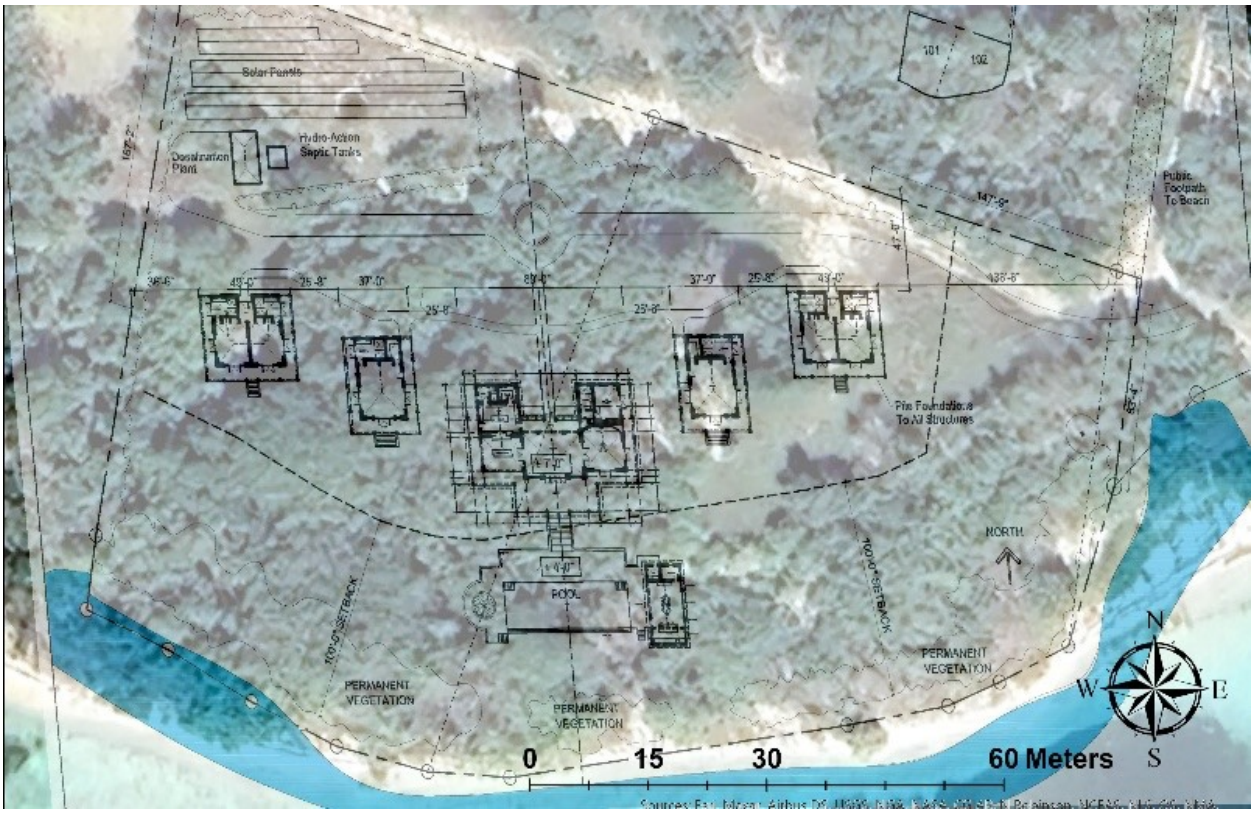

Figure 19. Proposed development over the satellite imagery showing the development in proximity of the shoreline.

6. POTENTIAL IMPACTS AND MITIGATION MEASURES

6.1. Introduction

The Impacts and Mitigation Measures section of this Environmental Impact Assessment (EIA) identifies and evaluates the potential environmental, social, and economic effects of the Johnson's Point Vacation Property Development. This section also outlines mitigation measures designed to minimise or eliminate adverse impacts while enhancing the project's sustainability and long-term environmental performance.

Environmental impacts will vary depending on the phase of development, including site preparation, construction, and operational activities. Some effects may be temporary, such as dust and noise pollution during construction, while others, such as changes to land cover or water consumption, may have longer-term implications. Given the project's location within the Cades Bay Marine Reserve (CBMR), particular attention has been given to coastal stability, marine biodiversity, wastewater management, and climate resilience.

The structure of this section follows an impact-based approach, categorising impacts by environmental aspect rather than by project phase. This allows for a clearer assessment of how each factor—such as water resources, air quality, or land use—may be affected, rather than forcing impacts into predefined phases where they may not be relevant. Where necessary, project phases will be referenced within each impact category.

6.2. Project Layout and Land Use

The Johnson's Point Residential Development is situated on a 3.7-acre site along the southwestern coast of Antigua, within the Cades Bay Marine Reserve (CBMR). The project has been carefully designed to integrate with the surrounding environment, maintaining the natural topography and existing vegetation while introducing a low-density residential retreat. The development consists of a main house, four guest cottages, a swimming pool and gazebo, and essential utility infrastructure, including a solar array, a desalination plant, and a wastewater treatment system. The placement of these structures optimises natural ventilation, preserves scenic coastal views, and ensures minimal disruption to ecological processes.

The layout of the development follows a clustered arrangement, with the main house centrally located, surrounded by the four guest cottages, each with verandahs designed to provide shade and passive cooling. The swimming pool is positioned between the main house and the sea, offering a seamless transition between the built environment and the coastal landscape. The solar array is discreetly located in the northwest corner of the site,

ensuring maximum solar exposure while minimising visual impact. The desalination plant and wastewater treatment system are placed to efficiently manage water resources while adhering to environmental best practices.

The site plan emphasises the retention of native coastal vegetation, which acts as a buffer against coastal erosion and provides habitat for local wildlife. Buildings have been placed to follow the natural contours of the land, reducing the need for excessive excavation and grading. Access pathways and landscaping have been designed to enhance the property's natural aesthetics, blending modern sustainability features with traditional Caribbean architectural elements.

6.3. Key Environmental Impacts and Proposed Mitigation Measures

6.3.1. Air Quality and Noise Pollution

The development of the Johnson's Point site will introduce temporary changes to air quality and noise levels, particularly during the site preparation and construction phases. These impacts will stem primarily from dust generation, emissions from heavy machinery, and construction-related noise. Although these effects will be temporary, they require careful management to minimise their impact on workers, residents, and the surrounding environment.

6.3.1.1. Site Preparation Phase

Potential Impacts

The initial clearing of vegetation, grading, and excavation will result in increased airborne dust and particulate matter, particularly in dry and windy conditions. Vehicle traffic on unpaved surfaces will also contribute to dust emissions, while the use of chainsaws, bulldozers, and other heavy equipment will introduce short-term noise disturbances.

Mitigation Measures

To mitigate these effects, dust suppression measures such as water spraying and covering stockpiled materials will be implemented to minimise airborne particles. Access roads and exposed soil will be dampened regularly, and vehicle speeds will be controlled to reduce dust generation. Noise levels will be managed by limiting site preparation activities to daytime hours and ensuring that all equipment used complies with noise control regulations.

6.3.1.2. Construction Phase

Potential Impacts

During the construction phase, the use of concrete mixers, pile drivers, and transport vehicles will contribute to both air and noise pollution. Diesel-powered equipment may release exhaust emissions, including carbon monoxide and fine particulate matter, which could affect local air quality. Prolonged exposure to high noise levels could also cause disruptions for nearby residents and workers.

Mitigation Measures

To reduce these impacts, contractors will be required to use modern, well-maintained equipment that meets emission control standards. Construction activities will be scheduled to avoid peak traffic hours, reducing unnecessary emissions from idling vehicles. Additionally, temporary noise barriers and buffer zones will be used where necessary to shield nearby properties from excessive noise. Workers exposed to prolonged noise will be provided with hearing protection, ensuring compliance with occupational health standards.

6.3.1.3. Operational Phase

Potential Impacts

Once construction is complete, air quality and noise levels are expected to return to baseline conditions. The primary sources of emissions during operation will be vehicle traffic associated with site maintenance and guest transportation. Additionally, occasional operation of backup generators or mechanical systems may introduce localised noise disturbances.

Mitigation Measures

To ensure long-term air quality management, landscaping and green buffers will be maintained to act as natural dust and noise barriers. The use of energy-efficient appliances and equipment will help minimise noise pollution from mechanical systems, ensuring that the development remains a low-impact, environmentally conscious retreat.

6.3.2. Water Resources and Hydrology

The Johnson's Point development is located within the Cades Bay Marine Reserve, an area where natural water flow patterns, stormwater runoff, and drainage efficiency must be carefully managed to prevent coastal and marine degradation. The project will introduce modifications to the site's drainage characteristics, and measures must be in place to ensure that runoff, sedimentation, and potential contamination are effectively controlled.

