ENVIRONMENTAL IMPACT ASSESSMENT

HOTEL DEVELOPMENT AT PART OF RICHMOND ESTATES, ST. ANN BY SECRETS RESORTS AND SPA

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1.0 EXECUTIVE SUMMARY

INTRODUCTION

Richmond Vista Limited wishes to develop a 715 room Secrets Resort & Spa at its 90,624 sqm (22.4 acre) property at Richmond Estate in the Parish of Saint Ann. The hotel resort will be developed in two (2) phases: i) the First Phase will include 500 hotel rooms and 15 over water suites; and ii) the Second Phase will include 200 additional hotel rooms. Phase 2 is expected to be implemented 24 – 48 months after Phase 1 is operational but is dependent on market conditions.

PROJECT DESCRIPTION

Hotel

The proposed design is expanded across the site with buildings consisting of 1-7 storeys and the total floor area is 81,544.15 m^2. The built areas comprising of 2 Hotels with 700 Rooms, 15 Overwater Villas, Spa, Specialty Restaurants, Technical Area, 3 Beach Bars, 3 Pool Bars, Coco Café, 2 Barefoot Grill, 3 Towel Gazebo, 2 Wedding Gazebo, Pools Toilets, Temazcal, Water Sports, 2 Resort Access and Service Access. There are a total of 672 Parking and 15 coach Parking areas.

The height for hotels 1 & 2 levels is 3.5m with exception for ground level 1 & 6 which is at 5m. The spa is on 2 levels with the first level at height 3.5m from floor level and 8m from ground floor level. The specialty restaurants floor level is 6m from ground water table level. The Technical Area is separated by 2 buildings, 1 with 2 storeys & the other at 1. The two storey Technical area has a height of 5m high on level 1 and 4.45 on level 2. The technical area with one storey is 5.80m from F.F.L. to roof beam.

Overwater Rooms

Fifteen (15) overwater villas will be constructed toward the south-eastern most boundary of the property. The proposed height from sea level is 3.5m and the height from floor to roof slab is 3m. All electrical, telecommunication, plumbing/water, wastewater, air conditioning and fire protection related utilities will be routed under the boardwalk in watertight piping. These utilities will be supplied from the main Hotel property.

The proposed Sea Rooms should be set at an elevation that limits the potential for flood under extreme events such as hurricanes. Floor levels were developed for a 25-year hurricane and swell wave conditions. Hurricane conditions would cause the greatest increase in the static water level and combined with the large waves, there is potential for extreme flooding to occur. However, swell waves can also cause a notable increase in the wave heights. Therefore, we took a two-level approach to setting the Sea Room floor elevations: the lower level is closer to sea level and could be a platform for entering and exiting the sea. The building elements placed on this lower platform should be mobile as this level would be flooded during a hurricane as its proposed deck floor level is +1.25m above MSL. The upper level would not be flooded during hurricane conditions as the FFL is +2.95m above MSL

Beach Works

The proposed shoreline enhancement plan includes the creation of a large, usable, accessible sandy beach area, which would be sufficiently protected from incoming waves without appearing 'over-built'. Considerations of the proposed design are:

1. Excavation of the existing shoreline and grading to an appropriate slope to create a wide sandy beach area that lends itself to many recreational uses.
2. The creation of a perched/dry beach along the north-western shoreline approximately 2m above MSL. This will be protected by a revetment and retaining wall at the back of the revetment. The crest height of the revetment will be +2m above MSL and a crest width of 3 D50 stones wide (≈3.3m).
3. At the north-eastern beach, there will be two groynes and a small breakwater. This beach will allow guests to enter the sea and be able to snorkel and wade in a water depth of -1m MSL.
4. Beach nourishment: As there is little appropriate sediment presently on the shoreline, the beach will have to be created through sediment nourishment. Appropriately sized sediment will be placed on the beach to create (1) a beach crest of 1.5m above MSL, and (2) a beach slope of 1/12 from the crest seaward. This is necessary to create a pleasant underfoot experience for people wading in the nearshore.
5. The eastern beaches will be anchored by three groynes with a crest height of +1m above MSL. This section of the shoreline will have a wading channel approximately 1.5m in depth for the guests to swim comfortably and to encourage water circulation.

The low-lying flat site will be completely inundated during an extreme hurricane and the property needs to be raised. The hurricane simulations with sea level rise projections for climate change indicated a 50-year inundation level of 2.4 to 2.6m. Based on this, a minimum ground elevation of +2.8m is proposed and a minimum floor elevation of +3.0m. In addition, a wall around the entire development is proposed as a solid method of protection against erosion from waves accompanying the surge.

The peninsula is exposed to extremely high waves as offshore offers no protection and the seabed is deep close to the shoreline. Using the outputs of wave conditions at the shoreline during the 50-year condition, an assessment was carried out to understand the overtopping impact on the area. Firstly, a seawall is proposed along the shoreline with a revetment at its base to reduce some overtopping in milder wave conditions. This wall, properly designed and constructed, will withstand immediate impacts from incoming waves. However, even with this wall, the buildings need to be set back so that during a storm the overtopping waves do not damage the buildings. The distance over which this mass of water travels before reaching the ground was determined to be approximately 11.5m. This was based on the speed of the incoming waves and using parametric equations. A safe distance of 15m was therefore recommended.

Auxiliary Project Activities

Wastewater Treatment Plant

The WWTP will be located at the southwestern-most boundary of the project site. All wastewater generated by the hotel will be channelled and treated by the hotels WWTP. Wastewater from the overwater rooms will be collected via hanging pipes and pumping manifolds and routed under the deck in watertight piping toward the WWTP to undergo treatment.

The projected treatment line is as follows:

- Coarse solids pit
- Compact pre-treatment pumping
- Compact pre-treatment
- Homogenization tank
- Pumping to biological treatment
- Biological treatment type SBR
- Effluent disinfection

The sludge generated in the process, will undergo the following treatment process:

- Mechanical thickener
- Pumping to centrifugal decanter
- Centrifugal decanter
- Dehydrated sludge pumping
- Hopper storage.

As the average daily inflow rate is 1,200 m^3/day, the actual effluent flow rate is about 134 m^3/h. To disinfect the treated water, and taking into account the above-mentioned hourly flow rate, an ultraviolet (UV) disinfection reactor will be installed in the piping. Given that we are dealing with an installation located inside a building, the space saving of this solution, compared to others such as the chlorination channel, makes its installation advisable. The treated effluent will be channelled to a tank to be used to store water for irrigation of landscaped areas around the hotel property. Chlorination of the effluent inside this storage tank will be conducted.

Seawater Desalination Plant

Potable water for hotel operations will be provided via desalination of seawater. The SWDP will be located at the southern-most boundary of the project site. The hotel complex has six (6) wells to collect water from the subsoil. These wells are distributed throughout the surface of the complex. The abstraction wells will be located in the parking area in front of the industrial building, inland at the south of the property. The daily extraction volume considered for each well is 450 m^3/day for potable water production, so it represents a daily extraction capability about 2,700 m^3. As previously stated, the daily drinking water requirement is 1,072 m^3/day, for which the installation of 3 reverse osmosis lines working in parallel is foreseen.

After pump discharge, the first treatment applied to water is UV disinfection. In order to filter all water towards the reverse osmosis process and withhold the small solids and colloids that could remain in the water, a water filter system will be placed. Reverse osmosis is the centrepiece of the proposed treatment. It consists of applying a high pressure to force water through a semi-permeable membrane that retains salts almost completely. By doing so, two outlet streams are generated: a permeate flow, composed of water without salts; and brine, water that accumulates all retained salts in addition to the salt contained in the inlet stream. As this kind of separation by membranes is very sensitive to environmental and operation conditions, some parameters such as flow, pH, temperature, conductivity, pressure must be controlled. The more stable the feed conditions are, the better the system will work. The proposed system is made out of three parallel streams, each one carrying 33% of the nominal flow rate. Should one of them cease working because of maintenance work, the other one would generate desalted water for the resort's consumption.

Following the withdrawal of salts in the permeate flow it acquires a corrosive character. This water could eventually dissolve the metallic pipe compounds and/or cause health issues derived from continued use. To prevent this from happening, sustaining remineralization until the water acquires a slightly incrustation nature. For remineralization, a sodium carbonate slurry is dosed into the water and the water is ready to be stored for consumption.

Brine disposal will involve injection into wells. In this way, brine is injected into wells dug into a permeable substrate which allows the infiltration of the liquid. For the injection, 2 horizontal pumps will be installed to push the brine through 2 additional wells. These brine injection wells will be located on the northern side of the property, at least 80 m form the closest abstraction well.

Concrete Batching Plant (construction phase only)

The batching plant to be used will be the Frumecar model, double silo system. The process entails the combination of water, aggregates and cement. The temporary batching plant facility will generate a total of approximately 75,000 cubic metres of concrete during the construction phase of the project. The batching plant will operate for approximately 20 months (or until project completion). Estimated total volume of water to be used in the process throughout the entire construction phase of the project is 4,000 m3.

Drainage

It is recommended that the 1 in 100-year event (346 mm/24hr) be used to calculate the flows generated from the property roof. It is recommended that all roof drains should have strainers extending not less than 102mm (4'') above the surface of the roof immediately adjacent to the roof drain. This will aid in prohibiting debris items (such as leaves, plastics, and rocks) from entering the roof drains. The design for the strainers should be guided by the criteria stipulated within Section 1105 of the International Plumbing Code (IPC) guidelines which indicated that strainers should have one available inlet area, above roof level, but not less than one and one-half times the area of the conductor of leader to which the drain is connected. For example, a 250mm and 125mm strainers should be used for a 100mm and 50mm conductors respectively.

It is proposed that the site will be raised to a minimum ground elevation and finish floor elevation of +2.8 and +3.0 meters above mean sea level respectively. This site will be properly graded to facilitate proper drainage from north to south. Storm runoff will sheet flow across the property into infiltration wells. The infiltration wells are interconnected via a pipe network which will allow overflow, if necessary, from one well to the next. There are also two overflow pipes from the last infiltration wells on the eastern and northern section of the proper that passes through the groyne structures and empties into the Caribbean Sea. Theses outfall pipes will provide emergency release for the infiltration well system during extreme event that is outside the design parameters and or in the event there is any failure to several infiltration wells. It is being further recommended that suitable measures such as the use of grasscrete pavers and green spaces be maximized to reduce runoff.

The proposed drainage master plan is as follows:

1. Stormwater runoff generated from the wider catchment will follow the natural slopes and grade of the land in a north-eastern direction where it will enter a covered U channel (box drain).
2. The stormwater will then flow in a south-easterly direction along the south-eastern property boundary and discharges into the Caribbean Sea.
3. Stormwater generated from the building roof and other areas within the property boundary will be directed to infiltration wells.
4. The infiltrations wells are interconnected and follow proposed slopes and grade of the property in a northern direction towards the Caribbean Sea.
5. The interconnected infiltration wells will culminate into two final infiltration wells located along the eastern and northern property boundary.
6. The final two infiltration wells are design with overflow pipes that leads to the Caribbean Sea through the proposed groynes. These pipes will provide a release for the infiltration system in the event several infiltration wells should fail and or a storm event occurs that’s outside the design criteria.

<u>Electricity and Water Supply</u>

Electricity supply will be obtained from the Jamaica Public Service Company Limited. The electricity demand for the resort when completed is estimated at 2,500 KWhr/day. Potable water for hotel operations will be provided via desalination of seawater by the hotel’s Seawater Desalination Plant.