6.3.2.1. Site Preparation Phase

Potential Impacts

During site preparation, clearing of vegetation and initial grading may temporarily disrupt the natural drainage pathways that direct water toward low-lying areas and the nearshore marine environment. Without proper control, loose soil and sediment could be washed into adjacent water bodies, increasing turbidity levels and potentially smothering seagrass beds and coral reefs.

Mitigation Measures

To mitigate these risks, silt fences and erosion control barriers will be installed along the coastal edge and drainage pathways to capture displaced soil before it reaches sensitive aquatic habitats. Grading will be carried out in phases, ensuring that exposed soil is quickly stabilised using temporary ground cover or mulching techniques.

6.3.2.2. Construction Phase

Potential Impacts

The installation of infrastructure, including foundations, paved surfaces, and underground utilities, will introduce impervious surfaces that can alter the site's natural water infiltration capacity. Increased stormwater runoff could lead to localised flooding or pooling, while improperly managed construction waste could introduce contaminants into the groundwater or coastal waters.

Mitigation Measures

To prevent these issues, a stormwater management plan will be implemented to direct runoff through designated filtration zones before discharging into the environment. Permeable surfaces will be prioritised where possible, allowing for natural infiltration and reducing runoff velocity. Additionally, construction materials and potential pollutants (e.g., fuel, cement, paints) will be securely stored away from drainage pathways, with spill containment measures in place to prevent accidental contamination.

6.3.2.3. Operational Phase

Potential Impacts

As the Johnson's Point development becomes fully operational, its water resource management will be defined by ongoing interactions between stormwater runoff, desalination processes, and

overall site hydrology. While permanent drainage systems and water control measures will be in place, there remain potential environmental impacts that must be carefully managed.

The introduction of built structures, impervious surfaces, and landscaped areas will alter natural drainage patterns, potentially leading to increased surface runoff and localised changes in infiltration rates. While permeable surfaces and landscaped zones will help absorb rainwater, there remains a risk that stormwater runoff could carry sediments, nutrients, or pollutants into the nearshore marine environment, particularly after heavy rainfall events. Additionally, if drainage pathways become obstructed, there could be water pooling or erosion along site perimeters.

A significant hydrological consideration is the AqSep Watermaker system, which will provide freshwater desalination for the development. While this system reduces reliance on municipal water supplies and groundwater extraction, it introduces brine discharge as a byproduct, which, if unmanaged, could increase local salinity levels in the discharge area. High-salinity effluent has the potential to affect marine organisms, disrupt local ecosystem balance, and alter seagrass and coral growth rates in sensitive areas.

Mitigation Measures

To control stormwater runoff, the development will feature a network of swales, vegetated buffers, and permeable paving, ensuring that rainwater is effectively absorbed and filtered before reaching the marine environment. Routine inspections and maintenance will be carried out to ensure that sediment buildup does not compromise drainage efficiency. Where necessary, additional drainage channels or retention areas will be implemented to handle excess runoff during extreme weather conditions.

For the AqSep Watermaker, a controlled brine diffusion system will be established to ensure that discharge is diluted before entering the surrounding waters. The discharge location will be strategically placed away from seagrass beds and coral habitats to prevent ecosystem disruptions. Additionally, routine water quality monitoring will be conducted to assess potential salinity fluctuations near the outfall point.

By integrating sustainable water management practices, monitoring drainage efficiency, and minimising desalination impacts, the development will maintain hydrological balance, supporting both site sustainability and the ecological health of the Cades Bay Marine Reserve.

6.3.3. Wastewater and Sewage Management

Effective wastewater and sewage management is critical to maintaining water quality, public health, and environmental integrity within the Johnson’s Point development. Given the coastal

location and proximity to the Cades Bay Marine Reserve, improper wastewater management could lead to nutrient pollution, groundwater contamination, and potential marine degradation. To mitigate these risks, the project will incorporate a Hydro-Action AN600 Aerobic Treatment Unit (ATU), which processes wastewater more efficiently than conventional septic systems, producing high-quality effluent with reduced nitrogen levels. The following discussion outlines the potential environmental impacts and mitigation measures associated with wastewater management at different project phases.

6.3.3.1. Site Preparation Phase

Potential Impacts

During the site preparation phase, the installation of the Hydro-Action AN600 wastewater treatment system will require excavation to accommodate the treatment unit and its associated plumbing infrastructure. This activity has the potential to disturb the soil, leading to temporary displacement and an increased risk of erosion and sedimentation in nearby drainage areas. If not carefully managed, displaced soil and construction debris could enter stormwater systems or coastal waters, introducing particulates and organic matter into the marine environment. Additionally, excavation near underground water flows may alter natural hydrological pathways, potentially changing drainage patterns or causing localised pooling.

Mitigation Measures

To mitigate these risks, silt fencing and erosion control barriers will be placed around the excavation site to capture displaced soil and prevent sediment migration to sensitive areas. The excavation will be phased carefully, ensuring that backfilling is completed promptly to reduce long-term exposure. Additionally, temporary drainage channels will be installed to redirect stormwater away from marine habitats, thereby preventing contamination.

6.3.3.2. Construction Phase

Potential Impacts

With the system in place, the next phase of construction will focus on connecting waste lines, sealing containment structures, and performing leak tests. Improper handling of construction materials, sealants, or fuel near the wastewater system could introduce pollutants into the environment, increasing the risk of contamination. If the system is not properly sealed, there is also a potential for leaks, which could allow untreated sewage to infiltrate the surrounding soil or groundwater.

Mitigation Measures

To address these concerns, all sealants, adhesives, and hazardous materials will be stored in designated areas away from drainage pathways to prevent accidental spills and contaminant infiltration. Additionally, the wastewater system will undergo pressure testing before it is commissioned to ensure that all joints and pipes are properly sealed, preventing potential leaks and operational failures.

6.3.3.3. Operational Phase

Potential Impacts

Once the system is fully operational, wastewater treatment will focus on managing effluent quality and ensuring the system remains functional over the long term. If not properly maintained, the system could contribute to nutrient loading in coastal waters, particularly through excess nitrogen and phosphate discharge. This could lead to eutrophication, promoting algal blooms and oxygen depletion, which would negatively impact marine ecosystems. Over time, organic matter will accumulate within the treatment unit, requiring periodic sludge removal to prevent blockages and system failures. Additionally, if aeration components malfunction, the breakdown of organic waste could lead to odor emissions, affecting both residents and visitors in the area.

Mitigation Measures

To mitigate these operational impacts, effluent quality monitoring will be conducted regularly to ensure compliance with NSF/ANSI Standard 245, particularly for nitrogen reduction and overall water quality standards. Scheduled system maintenance will ensure that aeration units, clarifiers, and filtration components remain fully functional. A sludge management plan will be implemented to facilitate scheduled sludge removal and disposal at approved treatment facilities. Given that the Hydro-Action AN600 relies on continuous aeration, a backup power system, such as a generator or battery storage, will be available to prevent system failures during power outages.

6.3.4. Energy and Solar Array Considerations

The Johnson's Point development will integrate a solar photovoltaic (PV) system as its primary energy source, designed to provide a self-sustaining and renewable power supply for the residences. The installation of 191 high-efficiency 400W solar panels across a 4,150 sq. ft. area will generate an estimated 382 kWh per day, amounting to approximately 140,000 kWh annually under optimal conditions. Since the development will operate off-grid, a battery storage system will ensure power availability during low solar production periods, with an estimated storage capacity ranging from 382 kWh to 764 kWh, depending on energy demand and backup requirements. While this approach significantly reduces dependence on fossil fuels,

its implementation carries site-specific environmental considerations that must be addressed at each project phase.

6.3.4.1. Site Preparation Phase

Potential Impacts

Prior to installing the solar array, the designated area will require land preparation and minor clearing to accommodate the panel mounting structures, inverters, and battery storage units. Since the system is designed to blend with the existing environment, major land alterations are not anticipated. However, clearing and grading activities could temporarily disturb soil stability and remove natural vegetation, which plays a role in erosion control and habitat support. Additionally, improper site grading could alter drainage patterns, leading to localized pooling or runoff issues.

Mitigation Measures

To mitigate these impacts, the solar array will be strategically placed in an area that requires minimal land clearing, preserving as much existing vegetation as possible. Where necessary, erosion control measures such as permeable surfaces, ground cover vegetation, and strategically placed drainage channels will be used to maintain soil stability and prevent excess runoff.

6.3.4.2. Construction Phase

Potential Impacts

The installation of the solar panels, battery storage units, and inverters will involve anchoring mounting structures, laying electrical wiring, and assembling storage components. This phase may introduce temporary environmental disturbances, including material waste from packaging, airborne dust from drilling, and localised noise pollution from mechanical equipment.

Mitigation Measures

To reduce the environmental footprint of construction, waste materials from packaging and installation will be collected and sorted for appropriate disposal or recycling. Where possible, non-biodegradable components will be repurposed. Additionally, construction activities will be scheduled during daylight hours to limit disturbance to nearby communities and wildlife. Water suppression methods will be applied in areas where drilling or movement may create dust, ensuring that air quality remains unaffected.

6.3.4.3. Operational Phase

Potential Impacts

Once fully operational, the solar array and battery system will provide a stable and sustainable power supply for the development. While the system itself is designed to have minimal long-term environmental impact, some potential concerns must be considered. The heat absorption of the panels could contribute to a localised heat island effect, particularly in areas with low vegetation cover. Additionally, lithium-ion battery storage systems require proper maintenance and temperature control to prevent overheating and potential fire hazards.

Mitigation Measures

To address these concerns, landscaping features such as native low-growing vegetation and ground cover materials will be incorporated around the solar array to reduce heat absorption. Reflective coatings or light-coloured gravel may also be used to mitigate localised temperature increases. Battery storage units will be housed in temperature-regulated enclosures, ensuring proper ventilation and fire suppression measures are in place. Regular maintenance and system monitoring will be conducted to ensure optimal performance and minimise risks associated with energy storage.

6.3.5. Marine Ecology

The marine ecology surrounding Johnson's Point presents a highly sensitive and ecologically significant environment, reinforcing the need for careful planning and mitigation throughout the development process. The presence of fringing coral reefs, extensive seagrass beds, and nesting beaches for endangered sea turtles means that even small disturbances could have far-reaching consequences on biodiversity, coastal protection, and marine health.

6.3.5.1. Site Preparation Phase

Potential Impacts

The initial preparation of the site, including clearing, grading, and excavation for foundations and utilities, could indirectly affect the marine environment if best practices are not followed. While direct marine intrusion is not anticipated, runoff and airborne debris could enter coastal waters, impacting water clarity and sedimentation levels.

Additionally, the designation of construction zones, material storage areas, and access routes could disturb natural drainage pathways, potentially increasing the likelihood of altered stormwater flow into sensitive marine habitats.

Mitigation Measures

To prevent unintended marine impacts, strict erosion control measures will be enforced. Silt fences, sediment traps, and vegetative buffers will be installed around disturbed areas to prevent soil displacement from reaching nearshore environments.

- No-construction buffer zones will be established near coastal edges, ensuring that material stockpiles and machinery do not encroach on areas where natural drainage into the marine environment occurs.
- Stormwater management strategies, such as retention swales and permeable surfaces, will help control surface runoff and reduce sediment transport into the reef ecosystem.

6.3.5.2. Construction Phase

Potential Impacts

During the construction phase, increased sedimentation, accidental pollutant spills, and physical disturbances pose the greatest risks to marine life. Without adequate controls, fine sediment particles from construction could enter the water column, potentially smothering corals and seagrass beds by reducing sunlight penetration and disrupting photosynthesis.

Another major concern is light pollution, as unshielded artificial lights from the construction site may disorient sea turtle hatchlings, leading them away from the ocean. Similarly, coastal noise and vibration could disturb sensitive marine fauna, particularly species that rely on auditory cues for navigation and breeding.

Mitigation Measures

To limit construction-related disturbances, several proactive strategies will be implemented:

- Turbidity barriers will be deployed in the nearshore waters as a precautionary measure to contain and monitor sediment plumes if any disturbances arise.
- Low-intensity, downward-facing lights will be used to reduce artificial illumination spillover onto nesting beaches.
- Equipment fuelling, material handling, and chemical storage will occur in designated inland zones, far from drainage pathways that could carry pollutants to the sea.

6.3.5.3. Operational Phase

Potential Impacts

The long-term operation of the development could contribute to nutrient loading, habitat degradation, and continued disturbance to marine wildlife if mitigation strategies are not rigorously maintained.

- Wastewater effluent from the Hydro-Action AN600 system could introduce excess nutrients (nitrogen and phosphorus) into the water, potentially fuelling algal blooms that could reduce reef health.
- Artificial light pollution from permanent structures may continue to impact sea turtle nesting and foraging patterns, especially if outdoor lighting is poorly designed.
- Runoff from the solar array and other hard surfaces may introduce additional sediment loads into the water, compromising water clarity and affecting seagrass bed stability.

Mitigation Measures

To mitigate these risks, strict environmental management practices will be sustained throughout the operational lifespan of the development:

- Effluent quality monitoring will be continuously conducted, ensuring that wastewater discharge complies with nitrogen reduction standards to prevent nutrient loading in nearby waters.
- Low-wavelength amber LED lighting will be installed across the property to minimise impacts on sea turtles, reducing disorientation risks while maintaining necessary illumination.
- Landscaped filtration buffers, including wetland vegetation and biofiltration areas, will trap runoff contaminants before they reach marine environments.

6.3.6. Coastal Processes

The coastal environment at Johnson's Point is shaped by dynamic interactions between wave action, sediment transport, and natural coastal defences such as fringing coral reefs. The proposed development must consider these processes to mitigate risks such as coastal erosion, storm surge, and sediment displacement. The following section outlines the key impacts of the project on coastal processes during the site preparation, construction, and operational phases, along with recommended mitigation strategies.

6.3.6.1. Site Preparation Phase

Potential Impacts

- During the site preparation phase, land clearing and grading activities may disrupt natural drainage and sediment dynamics, potentially leading to:
- Increased sediment runoff into nearshore waters, which can smother coral reefs and seagrass beds.
- Disturbance of native coastal vegetation, which plays a crucial role in stabilising sediments and preventing erosion.
- Modification of natural drainage pathways, leading to localised flooding or changes in sediment deposition.

Mitigation Measures

To minimise these impacts, the following mitigation measures will be implemented:

- Erosion and Sediment Control Measures: Silt fences, turbidity barriers, and sediment traps will be used to prevent sedimentation in the nearshore environment.
- Vegetation Retention and Restoration: Where possible, native coastal vegetation such as sea grape (Coccoloba uvifera) will be retained, and any disturbed areas will be replanted with native species.
- Drainage Management: Temporary drainage channels will be established to direct stormwater flow away from sensitive marine habitats, ensuring sediment is captured before reaching coastal waters.

6.3.6.2. Construction Phase

Potential Impacts

The construction phase will introduce additional risks to coastal processes, particularly through the installation of structures and associated earthworks. Key concerns include:

- Increased wave reflection and localised erosion due to improper placement of infrastructure.
- Heavy machinery use and material stockpiling may compact soil, altering runoff patterns and increasing the risk of erosion.

- Accidental spills of construction materials, including cement and oils, may enter the marine environment and degrade water quality.

Mitigation Measures

The following steps will be taken to mitigate construction-related impacts:

- *Controlled Construction Access:* Designated pathways for construction vehicles will minimise disturbance to natural ground cover and reduce soil compaction.
- *Coastal Setback Compliance:* All permanent structures will be sited outside the 100-foot coastal setback mandated by the Department of Environment, with the exception of the swimming pool and gazebo, which are located in a zone of demonstrated shoreline stability. Their placement is supported by site-specific coastal assessments indicating minimal erosion risk in that area. Mitigation strategies, including reinforced foundations, elevated construction, and the retention of vegetative buffers, will ensure their long-term resilience.
- *Best Practices for Material Storage:* Construction materials will be stored at a safe distance from the shoreline, and spill containment measures will be put in place to prevent contamination.
- *Regular Monitoring and Adaptive Management:* On-site environmental representatives will conduct routine inspections to ensure compliance with sediment control and drainage management protocols.

6.3.6.3. Operational Phase

Potential Impacts

Once operational, the development will continue to interact with coastal processes. The main concerns during this phase include:

- Coastal erosion due to storm surge and sea-level rise, exacerbated by increased impermeable surfaces within the development.
- Potential long-term changes in sediment transport patterns due to infrastructure placement.
- Increased human activity in the coastal zone, potentially leading to beach erosion and trampling of sensitive vegetation.

Mitigation Measures

To ensure the long-term sustainability of the coastal environment, the following mitigation strategies will be applied:

- *Shoreline Stabilisation:* The retention of native coastal vegetation will provide natural stabilisation, with periodic assessments to determine if additional planting is necessary.
- *Beach Monitoring Program:* The shoreline will be monitored for signs of erosion, with adaptive measures such as beach nourishment or dune restoration implemented as needed.
- *Low-Impact Development Strategies:* Permeable pathways, elevated structures, and rainwater harvesting systems will be used to minimise runoff and erosion.
- *Community and Environmental Awareness:* Residents and visitors will be encouraged to follow best practices for coastal stewardship, including using designated access points to reduce disturbance to dune systems.