<u>Fire Protection Systems</u>

Fire Protection Systems around the hotel property will include automatic detection and alarm systems, emergency lighting and signals, Type III portable manual fire extinguishers, water sprinkler system and automatic kitchen hood fire extinguishers.

<u>Solid Waste</u>

Garbage disposal areas will be clearly identified to adequately contain the daily solid waste from the building areas including the Hotels buildings, restaurants etc. Appropriate recycling methods will also be explored the minimize the overall waste for disposal and appropriate storage and systems for wet and dry garbage. Garbage collection and disposal will also be organized with an authorized solid waste company to have regularly schedule pickups.

PROJECT PHASING AND SCHEDULING

The hotel resort will be developed in two (2) phases: i) the First Phase will include 500 hotel rooms and 15 over water suites; ii) the Second Phase will include 200 additional hotel rooms. Phase 1 is estimated to have a total construction time of 24 months, and Phase 2 is expected to have a total construction time of 24 months. Phase 2 is expected to be implemented 24 – 48 months after Phase 1 is operational but is dependent on market conditions.

EMPLOYMENT

The work force for the site will at peak time be approximately 1,000 trade men and labourers during construction. This should create approximately 3,800 indirect and induced jobs during construction. Once fully operational, the hotel expects to employ approximately 1,600 persons (Phase I – 670 pers. and Phase II – 930 pers). This should create approximately 6,080 indirect and induced jobs. To the extent practicable, the Client will utilise local skills and labour for construction and operation of the hotel.

OPERATIONS

Energy Conservation

Jamaica has one of the highest electricity rates in the Caribbean, and hotels are generally energy intensive. The proposed project will incorporate several energy saving practices and technology to conserve on energy use and reduce costs. These will include:

- All rooms will be lit by Light Emitting Diodes (LED) technology.
- The other areas of the hotel will be LED type or low power consumption CFL (Compact Fluorescent Lamp).
- In every room there will be sensors that cut off the supply of air conditioning and some electrical circuits in the room when no detected any presence.
- The room air conditioning will be stopped in the event of a window/patio door opening although the sensor might indicate a presence.
- All air conditioning pipe will be coated with 1 inch of thermal insulation to reduce heat loss and therefore more efficient operation of the air conditioner.
- Solar power will be incorporated as part of the development's energy conservation strategies.

Water Conservation

Jamaica over the years have been experiencing water shortages especially during the summer months due to droughts. This has become more acute as the years pass by; therefore, water conservation strategies have become more critical.

This Project has incorporated water conservation features with the use of low consumption equipment. These include:

- Dual flush toilets with half (0.8 us gals) and full flush (1.6 us gals). This compares well with toilets in the 1980s that used approximately 3.5 us gals or traditional ones that used up to approximately 7 us gals.
- The faucets that will be used have water reducer (aerators) incorporated. This has the effect of restricting the maximum flow rate from the faucet. Typically, low flow bathroom faucets range from 0.5 – 1.5 us gpm (1.9 – 5.7 l/min).

In addition to these conservation features, treated wastewater effluent from the wastewater treatment plant will be used for irrigation around the property.

DECOMMISSIONING

At the time of decommissioning, the following activities will aim to satisfy the health, safety and environmental issues associated with the closing of the construction site in a manner which mitigates any adverse environmental impact.

1. Advanced notification (2 weeks) to relevant local authorities (NEPA, St. Ann Municipal Corporation) of near completion of construction and potential change in status of the site.
2. Final notification to relevant local authorities (NEPA, St. Ann Municipal Corporation) of completion of construction and change in status of the site to that of an operational hotel resort.
3. Notification to property neighbours and the immediate surrounding residential community will occur 1 week before decommissioning activities commence.
4. Security personnel will be present at all times, as it would be during normal construction phase until the decommissioning has been completed. Signage will be clearly posted at the entrance of the facility alerting the public that the facility is “Closed,” and the area is “Restricted.”
5. Vehicular and pedestrian access will be restricted to only personnel necessary to carry out the activities associated with decommissioning activities. Flag persons will continue to remain at the entrance to regulate any heavy equipment entering or exiting the site as during the construction period.
6. All access will be via the posted security personnel and recorded in the security log.
7. All equipment and material during construction will be removed from the site. This will include the boulders acting as a temporary access road to construct the overwater rooms/coastal structures as well as all debris and equipment in the marine environment and shoreline used in the searoom construction process (anchors, debris, rebar, scrap metal etc.)
8. Administrative office structures will be transported off the property (no permanent structures would be constructed)
9. Portable toilets and hand wash facility leased would expire and returned to the operator
10. All material stockpiles will be utilized in the construction process and the remainder removed from the site.

11. All solid waste and debris on site and in the marine environment will be removed and disposed of by licenced contracted municipal waste operators at an approved disposal site.

The estimated timeline for decommissioning activities is 1-2 months after each construction phase is completed.

POTENTIAL IMPACTS AND RECOMMENDED MITIGATION

Site Preparation and Construction Phase – HOTEL

CATEGORY		IMPACT	RECOMMEND MITIGATION
Physical	Stormwater Runoff and Water Quality	Ground and surface water quality may be prone to increased suspended solids from run-off from construction activities and rainfall events. Stored fuels, lubricants, hazardous substances and the repair and usage of construction equipment have the potential to leak hydraulic fuels, oils, etc and thereby have the potential to compromise water quality	i. The project site will put in sediment control measures such as turbidity barriers/silt screens and should be erected around the active work area to prevent the dispersion of sediments and contaminants throughout the water column. ii. A central area will be designated for the storage of raw materials. This area should be lined in order to prevent the leakage of chemicals into the sediment. iii. Fine grained materials (sand, marl, etc.) will be stockpiled away from drainage channels and low berms will be placed around the piles which themselves will be covered with tarpaulin to prevent them from being eroded and washed away. Silt fences may also be utilized to prevent siltation. iv. Stoppage of works during adverse weather conditions v. Raw materials that generate dust should be covered or wetted frequently to prevent them from becoming air or waterborne. vi. Raw material and equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff. vii. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by bunds to contain the volume being stored in case of accidental spillage. viii. Refuelling of boats should only be done at anchor out at sea if the sea conditions are calm, otherwise, all refuelling should be done when docked at land. Appropriate refuelling equipment (such as funnels) and techniques should always be used. ix. Appropriate minor spill response equipment (for containment and clean- up) will kept on site, including oil absorbent pads and disposal bags. x. In terms of transporting equipment, the paths of the planned roadways will be used, rather than creating temporary pathways just for equipment access. xi. Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway
	Noise	Noise nuisance from construction equipment on surrounding residential communities	i. Use equipment that has low noise emissions as stated by the manufacturers. ii. Use equipment that is properly fitted with noise reduction devices such as mufflers. iii. Operate noise-generating equipment during regular working hours (e.g., 7 am – 7 pm) to reduce the potential of creating a noise nuisance during the night. iv. Phase the use of noise generating equipment near the eastern boundary (near neighbours) v. Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.
	Air Quality	Dust nuisance from transportation of raw material on surrounding residential communities Fugitive dust effect on construction workers and residential communities	i. Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased. ii. Minimize cleared areas to those that are needed to be used. iii. Cover or wet construction materials such as marl to prevent a dust nuisance. iv. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators. v. Ensure material stockpiles and construction debris are stored away from the roadway vi. Consultation with Stakeholders to inform them of the work schedule and activities and to get their feedback. vii. Use of properly serviced and maintained equipment to reduce air emissions

CATEGORY		IMPACT	RECOMMEND MITIGATION
	Vibration	Effect on occupants of Residential units/villas located at the southern-most boundary	i. Sequence of operations: ○ Phase earth-moving and ground-impacting operations so as not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately. ○ Avoid night-time activities. People are more aware of vibration during the night-time hours. ii. Avoid impact pile driving where possible in vibration-sensitive areas. Drilled piles or vibratory pile driving causes lower vibration. iii. Have regular meetings or devise a communication strategy to inform the surrounding residents and businesses of construction activities
		Structural Effect on Residential units/villas located at the southern-most boundary	
		Effect on occupants of Unfinished residential housing located at the western-most boundary	
		Structural effect on Unfinished residential housing located at the western-most boundary	
Biological	Mangrove	2,098 m2 of mangrove near Quadrat 10 to be impacted as a result of reclamation	• Rehabilitation of 2,098 m² of mangrove. • Water from the roadway will naturally move northeast towards the southern "wetland" area, so development plans should consider this as a key drainage point. • The cluster of mangroves (Q9) on the south-eastern end should be retained if possible and shoreline revetment plans incorporate them into the design. They are ideal for erosion control and privacy and can be expanded with proper planning and designing. • Dwarfed mangroves near Q 13 and 14 should be conserved if possible. These are located outside of the development footprint.
		Loss of carbon storage and sequestration	
	Terrestrial Habitat	Coastal and Grassland Habitat	No Recommended Mitigation
	Rocky Shore	Species and Habitat Loss	
	Sea Turtles	Habitat loss and displacement	i. Attempts should be made to schedule the majority of the construction period outside of turtle nesting season (May – October). ii. All staff and workers should be sensitized to the sensitive ecosystems and species in the area, in particular turtles. The site should be inspected daily for any signs of turtle activity. If a nest is suspected or found, all activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs. iii. The stakeholders, proponents and the NEPA should develop clear lines of reporting and communication in the event that action needs to be taken. iv. Silt screens should be used to prevent sedimentation but should be removed promptly along with any other construction debris and material upon completion. v. Night-time activities should be limited or avoided when possible. No lights should be pointed out to sea which may cause confusion and disorientation of turtles or any other species that maybe affected by lunar activity. vi. Fixtures in direct line-of-sight from the beach should be shielded down-light only fixtures or recessed fixtures having low wattage "bug" type bulbs and non-reflective interior surfaces. vii. Fixtures mounted as low in elevation as possible through use of low-mounted wall fixtures, low bollards and ground level fixtures. viii. Floodlights, up-lights or spotlights for decorative and accent purposes that are directly visible from the beach, or which indirectly or cumulatively illuminate the beach shall not be used.