6.3.7. Setbacks

The shoreline at Johnson's Point exhibits a dynamic interplay of erosion and sediment deposition. Historical patterns indicate a general trend of landward and westward shoreline movement, suggesting ongoing erosion in some areas. However, sediment accumulation has also been observed along the eastern and western edges of the sandy peninsula, indicating that certain sections of the coastline are stable or even expanding. This variability in coastal processes highlights the importance of site-specific considerations when determining appropriate development setbacks.

The natural coastal environment provides additional stabilisation, with fringing coral reefs acting as buffers that dissipate wave energy and help regulate sediment movement. These features contribute to shoreline resilience, reducing the rate of erosion in some areas and influencing localised patterns of sediment transport.

6.3.7.1. Site Preparation Phase

Potential Impacts:

While the Department of Environment has set a standard 100-foot coastal setback to minimise risks associated with erosion and storm surges, the site's specific coastal dynamics indicate that not all areas within this zone are equally vulnerable. The proposed pool and gazebo are situated within a portion of the setback where sediment accumulation has been observed. However, improper site preparation, including excessive ground disturbance or removal of natural stabilising vegetation, could disrupt sediment transport patterns and increase erosion risk.

Mitigation Measures:

To minimise potential impacts, site preparation should incorporate measures that preserve the stability of the immediate coastal environment. Vegetative buffers, including native salt-tolerant

species like seagrape (Coccoloba uvifera), should be maintained and enhanced along the shoreline to reinforce sediment retention. Any site grading should be carefully planned to avoid disrupting natural drainage and sediment deposition processes. Additionally, no deep excavation should occur in proximity to the shoreline to prevent unnecessary destabilisation of sediments in the setback area.

6.3.8. Construction Phase

Potential Impacts:

Construction activities within the setback zone, including material storage, equipment movement, and grading, have the potential to disturb stabilising vegetation and introduce sediment into coastal waters. The temporary alteration of natural contours could affect localised erosion and deposition patterns, particularly if construction work extends into sensitive coastal areas.

Mitigation Measures:

Minimising the footprint of construction activities within the setback zone is essential. Protective barriers, such as erosion control silt fences and stormwater diversion measures, should be used to prevent construction-related sediment from entering nearshore waters. Construction staging areas should be positioned away from the immediate shoreline, and heavy machinery use should be restricted to designated paths to limit unnecessary disruption. Additionally, designing the pool deck and gazebo with slight elevation can help accommodate natural shoreline fluctuations while reducing long-term exposure to potential erosion.

6.3.9. Operational Phase

Potential Impacts

In the long term, the presence of structures within the 100-foot setback requires careful management to ensure they remain resilient to evolving coastal conditions. While the specific site exhibits accretion in some areas, natural shoreline variability, combined with potential climate change effects such as sea level rise and increased storm intensity, may require future adaptation strategies.

Mitigation Measures:

To ensure the sustainability of the development, continuous shoreline monitoring should be implemented to track sediment movement and identify any emerging erosion risks. If future coastal changes indicate increased erosion, soft engineering approaches, such as beach nourishment or sediment replenishment, should be considered to maintain shoreline integrity. Vegetative buffers should be maintained and, if necessary, expanded to reinforce natural coastal protection.

6.3.10. Elevations

6.3.10.1. Site Preparation Phase

Potential Impacts

The site's proximity to the coastline makes it vulnerable to storm surge, coastal flooding, and erosion. With elevations ranging between 2.0–2.5m above sea level, some areas may experience periodic inundation, particularly during extreme weather events. The presence of a shallow groundwater table in low-lying sections also raises concerns regarding foundation stability and waterlogging, especially during heavy rainfall.

Mitigation Measures

To address these risks, strategic site grading and foundation design will be employed to improve stability and drainage. The use of pile foundations will mitigate the effects of groundwater fluctuations, while preserving natural vegetation buffers along the shoreline will aid in erosion control. The 100-ft setback will further reduce exposure to storm impacts.

6.3.10.2. Construction Phase

Potential Impacts

Excavation and site modifications may disrupt natural drainage patterns, leading to localised water pooling and erosion. Improper handling of construction materials near low-lying areas could increase the risk of sediment displacement and surface runoff into marine habitats.

Mitigation Measures

To prevent structural instability and environmental degradation, stormwater management systems will be implemented to direct runoff away from sensitive areas. Temporary erosion controls such as silt fencing, geotextile barriers, and designated drainage channels will be used to manage surface water flow. Construction activities will also adhere to best practices for hurricane preparedness, ensuring that partially completed structures are secured against high winds and extreme weather events.

6.3.10.3. Operational Phase

Potential Impacts

Long-term risks include progressive shoreline retreat, exacerbated by wave action and storm surges. Inadequate drainage could lead to localised flooding, particularly in areas with a shallow groundwater table. Wind exposure may also impact roofing, solar panels, and other structural components.

Mitigation Measures

To enhance resilience, structures will be elevated above projected flood levels, and storm-resistant materials will be used for roofing, windows, and doors. The solar panel system will be engineered for wind uplift resistance, ensuring operational stability. Routine shoreline monitoring will be conducted to assess coastal changes and sediment movement, allowing for adaptive management strategies such as beach nourishment or additional coastal reinforcement measures if needed.

6.3.11.Biodiversity Considerations

The biodiversity at Johnson's Point is shaped by the interplay of terrestrial and coastal ecosystems, supporting a wide range of flora and fauna. The site's vegetation, particularly its coastal forest and shoreline buffers, plays a crucial role in stabilising sediments, mitigating erosion, and providing habitat for native and migratory species. Meanwhile, its fauna, including reptiles, birds, and small mammals, contribute to the ecological balance of the area. However, development activities pose potential risks to these interconnected systems, necessitating a structured mitigation approach across site preparation, construction, and operational phases.

6.3.11.1. Site Preparation Phase

Potential Impacts

The removal of vegetation for site clearing and grading presents several environmental risks, particularly for shoreline stability and habitat integrity. The dense sea grape (Coccoloba uvifera) along the seaward edge, a natural windbreak and storm surge buffer, may be disturbed if not properly preserved, potentially increasing erosion risks. Further inland, the manchineel (Hippomane mancinella) and cassie trees (Acacia spp.), while ecologically valuable, may require selective removal to accommodate construction.

The loss of canopy cover and root systems could also impact local fauna, especially birds and small reptiles, by reducing shelter and food sources. Additionally, the introduction of invasive

plant species through construction activities could alter native plant communities, threatening long-term ecological stability.

Mitigation Measures

To minimise the ecological footprint, vegetation retention strategies will be implemented, ensuring that key species such as sea grape and manchineel are preserved where possible. A buffer zone along the shoreline will be maintained to prevent excessive erosion, while a phased site clearing approach will reduce sudden habitat disruption. Erosion control barriers and mulching techniques will also be used to stabilise exposed soil and prevent sediment runoff into sensitive coastal areas.

Where vegetation removal is necessary, a replanting plan will be enacted, prioritising native coastal species to maintain habitat continuity. Special attention will be given to ensuring that site clearing does not coincide with bird nesting periods, particularly for species like the Zenaida Dove, Green Heron, and Caribbean Elaenia.

6.3.11.2. Construction Phase

Potential Impacts

Heavy machinery, material transport, and construction noise may lead to further disturbance of wildlife, potentially displacing sensitive species such as the Antigua Bank Tree Lizard and the Mangrove Cuckoo. Additionally, accidental damage to retained vegetation due to improper handling of construction materials and waste disposal could degrade the site's biodiversity value.

Another concern is the increased human activity, which may encourage opportunistic invasive species such as rats and mongooses, further threatening native wildlife. Improper waste management could also introduce hazardous pollutants into the environment, affecting soil and water quality.

Mitigation Measures

To mitigate construction-phase impacts, clearly designated vegetation protection zones will be marked, preventing accidental damage to preserved plant communities. No heavy equipment or storage of materials will be allowed near protected tree zones, particularly along the coastal buffer area.

Construction will follow a noise and activity management plan, limiting high-disturbance activities to non-critical wildlife periods. Additionally, strict waste management protocols will be

enforced to prevent food waste from attracting invasive species, reducing predation pressure on native fauna.

6.3.11.3. Operational Phase

Potential Impacts

Long-term biodiversity concerns include habitat fragmentation, artificial light pollution, and ongoing human disturbances. The introduction of permanent structures may alter wind and water flow patterns, influencing the growth of native vegetation and potentially leading to localised erosion.

Artificial lighting, particularly from landscape lighting and outdoor fixtures, could disrupt avian and nocturnal wildlife behaviours, impacting species such as the Mangrove Cuckoo and the Lesser Caribbean Bullfinch. Additionally, the persistence of invasive species, if not managed, could reduce the viability of native plant and animal populations.