CATEGORY		IMPACT	RECOMMEND MITIGATION
			ix. For high intensity lighting applications such as providing security and similar applications shielded low-pressure sodium vapour lamps and fixtures shall be used.
Natural Hazards	Liquefaction and Geotechnical	Layers of silty sand and silty gravel were found, with the potential of liquefaction in all borings at depths between 5 and 50 ft. (mitigate using deep foundation Auger cast in place piles)	The supporting of the structures using deep foundations is recommended. These piles should penetrate up to 23.5 meters deep and achieve a satisfactory skin friction capacity. For this project, end bearing capacity is not emphasized due to the heterogeneous nature of the soil formation where cavities and voids can be found at final depths. Auger cast in place piles of 40 and 60 cm diameter drilled down to 23.5 m depth are proposed. Piles shall have a minimum separation of three (3) diameter between centres. For the allowable axial and lateral capacities.
Socioeconomic / Cultural	Employment	Creation of direct, indirect and induced jobs Employment exclusion/discrimination due to diverse sexual orientations and gender identities	It is important that the Developer: • Anticipates and prevent adverse risks and impacts based on gender, sexual orientation, and gender identity, and when avoidance is not possible, to mitigate and compensate for such impacts. • Achieves inclusion in project-derived benefits of people of all genders, sexual orientations, and gender identities. • Implement measures to prevent Sexual and Gender Based Violence (SGBV), including sexual harassment, exploitation and abuse; and when incidents of SGBV occur, to respond promptly.
	Solid Waste	Increased generation of solid waste	i. A Solid Waste Management Plan will be done and is to be approved by the National Environment and Planning Agency (NEPA) and the National Solid Waste Management Authority (NSWMA). ii. Skips and bins should be strategically placed within the campsite and construction site. iii. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour. iv. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling. v. Disposal of the contents of the skips and bins should be done at an approved disposal site vi. A ticketing system will be developed between both the Permittee and the Solid Waste Contractor to ensure effective management of waste and verification of disposal at the correct site.
	Wastewater	Contamination of marine environment from accidental spillage from portable toilets	i. Provision and maintenance of portable sanitary conveniences for the construction workers for control of sewage waste by a licenced contractor. A ratio of approximately 25 workers per chemical toilet should be used. ii. Portable toilets should be located approximately 25 metres from the high water mark, away from the shoreline to avoid discharge into the marine environment in the event of accidental spillage.
	Vending and Hygiene	Illnesses resulting from improper food handling practices Negative visual effect on area	i. Provision of adequate supply of potable water. ii. The monitoring of the various “cook shops” by public health authorities and the construction management team, to ensure proper hygiene is being followed. iii. The provision of areas to adequately wash hands and utensils. iv. Support the St Ann Municipal Corporation to ensure an orderly layout of vending areas.
	Transportation and Traffic	Traffic Flow and delays at intersection of site access road and main road Large units including tankers, and trucks carrying building and operation machine parts will pose challenges because of their sizes and weight.	• To minimize the negative impacts that the construction flows could have on the background traffic, events such as the delivery of materials and equipment can be scheduled during off-peak hours. (Outside the regions of 7:00-9:30 AM and 3:00-6:00 PM). • Accommodations should be made to allow for prompt entry to the site area, by the implementation of a short lane and a deep enough ingress to prevent queueing from bleeding in main lanes. • Movements such as oversized truck movements will also need to communicate with the NWA and authorities within the parish for the requisite approval and planning • Signs should be placed to warn oncoming motorists of the hazards generated by the site such as but not limited to slow-moving vehicles and open trenches.

CATEGORY		IMPACT	RECOMMEND MITIGATION
			• Implementation of speed decrease signs or flashing amber signals to prompt road users to slow upon approach to the site entry. • All trucks are expected to adhere to the National Works Agency standards as per the expected loads per vehicle axle. Special permits will be requested from the NWA as required two weeks in advance
	Occupational Health and Safety	Potential for accidental injury of construction workers Fugitive Dust effect on health of construction workers	i. Ensure that there is an ambulance and requisite staff onsite for any eventualities. ii. The provision of lifelines, personal safety nets or safety belts and scaffolding for the construction workers (if necessary) iii. Ensuring that workers wear personal protective equipment (hard hats, reflective vests, safety shoes, eye protection etc.) iv. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators. v. Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased. vi. There should be onsite first aid kits and arrangement for a local nurse and/or doctor to be on call for the construction site. vii. Make prior arrangements with staff at the St. Ann's Bay hospital and/or health centre to accommodate any eventualities. There is a doctor's office in proximity to the site which could also be explored. viii. Make prior arrangements with the St. Ann's Bay police and fire stations (Freeport) to accommodate any eventualities. ix. Material Safety Data Sheets (MSDS) should be stored onsite. x. A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers. xi. Trench Excavation • A trench 1.2m or more in depth must have a means of egress (ladders/ stairways/ramps) and should be located at 8m intervals. • Excavated materials must be stored 0.6m or more from the open trench (not to be measured from the crown of the spoil). • Spoil should be placed so that the channels rainwater and other runoff water away from the excavation. • Take precautions regarding Tension Cracks – Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench. – Sliding or sloughing may occur as a result of tension cracks. [1] xii. Ensure that construction safety nets (catch nets) are installed that will catch personnel, debris, and small tools xiii. Designing and implementing an Emergency Response Plan (ERP) in the event of any emergency. This should include: o Hurricane o Earthquake o Flooding o Fire o Civil Unrest and Riots o Bomb Threats and Acts of Sabotage o Acts of Terrorism and Armed Attacks o Petroleum and Hazardous Material Stockpiling o Security and Safety Information o Medical Emergency Information o Technological Emergencies

[1] Worker Health and Safety Guidelines as per OSHA #510 Construction Industry Standard 29 CFR Part 1926.

CATEGORY		IMPACT	RECOMMEND MITIGATION
	Aesthetics	Decreased aesthetic appeal	• Good housekeeping activities and adherence to other mitigative measures. • An area of gravel should be placed on site (just before exiting onto the main road) to help remove mud/marl from truck wheels. • A wheel wash area on site (just before exiting onto the main road) should be implemented to rid wheels of as much mud/marl as possible.
		Trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing.	
	Grievance Mechanism	Inconveniences, health risks and can be a source of nuisance to stakeholders (both internal and external) on site	With the aim of establishing and maintaining a harmonious relationship between the stakeholders (both internal and external) and the Project, a Claims and Complaints Absolution Program will be implemented, whose general objective is to create a system that allows timely response to complaints from residents who are perceived to be affected or harmed by any aspect of the Project. A Grievance Redress Mechanism (GRM) to include reports of allegations of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination will be formulated.
		Incidences of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination	
	Historical Artefacts	No historical, archaeological features were uncovered. No artefacts were recovered. The possibility exists however that there could be foundations of historical structures or features.	Care should be taken during construction activities. Any vestiges of cultural material unearthed on should be collected and examined. It should be noted that in case archaeological features are found within the project area, the JNHT will evaluate and record the features and collect any such cultural material found.
	Fishers and Maritime Interests	Loss of use of site as access point to sea by spear fishers	Coordinate with the Tourism Enhancement Fund and the National Fisheries Authority to ensure that the proposed upgrading to the official fishing beach at Priory have the requisite infrastructure to accommodate the displaced fishers.
		Loss of use as an area used as a channel for vessels in times of emergency and inclement weather.	

Operations Phase - HOTEL

CATEGORY		IMPACT	RECOMMENDED MITIGATION
Physical	Drainage and Stormwater	Mixing time of stormwater (freshwater) with seawater	• The site should be well graded to facilitate proper drainage in a northern direction towards the coast and into the infiltration network. • The slopes and graded of the wider catchment towards the proposed covered "U" channel should be maintain, to capture runoff from the wider catchment area and safely discharge into the sea to mitigate flooding of the neighbouring property. • The external and internal drainage system should be implemented as designed. • Regular maintenance of the drainage system to keep it free from sediments, debris, and trash must be undertaken.
		Effect on benthos from mixing of stormwater with seawater	
		Potential flooding of areas of the property during extreme rainfall events.	
		Potential flooding of neighbouring properties	
	Hydrodynamics (Operational Wave Heights)	Reduction in wave heights, especially at the north-western beach	None Required
		No change in wave energy within the dredged swimming area	
		Little to no change in wave energy along the eastern beach and within the overwater suites.	
		Increased circulation due to creating of channel	
	Hydrodynamics (Swell Waves and Sediment Transport)	There were no noticeable downdrift impacts further south or west of the project site.	None Required
		Protected beaches appear to remain stable	
		Swell waves encourage water circulation between the two beaches	
		Currents reduced in the lee of the proposed structures	
		Breakwater reduces the wave energy entering the swimming beach significantly at the north-eastern beach.	
		Sand accretion is occurring along the eastern beach and north-eastern shorelines	
		No noticeable downdrift changes along the neighbouring properties as a result of currents or waves	
		There is sediment movement within the dredged wading area	
	Circulation	Changes in current speed and direction are localized along the eastern beach causing a slight increase in current speeds to improve water circulation	None Required
Biological	Sea Turtles	Operational activities, lighting and other barriers may discourage and or prevent turtle nesting and foraging activities	I. All staff and workers should be sensitized to the sensitive ecosystems and species in the area, in particular turtles. The beaches should be inspected daily for any signs of turtle activity. If a nest is suspected or found, all activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs. II. Turtle-friendly lighting and light positioning (if any) should also be placed on the searooms. Hotel operators should also educate their guests on sea turtle conservation and the correct actions to take if a sea turtle is observed nesting on the beach.

CATEGORY		IMPACT	RECOMMENDED MITIGATION
			The Hotel should also develop a Sea Turtle Monitoring programme which would include tagging and hatchling release. This could add to their attraction offerings (turtle watching)
	Rocky Shore and Intertidal Communities	Species expected to recolonise rocky shore and permanent structure with intertidal area.	No Recommended Mitigation
Natural Hazards	Hurricane Waves and Storm Surge	Potential of flooding to the property from storm surge as well as damage due to high energy waves from 50-yr storm event (mitigative structures to protect property for the 50-yr storm event)	Based on this, a minimum ground elevation of +2.8m is proposed and a minimum floor elevation of +3.0m. By increasing the ground level (also to facilitate drainage) the development is protected from hurricane-related flooding. In addition, a wall around the entire development is proposed as a solid method of protection against erosion from waves accompanying the surge. The following are noted: • Under 50-year hurricane conditions, the proposed structures around the beaches will be inundated. The structures are not intended to protect the beach during these extreme conditions; rather, they will be designed to withstand these extreme conditions so that they can function under normal operational conditions after the storm has passed. The perimeter wall and raised elevation of the property will protect the resort from flooding up to the 50-year hurricane event
Socioeconomic / Cultural	Employment	Creation of direct, indirect and induced jobs increase of persons with training in the hospitality sector. Employment exclusion/discrimination due to diverse sexual orientations and gender identities	It is important that the Hotelier: • Anticipates and prevent adverse risks and impacts based on gender, sexual orientation, and gender identity, and when avoidance is not possible, to mitigate and compensate for such impacts. • Achieves inclusion in project-derived benefits of people of all genders, sexual orientations, and gender identities. Implement measures to prevent Sexual and Gender Based Violence (SGBV), including sexual harassment, exploitation and abuse; and when incidents of SGBV occur, to respond promptly
	Solid Waste	Increased generation of solid waste	i. Provision of solid waste storage bins and skips. ii. Provision of adequately designed bins and skips to prevent access by vermin. iii. Monitor beach garbage. iv. Contracting a private contractor to collect solid waste in a timely fashion to prevent a build-up. v. Ensure that the solid waste collected is disposed in an approved disposal site vi. Waste sorting (plastics, papers, glass, organic waste etc.) should be facilitated and integrated into the development. vii. A ticketing system will be developed between both the Permittee and the Solid Waste Contractor to ensure effective management of waste and verification of disposal at the correct site.
	Health and Safety	Workers and guests may become ill or have accidents. In addition, disasters such as earthquakes, floods, storm surge and fires are real possibilities.	i. Have first aid kits located in various sections of the development ii. Design and implement an emergency response plan. iii. Arrange mutual assistance and make prior arrangements with: a. Health care facilities (St. Ann's Bay Hospital) and associated doctors and nurses to accommodate any eventualities. b. St. Ann's Bay Fire Station c. St. Ann's Bay Police Station
	Traffic	Delays for traffic coming from the St. Ann's Bay Road. Motorists needing to turn left onto the hotel's main entrance	i. Increasing the number of lanes on along the road corridor to facilitate a higher flow capacity of vehicles would significantly improve the LOS experienced by motorists traversing the area.

CATEGORY		IMPACT	RECOMMENDED MITIGATION
		from Laughlands Road and right from out of the hotel's entrance unto Laughlands Road	ii. Implement designated short lanes to allow traffic to leave the Laughlands and St. Ann Bay roads and enter the site without impeding the main road traffic. iii. The scheduling of the arrival of heavy vehicles should be organized for off-peak traffic hours. This would of course decrease delays and reduce the chances of accidents which are usually increased by the introduction of slow-moving and stationary traffic into a relatively fast-moving environment. iv. Installation of signs along the major road to warn motorists approaching each intersection, by NWA specifications. Signs instructing motorists to reduce their speed will significantly reduce the possibility of road accidents caused by the presence of the intersections
		Due to the significant increase in traffic volume in 10 years, the proposed signalized intersection would eventually lose its effectiveness	
	Tourism	Improvement of the tourism product of the country	No Mitigation Required.
	Grievance Mechanism	Incidences of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination	• Ensure a fair and rapid response by the representatives of the Project to the questions, concerns and / or complaints of the stakeholders, so that they do not become negative impacts. • Provide alternative methods to solve potential complaints in substitution of legal actions between the parties. • Properly document complaints and claims, elaborating respective formats for each stage of the process. • Build a process of mutual trust with local and regional groups of interest. • Clearly defining policy statements about the handling of complaints and claims (including, when appropriate, mechanisms to ensure confidentiality and access to the information). • Clearly establishing organizational responsibilities such as the assigning of specific personnel from the operation, managers, and/or functional units to implement the GRM, designating access points for complaints. • Defining, documenting, and disclosing workflow procedures and standards to ensure that all complaints are understood and analysed, as well as the criteria for decisions to determine the appropriate responses. • Establishing clear communications mechanisms with claimants, both regarding how to bring problems to the attention of the authorities and how those authorities communicate with the claimants. • Establishing systems to register and follow up on all complaints, disputes, or claims. • Establishing an appeal process (or other solutions) for cases where the parties involved in a complaint, or a dispute do not agree with the decisions at the operational level.
	Fishers and Maritime Interests	Loss of use of site as access point to sea by spear fishers	• Coordinate with the Tourism Enhancement Fund and the National Fisheries Authority to ensure that the proposed upgrading to the official fishing beach at Priory have the requisite infrastructure to accommodate the displaced fishers.
		Loss of use as an area used as a channel for vessels in times of emergency and inclement weather.	

Site Preparation and Construction Phase – BEACH WORKS AND OVERWATER ROOMS

CATEGORY		IMPACT	RECOMMENDED MITIGATION
Physical	Water Quality	Sedimentation of marine environment from beach works, sand (nourishment), boulders Pollution of marine environment from fuel, lubricants, hazardous substances from construction equipment Sedimentation from temporary construction pad needed for coastal structures	i. The project site will put in sediment control measures such as turbidity barriers/silt screens and should be erected around the active work area to prevent the dispersion of sediments and contaminants throughout the water column. ii. A central area will be designated for the storage of raw materials. This area should be lined in order to prevent the leakage of chemicals into the sediment. iii. Sand will be stockpiled away from drainage channels iv. Stoppage of works during adverse weather conditions v. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by bunds to contain the volume being stored in case of accidental spillage. vi. Refuelling of boats should only be done at anchor out at sea if the sea conditions are calm, otherwise, all refuelling should be done when docked at land. Appropriate refuelling equipment (such as funnels) and techniques should always be used. vii. Appropriate minor spill response equipment (for containment and clean- up) will kept on site, including oil absorbent pads and disposal bags. viii. In terms of transporting equipment, the paths of the planned roadways will be used, rather than creating temporary pathways just for equipment access. ix. Vehicle refuelling facilities must be situated on impermeable surfaces served by an oil trap, run-off collection system. Sediment basins and oil water separators should be constructed to intercept storm water before it is discharged. x. Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity in and around the project area should be conducted during construction for the first 3 months of construction. Monitoring can be conducted fortnightly thereafter. xi. Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed overwater villas and at control stations, on a monthly basis, for comparison to background levels and pre-construction sedimentation rates.
	Marine Excavation and Dredging	Increased suspended solids, turbidity, BOD and the reduction in light penetration and dissolved oxygen in the water column Suspension of heavy metals from the substrate Affect sensitive coastal ecological habitats Dredge spoil disposal from land may affect coastal water quality	• Turbidity barriers/silt screens are recommended to be used around all dredging activities. These should be placed so as to reduce/contain the resultant sediment plume during these activities. Dredging activities should only occur when these barriers are fully operational, that is; placed correctly; in calm to moderate sea conditions; and without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms. The silt screens should encircle the areas and be deep enough to contain the plumes so that plumes will not travel in the direction of the prevailing currents. • Care should be taken to dredge only in approved dredge areas. Dredge areas and a buffer area should be demarcated to avoid accidental dredging in unauthorized areas. • Dredging operations should be continually monitored to ensure equipment and machinery are in good repair and regularly serviced to prevent oil leaks during regular operations. • Dredge spoils deposited on land should be placed in a bermed holding area for dewatering after the fines have settle and then the material transferred to trucks to be either disposed of or used on site as fill material if needed
	Noise	Noise nuisance from construction equipment on surrounding residential communities	i. Use equipment that has low noise emissions as stated by the manufacturers. ii. Use equipment that is properly fitted with noise reduction devices such as mufflers. iii. Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) to reduce the potential of crating a noise nuisance during the night. iv. Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs

CATEGORY		IMPACT	RECOMMENDED MITIGATION
Biological	Rocky Shore	Habitat and Species loss	No Recommended Mitigation
		Smothering of habitat and filter feeding organisms	
	Coral Community	Smothering of sensitive nearby coral and reduced light from sedimentation	1. During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish. 2. Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity and Total Suspended Solids (TSS) in and around the project area should be conducted during construction for the first 3 months of construction. Monitoring can be conducted fortnightly thereafter. 3. Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and other marine works and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison. 4. All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area. 5. Relocation of sensitive species should be done if; they are suitable for relocation (that is suitable substrate, health and over all viability), those species fall within the potential impact area; and if mobile invertebrates are in or around the potential impact area. Sensitive organisms and systems in and outside the impact area include; hard and soft corals, sponges, seagrass and mobile invertebrates such as urchins, sea cucumbers, starfish and conch. **Detailed Seagrass and Coral Removal and Relocation Plans, as well as a Post-Relocation Monitoring Plan, must be prepared for approval by NEPA.** 6. Alternative mitigations should be proposed when relocation is unlikely to be successful. 7. Where possible, as little of the natural environment should be relocated or removed. Habitat fragmentation and species displacement should be temporary, with the placement of silt screens, construction materials and equipment as well as general human activity in the area. 8. Structures placed on the seafloor may cause habitat fragmentation and displace some species, however they may also serve to add ecological volume, providing substrate for organisms to settle and colonize and eventually may serve some ecosystem functions. 9. Any temporary floating structures and /or vessels should be placed in areas with less sensitive species where possible. Floating structures anchored or moored over seagrass beds or coral colonies should not be left for prolonged time periods as the resulting shading effects may cause deterioration in overall health of the seagrass bed and coral colonies.
		Species loss- not suitable for relocation	
		Species loss during relocation	
		Damage to colonies near work area or relocation areas	
	Other Benthic Communities	Habitat Loss (breeding, nursery and foraging grounds) and Fragmentation	
		Species Loss	
		Smothering of species and habitat / clogging of gills and filter feeding appendages	
		Damage during construction and relocation activities	
	Seagrass	Habitat Loss and Fragmentation	
		Species loss	
		Smothering of seagrass blades and epiphytes from sedimentation	
		Reduced light penetration and resulting decrease in photosynthesis	
		Mechanical abrasion from construction activities moorings and anchors	
		Loss of stored carbon and loss of further carbon sequestration	
	Sea Turtles	Temporary disturbance/displacement from construction activity, lights and noise	i. Attempts should be made to schedule the majority of the construction period outside of turtle nesting season (May – October). ii. All staff and workers should be sensitized to all sensitive ecosystems and species in the area, in particular turtles. The site should be inspected daily for any signs of turtle activity. If a nest is suspected or found; - The nest should cordoned off and remain undisturbed until it is hatched in approximately 60 days. - All activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs if the nest is located in a highly vulnerable area. iii. The stakeholders, proponents and the NEPA should develop clear lines of reporting and communication in the event that action needs to be taken. iv. Silt screens should be used to prevent sedimentation but should be removed promptly along with any other construction debris and material upon completion.
		Impeded beach access for nesting	

CATEGORY		IMPACT	RECOMMENDED MITIGATION
			v. Night-time activities should be limited or avoided when possible. No lights should be pointed out to sea confusion and disorientation of turtles or any other species that maybe affected by lunar activity. vi. Fixtures in direct line-of-sight from the beach should be shielded down-light only fixtures or recessed fixtures having low wattage "bug" type bulbs and non-reflective interior surfaces. vii. Fixtures mounted as low in elevation as possible through use of low-mounted wall fixtures, low bollards and ground level fixtures. viii. Floodlights, up-lights or spotlights for decorative and accent purposes that are directly visible from the beach, or which indirectly or cumulatively illuminate the beach shall not be used. ix. For high intensity lighting applications such as providing security and similar applications shielded low-pressure sodium vapour lamps and fixtures shall be used.
Socioeconomic / Cultural	Maritime Traffic	Impact on fishing and other maritime activities Accident potential is also increased due to presence of vessels, structures and equipment at sea.	The use of highly visible marker buoys demarcating an exclusion zone should be used to keep out other marine traffic and fishers from the work area to prevent potential accidents
	Health and Safety	Potential for accidental injury of construction workers	i. A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers. ii. At least two (2) certified lifeguards should be hired and be on site during work hours in the event of potential accidental drowning. iii. The construction management team should have onsite first aid kits and make arrangements for the nurse and doctor at St. Ann's Bay Hospital to be on call for the construction site. Prior arrangements should be made with health care facilities/clinics to accommodate any eventualities. iv. Make prior arrangements with the St. Ann's Bay Fire Station and St. Ann's Bay Police Station to accommodate any eventualities. v. Material Safety Data Sheets (MSDS) should be stored onsite. vi. Spotters in the water will assist the heavy equipment in accurate placement of the armour units. The slopes and elevations of the armour layer will be demarcated with visual aids to guide the placement of boulders and to ensure they are properly interlocked.
	Aesthetics	Decreased aesthetic appeal	Good housekeeping activities and adherence to other mitigative measures especially with regard to potential marine water quality contamination