Mitigation Measures

To ensure long-term biodiversity conservation, the property's landscaping plan will focus on preserving and restoring native vegetation, particularly along the shoreline. Regular monitoring of plant health and soil stability will help maintain the coastal buffer's function as an erosion control feature.

To mitigate light pollution impacts, low-wavelength amber LED lighting will be used, reducing disruptions to nocturnal wildlife and sea turtle nesting areas. Additionally, a long-term monitoring plan will assess species diversity and vegetation health, enabling adaptive management strategies to address emerging conservation concerns.

6.3.12. Climate Change and Resilience

The Johnson's Point development is a private residential project located within a broader community context but without immediate neighbouring residences. The site is positioned away from the main residential areas, with no direct impact on existing homes or businesses. The primary social considerations relate to perceived environmental concerns, the relationship between the project and community engagement efforts, and ensuring that the project integrates seamlessly into the coastal landscape without disrupting existing public access and recreational use.

6.3.12.1. Site Preparation Phase

Potential Impacts

The site preparation phase may cause temporary disruptions to local traffic flow, noise levels, and accessibility in and around Johnson's Point. Although the project site is not directly within a designated fishing zone, there is a risk that site clearing activities, material deliveries, and increased vehicular movement could affect nearby beachgoers, recreational users, and informal vendors operating along the coast.

Additionally, community members who have been actively engaged in environmental restoration projects—such as shoreline tree planting, beach cleanups, and marine conservation efforts—may express concerns over potential habitat disturbances resulting from initial land-clearing activities.

Mitigation Measures

To minimise social disruptions, a community engagement plan will be implemented to ensure residents are informed about project timelines, access restrictions, and mitigation efforts. Traffic management strategies will be put in place to limit construction-related congestion, and buffer zones will be established to ensure public access to nearby recreational beaches remains uninterrupted.

Additionally, the project proponents will collaborate with local conservation groups to ensure that the development complements and enhances existing environmental stewardship initiatives, rather than displacing them.

6.3.12.2. Construction Phase

Potential Impacts

Given the relative isolation of the development site, the direct social impacts during site preparation and construction will be minimal. Unlike developments in denser communities, this project will not result in disturbances to residential homes or local businesses. The main considerations involve temporary construction activity that may affect occasional recreational users of nearby beaches, as well as ensuring environmental safeguards remain in place.

Additionally, while fishing and marine-based livelihoods are important to the broader Johnson's Point community, the project site itself does not overlap with key fishing grounds or active landing sites. Concerns about livelihood disruption are therefore minimal.

Mitigation Measures

To ensure smooth construction operations, best practices for noise and dust control will be implemented as a precaution, even though there are no nearby homes to be significantly affected. The project proponents will continue to engage with community stakeholders to clarify the development's scope and reinforce its low-impact nature.

The development will not restrict beach access or limit the traditional use of coastal spaces, ensuring that locals can continue to enjoy the area's natural amenities without change. Given the community's strong environmental ethos, the project will also align with ongoing conservation efforts, including maintaining native coastal vegetation and protecting wetland areas east of the site.

6.3.12.3. Operational Phase

Potential Impacts

Since this is a private residence rather than a commercial development, long-term social impacts will be negligible. The scale of the project does not introduce increased tourism, commercial activity, or infrastructural pressures that would otherwise alter the social fabric of the Johnson's Point community.

However, community members with a vested interest in coastal conservation may have general concerns about environmental integrity, particularly regarding wastewater treatment, stormwater management, and landscape preservation.

Mitigation Measures

The design of the residence already integrates best practices for environmental management, ensuring wastewater is treated effectively, stormwater is managed to prevent runoff issues, and vegetation buffers are maintained. Transparency in environmental compliance will help build trust with local conservation advocates, reinforcing that the development is in line with sustainable coastal living.

Public access to adjacent beaches and recreational spaces will remain unchanged, as the development does not obstruct or encroach upon existing public-use areas.

7. RISK ANALYSIS

The risk analysis evaluates the potential environmental and operational hazards associated with the Johnson's Point Residential Development, with a focus on coastal resilience, hydrology, pollution control, and ecosystem sustainability. Given the site's dynamic coastal environment, a qualitative assessment of likelihood and severity has been conducted to ensure that all potential risks are effectively managed.

While the project's low-impact footprint minimises environmental disruption, certain site-specific risks—including coastal erosion, storm surge exposure, sediment transport, and wastewater management—require strategic mitigation. The proposed pool and gazebo within the 100-foot setback zone present additional considerations regarding long-term structural resilience and environmental impact.

This assessment confirms that, with appropriate mitigation measures, the project remains within an acceptable risk range and complies with environmental best practices and regulatory standards.

7.1. Risk Assessment Approach

The likelihood and severity of potential hazards have been evaluated using the following criteria:

a. Likelihood
- High – The impact is likely to occur frequently or under normal conditions.
- Moderate – The impact may occur occasionally, depending on external factors.
- Low – The impact is unlikely to occur under normal conditions.

B. Severity
- Major – Significant environmental, social, or economic consequences.
- Moderate – Manageable impacts requiring specific mitigation strategies.
- Minor – Limited or negligible impact that does not pose a serious threat.

7.2. Identified Risks and Mitigation Strategies

The following tables, 1 and 2, present a structured risk evaluation, detailing key environmental hazards, their likelihood, severity, and proposed mitigation strategies.

Table 1. Likelihood and Severity of Hazards or Impacts

Risk Category	Likelihood	Severity	Justification
Coastal Erosion & Shoreline Stability	Moderate to High	High	Historical shoreline data shows erosion trends in some areas, though sediment accumulation is occurring at others. Structures in the 100-foot setback could be at risk over time.
Storm Surge & Flooding	Moderate	High	Given the project's proximity to the coastline, storm surges and extreme weather events pose a risk, particularly to structures within the setback zone.
Seismic Activity	Moderate	High	Antigua falls within a **seismically active region**, requiring compliance with **earthquake-resistant design standards**.
Hydrology & Water Management	High	Moderate to High	Changes in **drainage patterns** from construction activities may cause localized flooding or sediment displacement.
Wastewater & Pollution Control	Moderate	Moderate	Improperly managed wastewater from the **Hydro-Action AN600** system could impact marine ecosystems.
Biodiversity & Habitat Disturbance	High	Moderate	Coastal vegetation removal could alter sediment stability and impact nearby habitats.
Air Quality & Noise Pollution	High (construction), Low (operation)	Moderate (construction), Low (operation)	**Dust and noise** from construction pose temporary impacts, but operational effects are minimal.

Risk	Proposed Mitigation Measures
Coastal Erosion & Shoreline Stability	Maintain natural sediment transport by preserving dune vegetation and using soft engineering techniques such as seagrape (*Coccoloba uvifera*) planting. Conduct ongoing shoreline monitoring to detect changes. If significant erosion occurs, consider beach nourishment strategies.
Storm Surge & Flooding	Position critical infrastructure outside high-risk flood zones. Implement elevated designs where necessary to withstand surges. Use permeable surfaces to improve drainage and reduce runoff velocity.
Seismic Activity	Adhere to Antigua and Barbuda's seismic building code and use flexible, reinforced foundations to minimize earthquake-induced damage.
Hydrology & Water Management	Implement stormwater control measures such as rain gardens, retention swales, and permeable surfaces to prevent runoff into marine areas. Limit impermeable paving near sensitive zones.
Wastewater & Pollution Control	Maintain regular monitoring of effluent quality to ensure compliance with NSF/ANSI Standard 245 for nitrogen reduction. Ensure backup power for continuous aeration in the Hydro-Action AN600 system.
Biodiversity & Habitat Disturbance	Preserve existing shoreline vegetation as a protective buffer. Avoid construction during bird nesting seasons and implement habitat restoration measures where necessary.
Air Quality & Noise Pollution	Utilize dust suppression techniques, restrict construction activities to daytime hours, and enforce noise control regulations.

Table 2: Summary of Risks and Mitigation Measures

7.3. Conclusion

The Johnson's Point Residential Development has been designed with sustainability in mind, integrating mitigation strategies to minimise coastal, hydrological, and ecological risks. While the project's proximity to the shoreline requires careful management, the combination of natural barriers (coral reefs, coastal vegetation), shoreline monitoring, and adaptive design measures ensures that risks remain within an acceptable range.

With the implementation of the proposed mitigation measures, the project is expected to maintain a low-risk profile while contributing to a responsible and well-integrated coastal development. Its design ensures resilience to environmental stressors, compliance with regulatory requirements, and alignment with sustainable coastal development principles.