Operations Phase - BEACH WORKS AND OVERWATER ROOMS

CATEGORY		IMPACT	RECOMMENDED MITIGATION
Biological	Reef and Seagrass Community	Pilings and Hard structures (groynes, breakwaters, jetty) will provide of ecological volume and substrate for colonization and recruitment	No Recommended Mitigation
		Shading from sea rooms (seagrass)	
		Trampling of beds and other benthic species	
		Habitat Fragmentation	
	Fish	Hard structures (groynes, breakwaters, jetty) will act as Fish Aggregation Devices (FADs)	
	Sea Turtles	Alteration of food source from seagrass bed modification	I. All staff and workers should be sensitized to the sensitive ecosystems and species in the area, in particular turtles. The beaches should be inspected daily for any signs of turtle activity. If a nest is suspected or found; - The nest should cordoned off and remain undisturbed until it is hatched in approximately 60 days. - All activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs if the nest is located in a highly vulnerable area. II. Turtle-friendly lighting and light positioning (if any) should also be placed on the searooms. III. Hotel operators should also educate their guests on sea turtle conservation and the correct actions to take if a sea turtle is observed nesting on the beach. IV. The Hotel should also develop a Sea Turtle Monitoring programme which would include tagging and hatchling release. This could add to their attraction offerings (turtle watching).
		Hard structures block or act as deterrent for onshore nesting	
		Noise and lighting act as deterrent from going ashore to nest	
Natural Hazards	Hurricane Waves	Increase in static water level and potential for extreme flooding	A two-level approach was taken to setting the Sea Room floor elevations: the lower level is closer to sea level and could be a platform for entering and exiting the sea. The building elements placed on this lower platform should be mobile as this level would be flooded during a hurricane as its proposed deck floor level is at +1.25m above MSL. The upper level would not be flooded during hurricane conditions as the FFL will be at +2.95m above MSL
Human/Social	Maritime Traffic	Maritime activities affected by presence of searooms	After construction is completed, permanent highly visible marker buoys should be placed at strategic points around the overwater rooms. Turtle-friendly lighting and light positioning should also be placed on the searooms so that they are visible to marine vessels at night-time
		Accident potential due to possibility of collision with searoom structures	
	Aesthetics	Improvement of the aesthetic appeal of the hotel	No mitigation is required
	Health and Safety	Workers and guests may become ill or have accidents. In addition, disasters such as storm surge and fires are real possibilities	• Have first aid kits located in various sections of the hotel. • Design and implement an emergency response plan. • Staff should be trained in CPR and basic first aid. • Arrange mutual assistance and make prior arrangements with: o Health care facilities, St. Ann's Bay Hospital and associated doctors and nurses to accommodate any eventualities. o Arrange with other health practitioners to be on call or have an in-house physician/nurse. o St. Ann's Bay Fire Station o St. Ann's Bay Police Station (Marine police to conduct patrols in the vicinity of the overwater searooms). This may also be conducted by contracted private security.
	Tourism	Improvement of the tourism product of both the hotel and the country	No mitigation required

IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

The following project alternatives have been identified and are outlined below:

- Alternative 1 - The "No-Action" Alternative.
    - Under the No-Action Alternative, the existing property, vegetation and benthic features at Richmond would remain as is, with no broadening of the tourism client base and overall diversified and enhanced Jamaican tourism product

- Alternative 2 - The Project as Proposed in the EIA.
    - Under Alternative 2, Richmond Vista Limited will develop a 715 room Secrets Resort & Spa at its 90,624 sqm (22.4 acre) property at Richmond Estate in the Parish of Saint Ann. The hotel resort will be developed in two (2) phases: i) the First Phase will include 500 hotel rooms and 15 over water suites; and ii) the Second Phase will include 200 additional hotel rooms. The proposed design is expanded across the site with buildings consisting of 1-7 storeys and the total floor area is 81,544.15 m2. The built areas comprising of 2 Hotels with 700 Rooms, 15 Overwater Villas, Spa, Specialty Restaurants, Technical Area, 3 Beach Bars, 3 Pool Bars, Coco Café, 2 Barefoot Grill, 3 Towel Gazebo, 2 Wedding Gazebo, Pools Toilets, Temazcal, Water Sports, 2 Resort Access and Service Access. There are a total of 672 Parking and 15 coach Parking areas.

- Alternative 3 – The Project as Proposed in the EIA, but with a different Overwater Searoom Location
    - Under Alternative 3, the hotel and all structures on the land would remain the same as Alternative 2. However, the overwater rooms would be located further north, closer to the edge of the shelf. The nearshore area around the overwater villas would be deepened to encourage more flow in to the nearshore for better water quality.

- Alternative 4 – The Project as Proposed in the EIA, but with a different layout for the northern beach.
    - Under Alternative 4, the hotel and all structures on the land would remain the same as Alternative 2. The two sandy beach areas would be proposed on the north-western shoreline. Both beaches would be anchored by three (3) groynes with two (2) submerged breakwaters to protect from incoming high waves, as opposed to two (2) groynes and one (1) breakwater as proposed in Alternative 2.

- Alternative 5 – The Project as Proposed in the EIA, but with a "No-Build" Zone on the peninsula.
    - Under Alternative 5, the hotel and all structures on the land would remain the same as Alternative 2. However, a no-build zone would be established on the peninsula.

- Alternative 6 - The Project as Proposed in the EIA, but with a Reduced Wading Area at the Eastern Beach
    - Under Alternative 6, the hotel and all structures on the land would remain the same as Alternative 2. However, the wading area along a portion of the eastern beach and around the overwater rooms would be reduced. The various locations where the reduction in wading areas occur are: i) At the T-groyne, where the nourishment area is also reduced resulting in the wading area being reduced; ii) To the south of the overwater room boardwalk; and iii) At the seaward end of the overwater rooms.

- Alternative 7 - The Project as Proposed in the EIA, but with a Reduced Wading Area at the Eastern Beach and Shorter Overwater Room Boardwalk
    - Under Alternative 7, the exact same scenario in Alternative 6 occurs here, however, the boardwalk for the overwater rooms is slightly shorter because of a shift of the overwater rooms one (1) villa-width in a landward direction.

The Preferred Alternative is Alternative 7 - The Project as Proposed in the EIA, but with a Reduced Wading Area at the Eastern Beach and Shorter Overwater Room Boardwalk. This alternative will result in the reduction of impacted seagrass by 3,332.92 square meters.

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

As part of the Environmental Management System (EMS), it is recommended that several parameters be monitored before, during and after the project implementation to record any negative construction impacts and to propose corrective or mitigation measures. The suggested parameters include but are not limited to the following:

1) Water Quality to include but not be limited to:
    a. Nitrates
    b. Phosphates
    c. BOD
    d. Fats, oil, and grease
    e. pH
    f. TSS
    g. Turbidity
    h. TDS
    i. Faecal Coliform
2) Noise
3) Coral and Fisheries
4) Seagrass
5) Traffic
6) Maritime Operations
7) Solid Waste Generation and Disposal
8) Sewage Generation and Disposal
9) Equipment Maintenance

10) Health and Safety

Other specific Management/Monitoring Plans applicable to this project include:

- Coral Management Plan: will include a combination of coral monitoring exercises, water quality monitoring and sediment dispersal monitoring, before, during and after construction. The activities will be conducted by qualified and trained marine scientists and SCUBA divers.
- Seagrass Management Plan: will include a combination of seagrass survey/monitoring exercises and water quality monitoring before, during and after construction. The activities will be conducted by qualified and trained marine scientists and SCUBA divers.
- Mangrove Management Plan: will include a combination of existing and replanted mangrove survey/monitoring exercises and water quality monitoring before, during and after construction. The activities will be conducted by qualified and trained mangrove ecologists.

CONCLUSIONS AND RECOMMENDATIONS

This proposed development is slated to increase the room offerings of the island, thereby creating jobs and economic benefits, growing the tourist clientele and in the process enhance and diversify the Jamaican tourism product.

On the contrary, the degradation, loss and adverse effects of natural habitats as well as impacts on the noise climate, air quality and solid waste facilities, are some of the potential negative impacts of the project. These concerns are highlighted through the stakeholder involvement and public interviews conducted for the purposes of this EIA.

The implementation of the recommended mitigation measures detailed in this EIA, as well as the various environmental management and monitoring programmes, will assist in reducing these negative impacts

2.0 INTRODUCTION

2.1 PROJECT BACKGROUND

2.1.1 Proposed Project and Context

Richmond Vista Limited wishes to develop a 715 room Secrets Resort & Spa at its 90,624 sqm (22.4 acre) property at Richmond Estate in the Parish of Saint Ann. The hotel resort will be developed in two (2) phases: i) the First Phase will include 500 hotel rooms and 15 over water suites; and ii) the Second Phase will include 200 additional hotel rooms. Phase 2 is expected to be implemented 24 – 48 months after Phase 1 is operational but is dependent on market conditions.

The proposed design is expanded across the site with buildings consisting of 1-7 storeys and the total floor area is 81,544.15 m^2. The built areas comprising of 2 Hotels with 700 Rooms, 15 Overwater Villas, Spa, Specialty Restaurants, Technical Area, 3 Beach Bars, 3 Pool Bars, Coco Café, 2 Barefoot Grill, 3 Towel Gazebo, 2 Wedding Gazebo, Pools Toilets, Temazcal, Water Sports, 2 Resort Access and Service Access. There are a total of 672 Parking and 15 coach Parking areas.

Destination Jamaica continues to offer a diverse product of very high quality to its visitors, through its expansive and inclusive nature. The wide range of hotels, attractions and activities has allowed Jamaica to deliver on visitor expectations, unequalled visitor experiences and provide value for money. This development fits into the Governments' drive of increasing tourism arrivals, diversifying the locations of tourism infrastructure from the traditional areas of Negril, Ocho Rios, Montego Bay, Port Antonio and Kingston and increasing the tourism offerings. With the Governments' drive of increasing tourism arrivals there's a concomitant increase in hotel rooms to accommodate the expected stop over visitors.

The proposed project complies with Vision 2030; the National Vision Statement - "Jamaica, the place of choice to live, work, raise families, and do business". A part of the vision is that; we are the premier destination to visit and do business. This proposed development will increase the room offerings of the island, thereby growing the clientele and in the process enhance the Jamaican tourism product.

2.1.2 Location and Study Area

The proposed project is located at Richmond Bay, Richmond Estate, St. Ann, less than nine kilometres west of the Edward Seaga Highway (North South Link of Highway 2000) (Figure 2-1). The property, located on Jamaica's north coast, is bounded to the north and the east by the Caribbean Sea, to the west by unfinished residential development (Volume: 1180 Folio: 118) and to the south by more residential developments (1 - 6 Richmond Estate (Volume/Folio: 1448/874, 1451/791, 1469/436, 1489/288, 1489/284 & 1456/119) (Plate 2-1 to Plate 2-3).

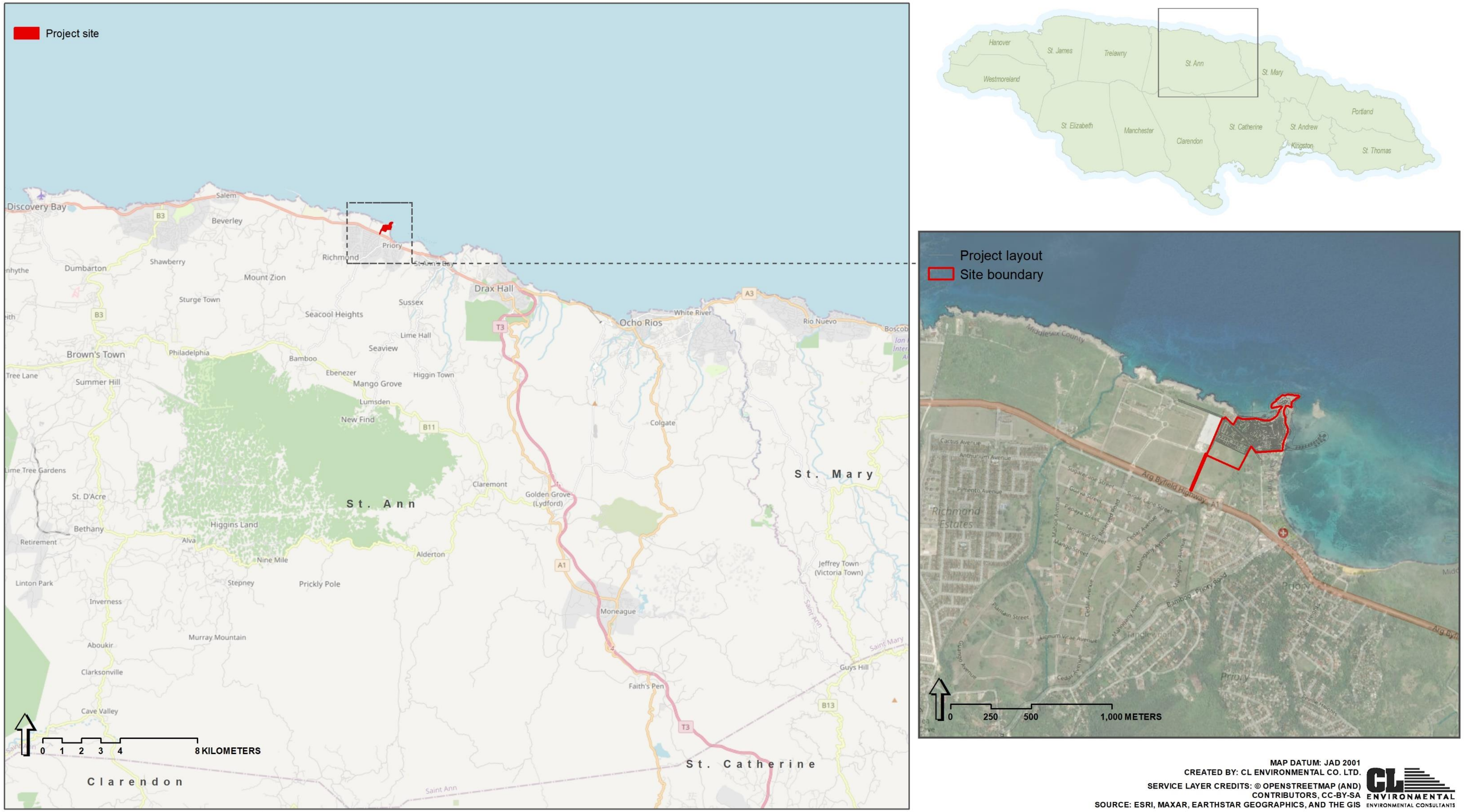


Figure 2-1 Location of proposed project

Plate 2-1 Aerial view of property looking northwest

Plate 2-2 Aerial view of property looking west

Plate 2-3 Aerial view of property looking south

2.2 SCOPE OF WORK

The Natural Resources Conservation Authority Act (NRCA) Act of 1991 and subsequent legislation and regulations, state that persons undertaking new developments that fall within a prescribed category will require a permit (see section 3.1 for further detail). Further, an Environmental Impact Assessment (EIA) was deemed necessary by the National Environment and Planning Agency (NEPA) and the approved Terms of Reference (TORs) for the EIA may be found in Appendix 1.

As outlined in the TORs, an EIA seeks to identify the impacts the proposed project is likely to have on the area in which the physical development will be carried out, as well as the impact of the environment on the proposed development. It also outlines mitigation measures necessary to reduce the negative impacts of the project. Data collation activities and analyses carried out for the purposes of this EIA were guided by the TORS, and similarly this EIA report was compiled in accordance with the TORs.

3.0 LEGISLATION AND REGULATORY CONSIDERATION

3.1 ENVIRONMENTAL IMPACT ASSESSMENT FRAMEWORK

3.1.1 Rationale and Basis

An Environmental Impact Assessment (EIA) is "a structured approach for obtaining and evaluating environmental information prior to its use in decision-making in the development process. This information consists, basically, of predictions of how the environment is expected to change if certain alternative actions are implemented and advice on how best to manage environmental changes if one alternative is selected and implemented" (Bisset, 1996).

The basis and rationale of an EIA has been summarised as follows (Wood, n.d.):

- Beyond preparation of technical reports, EIA is a means to a larger end - the protection and improvement of the environmental quality of life.
- It is a procedure to discover and evaluate the effects of activities on the environment - natural and social. It is not a single specific analytical method or technique but uses many approaches as appropriate to the problem.
- It is not a science but uses many sciences in an integrated inter-disciplinary manner, evaluating relationships as they occur in the real world.
- It should not be treated as an appendage, or add-on, to a project, but regarded as an integral part of project planning. Its costs should be calculated as a part of adequate planning and not regarded as something extra.
- EIA does not 'make' decisions, but its findings should be considered in policy - and decision-making and should be reflected in final choices. Thus, it should be part of decision-making processes.
- The findings of EIA should focus on the important or critical issues, explaining why they are important and estimating probabilities in language that affords a basis for policy decisions.

3.1.2 Development Application and the EIA Process

The National Environment and Planning Agency (NEPA) [2] has been given responsibility for environmental management in Jamaica under the Natural Resources Conservation Authority Act (NRCA) Act of 1991. Since the promulgation of the NRCA Act, it has been strengthened by various supporting regulations that became effective in January 1997. The Environmental Permit and License

[2] NEPA represents a merger of the Natural Resources Conservation Authority (NRCA), the Town Planning Department (TPD) and the Land Development and Utilization Commission (LDUC). Among the reasons for this merger was the streamlining of the planning application process in Jamaica.

System (P&L) is administered by NEPA through the Applications Section. It was introduced in 1997 to ensure that all developments meet required standards and negative environmental impacts are minimized. Under the NRCA Act of 1991, the NRCA has the authority to issue, suspend and revoke environmental permits and licenses, as well as the power to request EIAs for a permit or for any activity in a prescribed area (entire island of Jamaica) where it is of the opinion that the environment is likely to have adverse effects due to the activities.

The NRCA permit procedure is initiated by the submission of the Project Information Form (PIF) to the Authority. The PIF screening form is reviewed to determine whether an EIA is required and to begin determining areas of environmental significance, especially in waste discharge. Based on the review of the PIF, the NRCA advises if an EIA would be required for the proposed project and determines the scope of the EIA through proposed Terms of Reference (TORs). The TORs are proposed using NRCA guidelines and are ultimately approved by the NRCA. NRCA gives the approved final TORs for the proposed project.

The NRCA requires that the EIA include the following:

- A description of the present environment, i.e., physical, biological, and social environment. This includes, for example, consideration of economic situations, cultural heritage and ecological preservation;
- A description of the significant impacts the environmental professionals expect the development to have on the environment, compared to the environment that would remain if there were no development. This will include indirect and cumulative impacts;
- An analysis of alternatives that were considered in order to consider means of minimising or eliminating the impacts identified above; and
- An Environmental Management Plan, which includes a Monitoring & Hazard Management Plan and an Auditing schedule.

The NRCA guidance on EIAs states that this process "should involve some level of stakeholder consultation in either focus groups or using structured questionnaires." A draft EIA is submitted to the developer to solicit the proponents' input into the description of the project (to check for accuracy of statements, and to enter into realistic discussions on the analysis of alternatives, as well as to inform the proponents of any other relevant legislation with which they must comply). Fourteen copies of the finalised draft are then submitted to NRCA, two to the client, and the consultant keeps one (17 in all are produced). The NRCA distributes these to various other public sector institutions who sit on the Technical Committee (e.g., Office of Disaster Preparedness and Emergency Management (ODPEM), Water Resources Authority (WRA), Environmental Control Division in the Ministry of Health (ECD), Jamaica National Heritage Trust (JNHT)) for their comments. Typically, this depends on the nature of the project.

As deemed necessary by the NRCA, Public Meeting(s) are then held, following the deposition of the Draft EIA at Parish Libraries (by the NRCA). A verbatim report of the public meetings is required, as well as a summary report of the main stakeholder responses which emerged. The comments of the NRCA, the other GOJ interests and the public are compiled and submitted in writing to the consultant not only for finalisation of the report, but for incorporation into the development's design. The NRCA then reviews this report again, and if further clarifications are needed, these are again requested. Once the NRCA is satisfied, the EIA is submitted to the Technical Committee of the NRCA Board for final approval. If the EIA is not approved, the proponents may appeal to the Office of the Prime Minister.

3.2 NATIONAL LEGISLATION

3.2.1 Development Control and Planning

3.2.1.1 Town and Country Planning Act (TCP Act), 1957

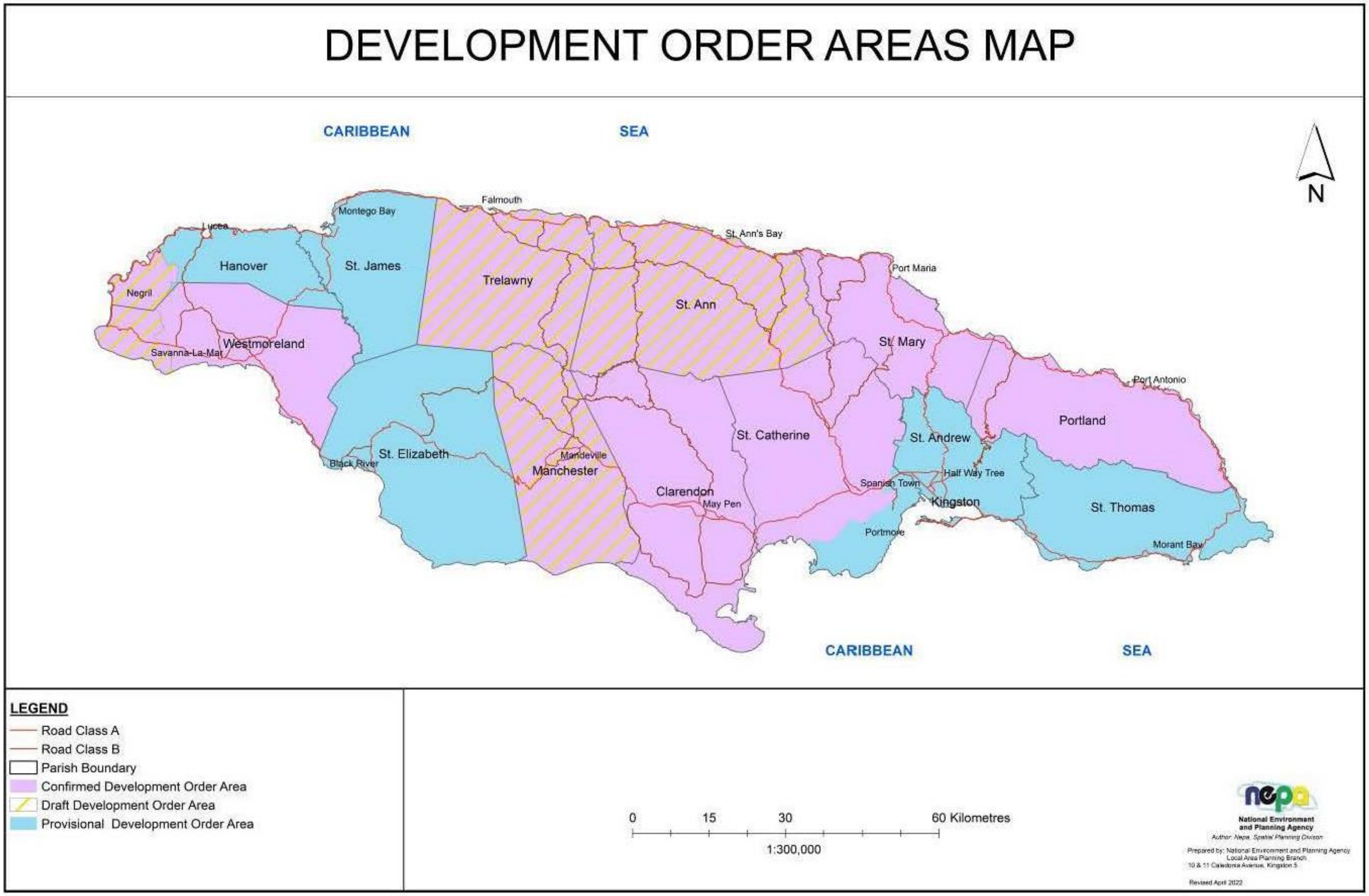
The Town and Country Planning Act (TCP Act) 1957 provides the statutory requirements for the orderly development of land through planning, as well as guidelines for the preparation of Development Orders. A Development Order is a legal document which is used to guide development in the area to which it applies, and the TCP Act is only applicable in an area where a Development Order exists. It constitutes land use zoning map/s, policy statements and standards relating to land use activities. Tree Preservation Areas and Conservation Areas (as specified areas the gazetted Development Orders) are two types of protected areas associated this Act. Matters addressed in the order include: Roads; Buildings and other structures; Community Planning; Amenities; Public Services; Transportation and Communications; and Miscellaneous.