8. DISASTER MANAGEMENT PLAN (DMP)

8.1 Purpose

The Disaster Management Plan (DMP) is designed to identify potential natural and operational hazards associated with the Johnson's Point Residential Development and to establish a comprehensive strategy for preparedness, mitigation, response, and recovery. Given the project's coastal location, disaster resilience is a critical component of risk management. The DMP aims to minimise disruptions to site operations, protect the integrity of the environment, and ensure the safety of all individuals involved with the property.

8.2. Identified Emergencies and Risks

Based on the site's environmental characteristics and geographic location, the following hazards have been identified as requiring preparedness and mitigation strategies:

Natural Hazards

- *Hurricanes & Storm Surges* – Given the project's coastal location, extreme weather events present the most significant risk.
- *Earthquakes* – While relatively infrequent, seismic activity is a regional hazard that must be considered in construction.
- *Flooding & Heavy Rainfall* – Stormwater management must be optimised to prevent waterlogging and sediment displacement.
- *Tsunamis* – Though rare, preparedness measures should account for potential evacuation needs.
- *Coastal Erosion* – The integrity of the shoreline must be monitored to prevent gradual loss of protective vegetation.

Technological or Operational Hazards

- *Fire Hazards* – Electrical systems, cooking facilities, and mechanical equipment pose a fire risk.
- *Wastewater System Malfunctions* – A failure in the Hydro-Action AN600 system could lead to localised contamination.
- *Energy & Power Outages* – As an off-grid property, power interruptions could impact critical systems such as desalination and wastewater treatment.
- *Chemical & Fuel Spills* – Accidental spillage of stored fuels or chemicals could pose environmental hazards.

8.3. Organisational Structure & Responsibilities

A Disaster Management Team (DMT) will be established to oversee disaster preparedness and emergency response. The DMT will include:

- Project Management Team (responsible for site oversight and emergency coordination).

- Property Maintenance & Operational Staff (trained to execute emergency measures).
- Emergency Response Contacts (liaison with local authorities and response agencies).

The DMT's primary responsibilities include:

a. Developing and updating emergency response plans, including site-specific evacuation routes.
b. Conducting risk assessments and safety drills to enhance preparedness.
c. Overseeing storm readiness procedures before, during, and after extreme weather events.
d. Implementing fire safety protocols and hazardous materials handling procedures.
e. Maintaining communication with local emergency response teams and regulatory bodies.

8.4. Mitigation Measures

Natural Hazards Mitigation

To minimise natural disaster risks, the following preventative strategies will be implemented:

- *Hurricane & Storm Surge Preparedness:* All critical infrastructure, including electrical panels, backup power systems, and the solar array, will be elevated above expected flood levels to mitigate storm surge impacts.
- *Drainage & Flood Control:* The site design incorporates permeable surfaces and vegetative buffers to reduce runoff and promote natural water infiltration.
- *Coastal Resilience:* Native shoreline vegetation will be maintained and enhanced to mitigate erosion and protect against storm impacts.
- *Seismic-Resistant Construction:* Foundations and structural supports will be engineered to meet regional earthquake resilience standards.
- *Tsunami Preparedness:* Clear evacuation routes will be established and communicated to residents and site personnel.

Technological & Operational Risk Mitigation

- *Fire Prevention & Control:* Fire extinguishers, smoke detectors, and emergency response plans will be installed in all residential structures, with periodic fire safety training for staff.
- *Wastewater System Management:* Regular maintenance schedules will ensure the Hydro-Action AN600 plant operates efficiently, minimising risks of leaks or malfunctions.
- *Energy Resilience:* Battery storage will provide backup power for critical systems, ensuring continuity during outages.
- *Hazardous Material & Spill Prevention:* Any fuel or chemical storage on-site will be managed within designated containment areas to prevent accidental contamination.

8.5. Verification & Monitoring

To ensure ongoing effectiveness of the disaster preparedness plan, the DMT will:

- Conduct regular audits of emergency infrastructure, including drainage systems, power backups, and fire suppression equipment.
- Maintain training records for staff and emergency preparedness drills.

- Update the DMP annually, incorporating lessons learned from previous incidents or regulatory changes.

8.6. Post-Disaster Recovery & Reporting

After a disaster or emergency event, the DMT will initiate a structured recovery process, including:

a. Damage Assessment: Conducting site inspections to determine structural and environmental impacts.
b. Cleanup & Restoration: Overseeing debris removal and ecological rehabilitation as required.
c. Post-Event Documentation: Preparing a post-disaster report that includes:
    - Cause & Timeline of the Event
    - Response Effectiveness & Key Challenges
    - Recommendations for Strengthening Future Mitigation Strategies

9. ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN (EMMP)

Purpose

The Environmental Monitoring and Management Plan (EMMP) establishes a structured approach to monitoring and mitigating environmental impacts associated with the **Johnson's Point Residential Development**. This plan ensures that the mitigation measures outlined in the Environmental Impact Assessment (EIA) are effectively implemented before, during, and after construction.

ETC Ltd. will act as the Developer's Environmental Representative, overseeing all environmental compliance measures and ensuring adherence to national regulations. The EMMP also provides a framework for adaptive management, enabling continuous assessment and improvements based on monitoring results.

Objectives

The key objectives of the EMMP are to:

A. Monitor significant environmental impacts identified in the EIA.

B. Ensure adherence to regulatory requirements and mitigation measures.

C. Provide a structured approach to evaluating the effectiveness of mitigation strategies.

D. Submit periodic monitoring reports to the Department of Environment for review and regulatory oversight.

Monitoring Framework

The table below outlines the proposed environmental monitoring framework, specifying key parameters, methods, and responsibilities.

Table 3. Environmental Monitoring Framework

Component	Parameters	Monitoring Methods	Frequency	Responsibility
Water Quality	Turbidity, bacterial contamination (nitrates, phosphates), dissolved oxygen, salinity	Sampling at designated points near mangroves and marine areas	Biannual	Project Manager, Contractor
Marine Life	Seagrass coverage, canopy height, bioindicator species (e.g., Green Sea Urchins, Upside-down Jellyfish)	Visual surveys, species counts, and transect assessments	Biannual	Environmental Representative
Mangrove Health	Survival rates of replanted mangroves, canopy density, and root health	Transect surveys and photo documentation	Biannual	Contractor

Sediment Control	Sediment plume extent and deposition patterns	Visual inspections and sediment sampling	Biannual (construction)	Contractor
Waste Management	Compliance with waste segregation, hazardous material storage, and disposal protocols	Site inspections and waste tracking logs	Biannual	Contractor
Structural Compliance	Elevation of infrastructure (fuel tanks, generator pads) and storm surge resilience	On-site inspections and measurements	Annual (construction)	Project Manager

Roles and Responsibilities

- *Project Manager:* Oversees the implementation of the EMMP and ensures compliance with monitoring requirements.
- *Contractors*: Conduct monitoring activities, maintain records, and implement mitigation measures.
- *Environmental Representative:* Conducts independent audits of monitoring activities and submits reports to the Department of Environment for review.

Reporting

- *Frequency*: Monitoring reports will be prepared biannually and submitted to the Department of Environment.
- *Content*: Reports will include:
    - Summary of monitoring results.

- Analysis of trends or deviations from baseline conditions.
- Recommendations for corrective measures, if necessary.

Adaptive Management Framework

Monitoring results will inform adjustments to mitigation measures if significant deviations or risks are detected. The table below outlines adaptive management strategies based on key environmental risks.

Table 4. Adaptive Management Framework

Impacts	Objective	Priority EIA Recommendations	Monitoring Activity	Monitoring Frequency	Indicators of Change	Potential Impacts
Water Quality	Maintain water quality levels	Prevent increased sedimentation from runoff over paved areas	Turbidity and nutrient measurements	Annually	Diminished water quality	Increased turbidity and bacterial nutrient load
		Permeable parking lots, silt fences, etc.	Weekly			
	Prevent wastewater and sewage from entering nearshore waters	Bacterial water quality tests (Enterococci)	Biannually			
	Prevent chemical spills from construction equipment	Water quality testing for organic compounds	Biannually	Ecological decline of nearshore waters		
Marine Life	Ensure effectiveness of marine habitat conservation	Establish mooring buoys and prohibit anchoring	Monitoring of seagrass beds and reefs	Annually	Changes in distribution and population size of threatened species	Decrease in biodiversity
Structural Compliance	Maintain planned elevation levels	Verify building elevations before and during construction	Elevation monitoring	Before and during construction	Non-compliance with planned elevations	Increased vulnerability to storm surge

10. POLLUTION RESPONSE STRATEGY

Introduction

The Pollution Response Strategy for the Johnson's Point Residential Development outlines the overarching approach to managing and mitigating pollution-related risks throughout the project's lifecycle. While the Environmental Impact Assessment details specific mitigation measures within each impact category, this strategy serves as a consolidated framework for anticipating, preventing, and responding to pollution events in a proactive and environmentally responsible manner.