The Town and Country Planning Act also establishes the Town and Country Planning Authority, which in conjunction with the Local Planning Authorities (LPAs), also referred to as Municipal Corporations, are responsible for land use zoning and planning regulations as described in their local Development Orders (Figure 3-1).

The local planning authority for this project is the **St. Ann Municipal Corporation** and the proposed project falls within **The Town and Country Planning (St. Ann Parish) Confirmed Development Order 2000.** Several policies pertaining to new developments in the parish are outlined within this order, as well as three objectives relating to the tourism sector:

- Obj. 15: To transform small towns and villages into centres of vitality and interest through the integration of tourism development thereby creating a broader economic base.
- Obj. 16: To diversify the type of Tourist facilities and attractions offered.
- Obj. 17: To transform resort areas into more interactive communities this deemphasizing the clear demarcating line between Tourist facilities and local facilities.

The St. Ann's Bay Local Planning Area is the closest local planning area in proximity to the site. The order states that a potential for growth in the tourism industry in the St. Ann's Bay area is noted, though careful control will be required to avoid problems created by unbridled growth and overdependence on one sector. Section 5.6.5.4 provides further details.



Source: NEPA

Figure 3-1 Development Order Areas in Jamaica

3.2.1.2 Building Act 2016

The Building Act 2016 repeals the Kingston and St. Andrew Building Act and the Parish Councils Building Act and makes new provisions for the regulation of the building industry. It aims to facilitate the adoption and efficient application of national building standards (National Building Code of Jamaica) for ensuring safety in the built environment, enhancing amenities, and promoting sustainable development. A “building” is described as a domestic building, a public building, a building of the warehouse class and any other physical structure, whether a temporary structure or not, any part of the structure, and any architectural or engineering product or work erected or constructed on, over or under land or the sea or other body of water.

For the purposes of this Act, the KSAC (for the parishes of Kingston and St. Andrew), the Parish Council (any other parish) and the Municipal Council (for the Municipality) is designated as the Local Building Authority for the respective area; in relation to this project, the St Ann Municipal Corporation is the local planning authority. A person who proposes to carry out building work must apply to the relevant Local Building Authority for the appropriate building permit. A person shall not carry out any building work unless the respective building permit has been issued; where applicable, a planning permit has been issued under the Town and Country Planning Act; and the work is carried out in accordance with the building permit, the provisions of this Act, the National Building Code, or of any other regulations made under this Act.

3.2.1.3 Local Governance Act 2016

This Act is a consolidation of the following existing Acts, which were repealed once the new legislation was enacted:

- The Parish Councils Act (1887)
- The Kingston and St. Andrew Corporation Act (1923)
- The Municipalities Act (2003)
- The Parochial Elections (Modifications) Act (1979)

This Act introduces new concepts and tenets which reflect a modern approach to local governance, and which strengthen local self-management. Local Authorities (formerly referred to as Parish Councils) are categorised as Municipal Corporations and City Municipalities or Town Municipalities. The **St Ann Municipal Corporation** is the Local Authority with responsibility for development within the study area.

3.2.1.4 Beach Control Act 1956 and the Beach Control (Amendment) Act 2004

This Act was passed in 1956 to ensure the proper management of Jamaica’s coastal and marine resources by means of a licensing system. This system regulates the use of the foreshore and the floor of the sea. In addition, the Act speaks to other issues including access to the shoreline, rights related to fishing and public recreation and establishment of marine protected areas. Under section 5 of this act, it is an offence to encroach on the foreshore or floor of the sea for a public or commercial purpose without a licence.

The Beach Control (Licensing) Regulations 1956 require a permit for any works on a beach, coastline or foreshore. Application for this permit must be made to NEPA. The requirements of the permit include a Notice of Application to be posted on the landward and seaward sides of the property and said Notice should be served on adjoining neighbours. Member of the Natural Resources Conservation Authority or any officer authorised by the Authority may conduct investigations to ensure compliance with licence and require information to be furnished. An application will be made to NEPA for BCA Licence for use of the foreshore and floor of the sea for commercial/recreational activities.

3.2.1.5 Overwater Structure Planning Guidelines, 2016

The decision to develop planning guidelines on overwater structures was made in recognition of the growing interest in developing overwater rooms in the tourism sector in Jamaica. The scope of this document is limited to the establishment of overwater structures in commercial, tourism resorts and the establishment of structures related to navigation such as docks, jetties, piers, wharfs, and encroachments such as groynes should be guided by the Beach Control Act.

The following statements have been developed to guide the development of overwater structures

a. The development of overwater structures **will not be permitted** in the following areas:
    - Areas within 100m of a coral reef.
    - Declared public bathing and fishing beaches
    - Fish sanctuaries
    - Marine protected areas
    - Navigational channels
    - Within 100m of river mouths and drainage features
    - Areas within 30 m of mangroves and riparian forest
    - Exposed and high energy coastline
    - Within 30m of underwater infrastructure e.g., cables and pipelines
    - Proposed development areas with 30% or more of seagrass coverage
b. All potential developments will require an Environmental Impact Assessment. The Terms of Reference of the EIA will address concerns specific to the development and must be approved by NEPA.
c. The developer of any overwater structure must obtain the necessary licence and permit from the NRCA before proceeding with the development.
d. All overwater structures will be required to conform to the environmental standards for the prevention of pollution.
e. A performance bond will be required for companies or persons permitted/licensed to construct an overwater structure. The performance bond seeks to ensure compliance with the terms of the permit/licence including environmental management, monitoring and decommissioning.
f. Only persons owning (titled) or in possession of development rights of the adjoining lands to the foreshore and floor of the sea shall be permitted to construct overwater structures.

g. All developments on the seafront property will be required to leave as land reservation an area of usable land, which may include open space, equivalent to or larger than the area of the footprint of the overwater structures to be located along the coastline of the property.
h. The permitting agency will apply a policy of no-net-loss of critical habitats, such as, but not limited to riparian and littoral forests, fringing mangroves, corals, and sea-grass beds.
i. Only a maximum of 20% of the total length of sea frontage will be permitted for overwater structures; and the footprint of the overwater structures area shall not exceed 10% of the developer's property.
j. The location of an overwater structure must not conflict with zoning objectives, Conservation Management Plans, or other management measures within a zoned area.
k. No person will be allowed ownership of the land (seabed) where overwater structures are being constructed but would be permitted to have long-term leases or concessions.
l. The Commissioner of Lands will negotiate the terms of the lease and determine the annual and other fees to be paid for the lease of the floor of the sea contingent upon obtaining a permit/licence from NEPA.
m. All overwater structures are to be of "Green Buildings" standard of Passive Climatic Design.
n. The design and outlay of the overwater structure must be such that it blends with the natural surroundings and maintains as much as possible a tropical look.
o. All facilities are encouraged to use renewable energy sources.
p. Public access to the licensed area for legitimate purposes and during emergency situations shall be permitted and accounted for as a condition of the licence.

General guidelines for the development of overwater structures intended to provide guidance for the project proponent are also listed in this draft document. In addition, it is stated that detailed and specific conditions and guidelines will be provided on a case-by-case basis as part of the licence/permit process. These guidelines, while being flexible, are intended to ensure that the natural ecological processes are not unduly disrupted and that marine resources are protected from construction-related activities.

3.2.1.6 NRCA Guidelines for the Planning, Construction and Maintenance of Facilities for Enhancement and Protection of Shorelines

This document offers guidance on the NRCA permitting process, the environmental aspects, and the coastal engineering planning and design of projects conceived for the protection and enhancement of shorelines. With such guidance., it is intended that the undesirable environmental impacts that these types of projects can cause will be eliminated or mitigated.

Under the *Permitting Procedures* section, it is stated that certain types of activities in the coastal zone give rise to particular effects, and therefore it is important for all concerned to be aware of the particular types of negative effects that are likely to arise from a given type of project. Project Sponsors are therefore encouraged to make contact with NRCA (NEPA) from the very earliest stages of project planning.

3.2.1.7 Office of Disaster Preparedness and Emergency Management Act 1998

This Act established the Office of Disaster Preparedness and Emergency Management (ODPEM). The ODPEM's main responsibility is to develop and implement policy and programmes to achieve and maintain an appropriate state of national and sectoral preparedness for coping with emergency situations. The proposed project should ensure that it collaborates with this agency in the preparation of the appropriate emergency response plans in relation to natural hazard events such as hurricanes.

3.2.1.8 Tourist Board (Water Sports) Regulations 1985

These regulations govern the operation and conduct of water sports, which will be applicable to the proposed hotel development once in operation. Three categories of water sports are addressed: SCUBA diving; parasailing & water skiing, and jet-skiing; and sunfish sailing and board sailing. Rules are provided, among other things, for licensing of water sports operations and inspections.

3.2.2 Environmental Conservation

3.2.2.1 Protected Areas System Master Plan: Jamaica 2013 – 2017

The Protected Areas System Master Plan (PASMP) sets out guidelines for establishing and managing a comprehensive system of protected areas that supports national development by contributing to long-term ecological viability; maintaining ecological processes and systems; and protecting the country's natural and cultural heritage (National Environment and Planning Agency, n.d.). The PASMP is consistent with several national policies and plans, including the Policy for Jamaica's System of Protected Areas 1997, the National Strategy and Action Plan on Biological Diversity in Jamaica (2003) and Vision 2030 Jamaica: National Development Plan (2009). It is also a requirement under the Convention for Biological Diversity's (CBD's) Programme of Work for Protected Areas (PoWPA).

Existing protected area categories in Jamaica are listed in Table 3-1, Table 3-2 and Table 3-3. The NRCA/NEPA is responsible for areas declared/designated under the acts it administers, including the Wild Life Protection and Natural Resources Conservation Authority Acts. In addition, a number of other government entities (such as the Forestry Department, Fisheries Division and Jamaica National Heritage Trust), local management entities, non-governmental entities, private sector and individuals are outlined as important role players as well. Indeed, responsibility for protected area management has been a shared endeavour and this collaborative approach to protected area management will continue under the PASMP (National Environment and Planning Agency, n.d.).

No protected area is located within the project area; the closest area is the Ocho Rios Marine Park Protected Area, whose western boundary is found about 5.5km east of the project site (Figure 3-2 and Figure 3-3).

Table 3-1 Existing categories of protected areas in Jamaica (January 2012) - protected area system categories

Source: (National Environment and Planning Agency, n.d.)

CATEGORY	RESPONSIBLE AGENCY	LAW
Protected Area	Forestry Department: Ministry of Economic Growth and Job Creation (MEGJC).	Forest Act, 1996 and Forest Regulations
	National Environment and Planning Agency (NEPA): MEGJC	NRCA Act, 1991
	NEPA: MEGJC	Beach Control Act, 1956
National Park	NEPA: MEGJC	NRCA Act, 1991
Marine Park	NEPA: MEGJC	NRCA Act, 1991
Environmental Protection Area	NEPA: MEGJC	NRCA Act, 1996
Forest Reserve	Forestry Department: MEGJC	Forest Act, 1996 and Forest Regulations
Special Fishery Conservation Area	Fisheries Division: Ministry of Industry, Commerce, Agriculture and Fisheries (MICAF)	Fisheries Act, 2018
National Monument	Jamaica National Heritage Trust (JNHT) Ministry of Youth and Culture (MYC)	JNHT Act, 1985
Protected National Heritage	JNHT: MYC	JNHT Act, 1985
Game Sanctuary	NEPA (NRCA): MEGJC	Wildlife Protection Act, 1945
Game Reserve	NEPA (NRCA): MEGJC	Wildlife Protection Act, 1945

Table 3-2 Existing categories of protected areas in Jamaica (as at 1 January 2012) - other designations not considered part of the system

Source: (National Environment and Planning Agency, n.d.)