This strategy is focused on four key pillars:

- Long-term Vision: To support a development that maintains environmental integrity through all phases—site preparation, construction, and operation—while integrating sustainable waste and pollution management practices.
- Core Objectives: To minimise the risk of pollution to the marine and terrestrial environments, ensure proper handling of all waste streams, and comply with national environmental regulations and best practices.
- Guiding Principles: To apply the waste hierarchy—avoid, reduce, reuse, recycle, and responsibly dispose—as the foundation for pollution response. To work with nature-based solutions wherever feasible.
- Adaptive Approaches: To build flexibility into waste management procedures that respond to evolving site conditions, construction phasing, and operational realities, particularly in a sensitive coastal context.

Types of Anticipated Waste

The waste generated throughout the project can be categorised into the following types:

- Construction and Demolition Waste: Includes inert materials such as concrete, bricks, timber off-cuts, packaging, and surplus building materials.
- Municipal Waste: Organic kitchen waste, packaging, and general refuse from construction crews and future property users.
- Hazardous Waste: Paints, solvents, oils, sealants, and cleaning chemicals, especially during the construction phase.
- Electronic Waste (E-Waste): Any discarded electrical and electronic components, particularly during the operational phase as systems are upgraded or replaced.
- Earth Movement Waste: Excavated soils and vegetation cleared during site preparation, including some organic matter that may be reused on-site.

Anticipated Impacts

Construction Phase:

Without proper controls, construction activities can lead to the accumulation of debris, improper disposal of hazardous substances, contamination of stormwater systems, and environmental degradation of adjacent sensitive ecosystems.

Operational Phase:

Long-term waste generation from maintenance, landscaping, and residential use may result in cumulative impacts if segregation, storage, and disposal systems are not formalised and maintained. Improper e-waste disposal and organic waste accumulation can lead to health and sanitation issues, pest attraction, and pollution of soil and water systems.

Mitigation Measures

- Construction Waste Management:
  - A dedicated waste segregation area will be established for sorting recyclable, reusable, and general waste.
  - Inert materials will be stockpiled and reused on-site where feasible (e.g., as fill material or landscaping substrate).
  - Hazardous materials will be stored in leak-proof containers in clearly marked, weather-protected areas away from drainage lines. Spill kits will be available on-site.

- Municipal and Organic Waste:
  - Construction crews will be provided with designated waste disposal bins and education on proper separation of waste.
  - A composting area may be designated for organic landscaping waste during the operational phase.

- Hazardous Waste:
  - Paints, fuels, solvents, and other hazardous substances will be tracked and securely stored.
  - Any expired or unused chemicals will be removed by certified waste handlers in accordance with national regulations.

- E-Waste:
  - E-waste will be stored separately and removed by licensed electronic waste recovery agencies during both commissioning and operational upgrades.

- Earth Movement and Excavation Waste:
  - Topsoil will be stockpiled and reused in landscaping.

- Any excess earth will be disposed of at authorised fill sites, with care taken to avoid disturbance to coastal and wetland areas.

Management of Temporary Structures

All temporary construction-related structures such as material sheds, worker accommodations, and scaffolding will be removed promptly after the construction phase. Foundations will be decommissioned and the ground rehabilitated with native vegetation or landscaped according to the site plan.

Recycling and Waste Minimisation

The project will adopt a proactive approach to waste minimisation through:

- Prioritising reusable and recyclable construction materials.
- Working with suppliers to minimise packaging waste.
- Encouraging residents and property management to participate in source separation of waste during the operational phase.
- Exploring partnerships with local recycling cooperatives for the management of paper, plastics, metals, and e-waste.

Conclusion

The pollution response strategy ensures that all anticipated waste streams are responsibly managed, reducing environmental impacts and promoting sustainability across all project phases. Through a combination of targeted mitigation measures, education, and adaptive planning, the development will maintain compliance with national standards while fostering a clean, safe, and resilient site environment.

11.SUMMARY AND CONCLUSION

The Environmental Impact Assessment (EIA) for the Johnson's Point Residential Development has comprehensively evaluated the potential environmental and social impacts associated with the project, spanning its site preparation, construction, and operational phases. Key risks, such as coastal erosion, storm impacts, and seismic activity, are identified, but mitigations like enhancing shorelines with native plants, using hurricane-resistant materials, and ensuring seismic-resistant building designs are proposed to manage these.

The project has been designed with a low-impact development approach, integrating sustainable building practices such as rainwater harvesting, renewable energy generation, and wastewater treatment systems to ensure minimal environmental disruption. Additionally, the site layout preserves existing coastal vegetation, mitigating erosion risks while maintaining natural buffers between the built environment and sensitive ecosystems.

Ongoing monitoring and management plans will help address any changes, especially with climate change making storms and sea levels worse. An unexpected detail is the significant seismic risk, highlighted by recent earthquakes, which is crucial for safety despite being a coastal project. This development sets a standard for responsible coastal development, provided all measures are implemented diligently.

Key Findings and Mitigation Strategies

1. Marine and Coastal Ecology

- The development is situated in proximity to fringing reefs and seagrass beds, which serve as critical habitats for marine life. To prevent sediment disturbance and nutrient loading, strict stormwater management and wastewater treatment protocols will be enforced.
- Coastal vegetation will be preserved and supplemented to maintain shoreline stability and reduce erosion.

2. Water Resources and Hydrology

- The inclusion of an AQSEP desalination unit allows for water self-sufficiency, reducing pressure on public utilities.
- A stormwater management system will be implemented to prevent flooding, runoff pollution, and sedimentation impacts on marine environments.

3. Wastewater and Sewage Management

- The Hydro-Action AN600 wastewater treatment system will be installed to ensure high-efficiency treatment of domestic sewage, preventing nutrient enrichment of marine ecosystems.
- Regular monitoring and maintenance of the system will be undertaken to ensure compliance with water quality standards.

4. Energy Considerations

- The development will operate using an off-grid solar energy system, generating approximately 140,000 kWh annually to meet household energy needs.
- Battery storage and backup systems will ensure energy resilience and self-sufficiency.

5. Social and Community Considerations

- While the project site is located within a broader community, its positioning on the opposite side of the road from residential clusters minimises potential disturbances.
- The project is expected to provide economic opportunities through local employment and supplier engagement during construction.

Risk and Resilience Measures

A qualitative risk assessment confirmed that most risks associated with the development—such as climate-related hazards, construction-phase disturbances, and pollution risks—can be effectively managed through site-specific mitigation measures. The Environmental Monitoring and Management Plan (EMMP) will ensure continuous compliance with regulatory standards, with routine monitoring of water quality, sediment control, marine life, and structural compliance.

Conclusion

The Johnson's Point Residential Development aligns with the principles of sustainable coastal development, integrating modern engineering solutions with ecological conservation strategies. The implementation of mitigation measures, coupled with proactive environmental monitoring, ensures that potential adverse impacts are minimised while maintaining the ecological integrity of the project site.

With adherence to the proposed mitigation strategies and regulatory compliance requirements, the project is expected to achieve a low environmental footprint, balancing luxury, sustainability, and environmental stewardship.

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ANNEX 1 Disclosure of consultants engaged

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;**

DR. SHANNON GORE

Coastal & Marine Scientist

Email: sgore@cmcbvi.com

Tel: (284) 496-7998 or (284) 343-7003

Website: www.cmcbvi.com

PROFILE

I am a high-level environmental professional with over 20 years of practical experience in the Caribbean, with a strong background in coastal and marine sciences, supported by published scientific papers. I have a wide range of skills, such as conducting marine and terrestrial field surveys using mapping techniques with Geographic Information Systems (GIS) and drone technology, monitoring coral reefs and beaches for spatial & temporal change, sustainable development planning and mitigation and building resiliency and adaptation for climate change.

CAREER SUMMARY

Coastal Management Consulting, BVI ***Owner/Principal Consultant***
January 2014-Present

- Successfully completed over 50 environmental and social impact assessments (ESIAs) and environmental management plans (EMPs) on various public and private projects throughout the Caribbean.

Association of Reef Keepers (ARK)
Managing Director
(www.bviark.org) March 2014 – Present

- Restructured an NGO and has been implementing successful programmes with sustainable financing mechanisms, including a sea turtle conservation programme, coral restoration initiatives, sustainable yachting (marine spatial planning, education) and a ridge-to-reef programme that engages communities to implement low-cost green engineering to help reduce flooding, coastal erosion and sedimentation.

Conservation & Fisheries Department, Government of the BVI
Senior Marine Biologist
Nov. 2002 – Dec. 2013

- Principal marine scientist for the Government of the Virgin Islands with diverse leading roles in implementing various projects such as biodiversity assessments, monitoring of key species & habitats, review and compliance monitoring of private sector and governmental development projects.

SELECTED PROJECTS

Sustaining Turtles, Environments, economies and Livelihoods (STEEL Project) -DARWIN PLUS Grant (ARK Project)
Project Co-Lead
Overall project management to ensure the participation of all project partners, including the Government of the Virgin Islands, which resulted in the development of an overall Sea Turtle Recovery Action Plan.

Coastal Resource Atlas & Temporal Analysis of the BVI Marine Ecosystems - DARWIN PLAS Grant (CMC Project)
Project Partner
Updated the marine habitat maps of the BVI through ground truthing and data analysis for temporal changes in patch reefs in Anegada.

ACADEMIC QUALIFICATIONS

PhD Coastal Geomorphology & Management
(2012) University of Ulster, Coleraine, N. Ireland

MSc Coastal Zone Management-Distinction
(2004) University of Ulster, Coleraine, N. Ireland

BSc Environmental Sciences
(1998) Northwestern University, Evanston IL

Executive Scholar Certificate in Nonprofit Management
(2019) Kellogg School of Management Northwestern University, Chicago, IL

CORE AREAS OF EXPERTISE

- Environmental & Social Impact Assessments (ESIAs)
- Environmental & Social Management Planning
- Coastal and Marine Habitat Mapping & Assessments
- Coastal Geomorphology Marine Spatial Planning
- Geographic Information Systems (GIS) Sea Turtle Biology & Conservation Community Engagement & Capacity Building Programmes

AFFILIATIONS

- Board Member - Virgin Islands Climate Change Trust Fund
- Registered reviewer for the Journal of Environmental Management
- American Association of Underwater Scientists (AAUS)

Climate Risk & Hazard Vulnerability Assessment for the Eslyn Henley Richez Learning Centre
Environmental Consultant
Worked with a local architect during the development planning stages for the redevelopment of the Eslyn Henley Richez Learning Centre on Tortola. A Climate Risk & Vulnerability Assessment was produced and included the use of GIS-based software to ensure climate resilient measures were incorporated into the final design.

North Shore Integrated Coastal and Watershed Stabilization Project: Brewer's Bay & Cane Garden Bay, Tortola, BVI
Collaborator & EIA author
Teamed with Smith Warner International and the Horsley Witten Group (HWG) to provide local technical support under a project aimed to analyse, arrest and reverse the causes of coastal erosion, flooding impacts and sedimentation of coastal waters that have plagued both Cane Garden Bay and Brewers Bay, Tortola over the past several decades. Dr. Gore authored the four environmental impact assessments required for project approvals under the VI Planning Authority.

Caribbean Regional Communications Infrastructure Program (CARCIP): Planning and Environmental & Social Impact Assessment, Grenada, St Vincent and the Grenadines
Prinoipal Marine Soientist
Subcontracted under Digicel to carry out all ecologic marine studies and provide environmental permit support for the proposed installation of telecommunications cabling along the sea floor and landing ashore at nine individual sites across Grenada, St Vincent & the Grenadines.

SELECTED PUBLICATIONS

- Cescon AL, Cooper JA, Jackson DW, Collin A, Gore S, (2023). Mesoscale Shoreline Evolution on a Carbonate Sand Island: Anegada, British Virgin Islands. Journal of Marine Science and Engineering, 11(9):1725.
- Gore S, Cooper JA, Jackson DW, Jarecki L, (2019) Spatial variability in beach biogeomorphology in a tropical archipelago. Earth Surface Processes and Landforms, 44(9):1860- 75.
- Gore S, Wynne S, Myers A, (2019). UK Overseas Territories in The Northeast Caribbean: Anguilla, British Virgin Islands, Montserrat. In: Sheppard CRC, (Ed). World Seas: An Environmental Evaluation, Volume I: Europe, The Americas and West Africa, Second Edition. 88
- Gore, S and Petrovic, C, (2015). Coastal & Marine Resources. In: Island Resources Foundation (Ed.). An Environmental Profile of the Island of Tortola, British Virgin Islands. Island Re-sources Foundation. Tortola, BVI and Washington, DC. 351 pp.
- Gore S, (2013). Introduction to reefs and shorelines of the British Virgin Islands. In: Sheppard CRC, (Ed). Coral Reefs of the United Kingdom Overseas Territories, Springer, Netherlands, pp 23-35.
- Gore S, (2013). Anegada: An emergent Pleistocene reef island. In: Sheppard, CRC, (Ed). Coral Reefs of the United Kingdom Overseas Territories, Springer, Netherlands, pp 47-60.
- Cooper JAG, Jackson DWT, Gore S, (2013). Groundswell event on the coast of the British Virgin Islands: spatial variability in morphological impact. Journal of Coastal Research SI 65. pp 696-701.
- Eakin CM, et al., (2010). Caribbean Corals in Crisis: Record Thermal Stress, Bleaching, and Mortality in 2005. PLoS ONE, 2010; 5 (11).
- Gore S, (2007). Framework development for beach management in the British Virgin Islands. Ocean & Coastal Management. 50(9). pp 732-753.

HALDAIN SPENCER

CONTACT INFORMATION

Swetes Village, St. Paul's, Antigua

1-268-720-9979

haldain10@gmail.com

I.T. SKILLS

- Proficiency in Microsoft Word, Access, Excel, and PowerPoint
- Proficiency in online collaborative productivity software such as Google Drive and One Drive etc...

LANGUAGES

English:
A+

Advanced Proficiency/Expert (Caribbean Examination Council – Grade 1 with distinction in English A)

Spanish:
B

General Proficiency (Caribbean Examination Council – Grade 2 in Spanish)

HOBBIES

- Former Member of Global Leadership Interlink (2013 - 2017) - Visit **www.glinetwork.org**
- Former Member of Curtain Bluff tennis club
- Member of the Congress Global Communications and Technology (Videographer)
- Former member and player Villa Lions Football club
- Former member and player of Haynesville Football Club (Barbados)
- Former Member and player of John Hughes Sports Club
- Member and player of the Swetes Football Club

WORK EXPERIENCE

- **National Park's Authority - Environment Officer,** 01/2022 – Present.
- **Environment Tourism Consulting Ltd. – Ecological Consultant,** 08/2021 – Present.
- **Environmental Awareness Group - SPAW RAC Cactus Project Coordinator,** 09/2021.
- **Department of Environment - Two months of Environmental Assessment and Monitoring with the National Parks Authority (NPA),** 07/2021-08/2021.

TERTIARY EDUCATION

- **University of the West Indies Cave - Master of Science:** Natural Resource and Environmental Management; Tropical, Coastal, and Marine Environments 09/2019 – 2021
- **University of the West Indies Cave Hill - Bachelor of Science:** Biology, 09/2015 - 06/2019

OTHER EXPERIENCE AND VOLUNTARY WORK

- Antigua Racer Snake Project
- The Environment Awareness Group Turtle Conservation Project (Antigua)

PERSONAL INFORMATION

I am a hard-working and patriotic individual committed to improving the conservational and sustainable status of Antigua and Barbuda's environment. I am interested in implementing my knowledge and skills to enhance biodiversity conservation, ecosystem management and/or sustainable development, as I am of the belief that biodiversity in the Caribbean is largely marginalized or misunderstood. I am flexible and can work in other areas if needed or requested. I am willing to work hard and give my best always.

TRAINING AND SKILLS

- PADI Open Water Diver - 2022
- Environmental Awareness Group - Antigua Marine Conservation Programme (AMCP) Sea Turtle Training (certificate received) - 2022.
- Caribbean Leadership Programme (CLP) – Proposal Writing and Fund Raising (certificate received) – 2022.
- GIS for Biology/Ecologists (certificate received) – 2022.
- Jamaica Bureau of Standards – ISO 14001 Environment Management Systems (EMS)/Green House Gas (GHG) Emissions Audit Training. (Certificate received) – 2023.
- BIOSPACE Drone Training (certificate received) – 2024
- AGGRA Benthos Surveyor Antigua (certificate received) - 2024
- PADI Advanced Open Water Diver - 2024
- CAMPAM 14th Edition of the Training of Trainers in Marine Protected Area Management (certificate received) – 2024

ANNEX 2 Declaration of Completeness and authenticity

I, Lucia Mings, Managing Director of Environment Tourism Consulting limited (ETC ltd.), hereby declare that the report entitled "Johnsons Point Residential Development : Environmental Impact Assessment" submitted to the Development Control Authority, is true and complete.

Ms. Lucia Mings

Managing Director ETC Ltd.

ANNEX 3 Enclosures:

Enclosure 1. Department Of Environment Review Of Plan Application #G07-2024 (Residential Development Johnsons Point)