CATEGORY	RESPONSIBLE AGENCY	LAW
Tree Order Preservation	Local Authority (Town and Country Planning Authority): MEGJC and Local Government Department, through Local Authorities	Town and Country Planning Act, 1958
Conservation Area	NEPA (Town and Country Planning Authority, Local Authorities): MEGJC	Town and Country Planning Act, 1958
Protected Watershed	NEPA (NRCA): MEGJC	Watershed Act, 1963 Protection

Table 3-3 Existing categories of protected areas in Jamaica (January 2012) - international designations

Source: (National Environment and Planning Agency, n.d.)

CATEGORY	RESPONSIBLE AGENCY	CONVENTION
Ramsar Site	NEPA (NRCA): MEGJC	Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)
World Heritage Site (no existing sites, however submissions have been made)	Jamaica National Heritage Trust: MYC	World Heritage Convention

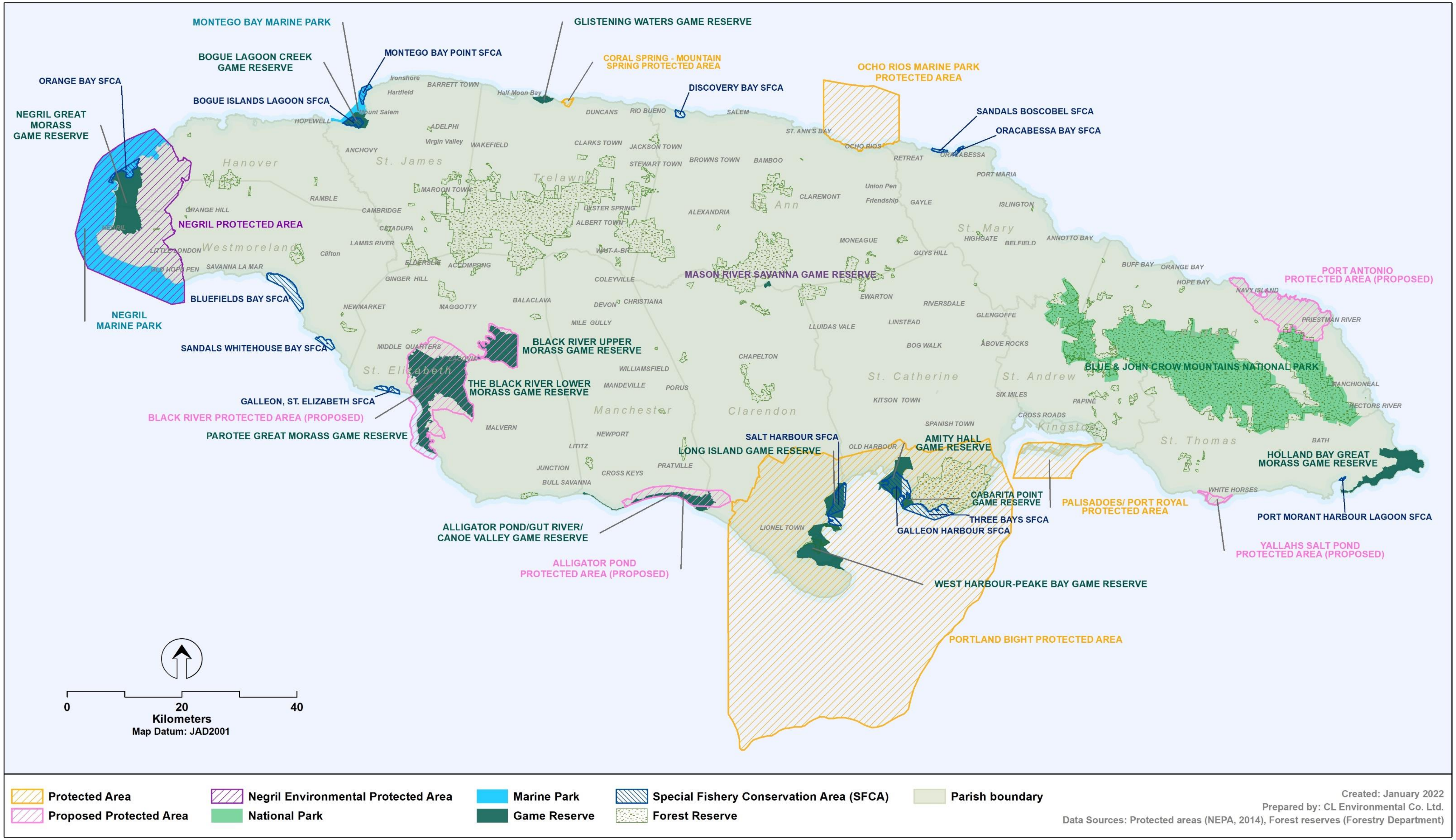
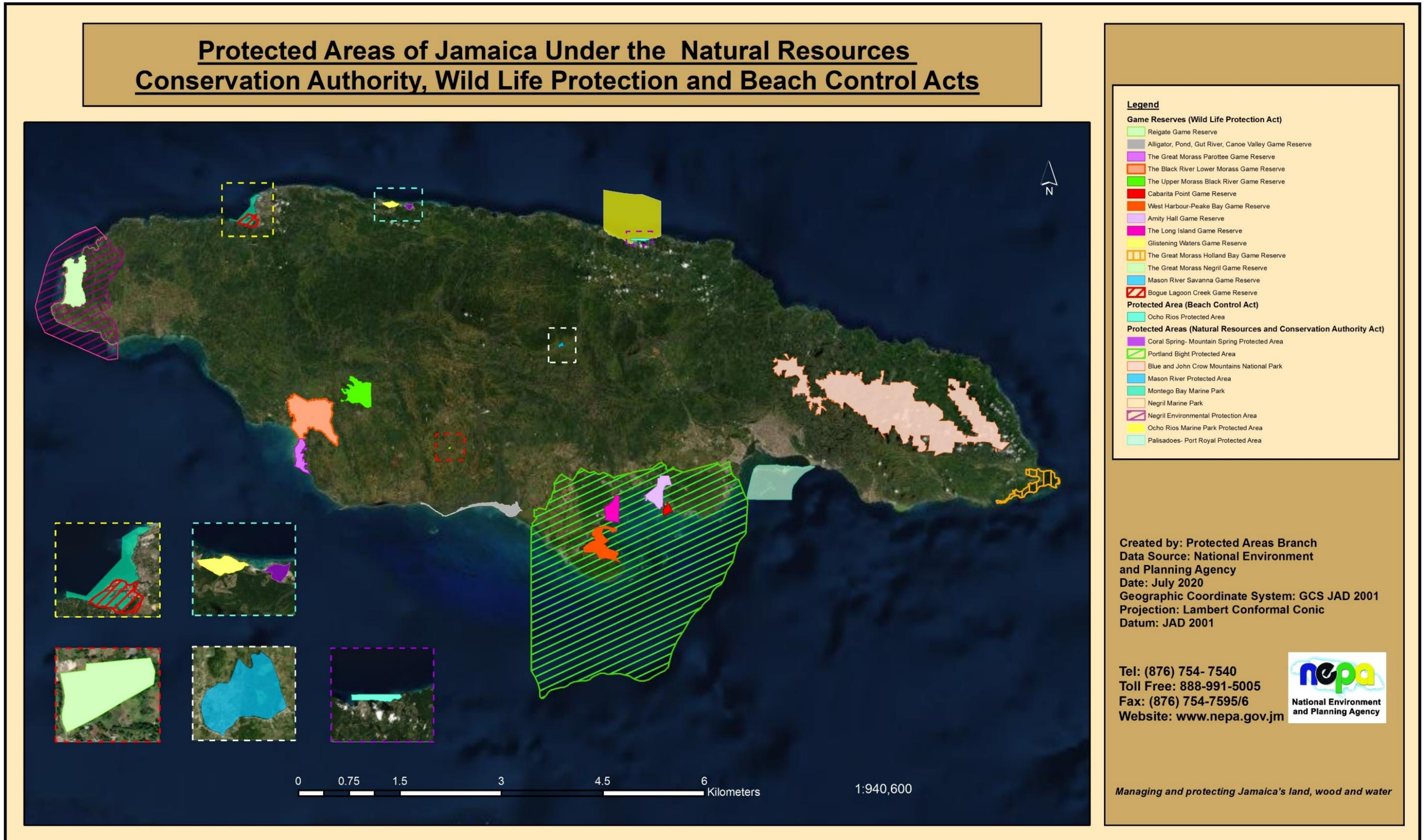


Figure 3-2 Areas protected under various Jamaican legislation including existing and proposed protected areas, national parks, marine parks, game reserves, forest reserves and Special Fishery Conservation Areas



Source: National Environment and Planning Agency, 2020

Figure 3-3 Protected areas of Jamaica under the Natural Resources Conservation Authority, Wildlife Protection and Beach Control Acts

3.2.2.2 Natural Resources Conservation Authority Act 1991

The Natural Resources Conservation Authority Act (NRCA) is considered Jamaica's umbrella environmental law and is the main environmental legislation that relates to the proposed project. This Act establishes the Natural Resources Conservation Authority (NRCA) with primary responsibility for ensuring sustainable development through the protection and management of the country's natural resources and the control of pollution. This is done mainly through an environmental permit and licence system. The Act empowers the Authority to:

- Issue permits to the person responsible for undertaking any enterprise, construction or development of a prescribed category in a prescribed area [Section 9]. This section, the Prescribed Area Order, designates all of Jamaica as being within the prescribed area.
- Issue licences for discharge of trade or sewage effluent or for construction or modification of any works for such discharge [Section 12 (1) (a) and (b)]; • request information or documents as the Authority thinks fit [Section 10 (1) (a)].
- Request an environmental impact assessment containing such information as may be prescribed [Section 10 (1) (b)].
- Request information on pollution control facilities [Section 17]; and
- Revoke or suspend permits.

The Act also gave power of enforcement of a number of environmental laws to the NRCA, namely the *Beach Control Act*, *Watershed Act* and the *Wildlife Protection Act*, as well as a number of regulations and orders including:

- *The Natural Resources (Permit and Licences) Regulations 1996 and* (Amendment) Regulations *2015;*
- *Natural Resources (National Parks) Regulations 1993 and (Amendment) Regulations 2003;*
- *The Natural Resources (Marine Parks) Regulations 1992, (Amendment) Regulations 2003,* and *(Amendment) Regulations, 2015;*
- *The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order 1996* and *(Amendment) Order 2015; and*
- *The Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013.*

Natural Resources Conservation (Permit and Licences) Regulations 1996 and (Amendment) Regulations 2015

A permit and licencing system was established under these regulations to control the undertaking of any new construction or development of a prescribed nature in Jamaica and the handling of sewage or trade effluent and poisonous or harmful substances discharged into the environment.

Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order 1996 and (Amendment) Order 2015

The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order (1996) and the Permits & Licensing Regulations was passed because of section 9 of the NRCA Act. Section 9 of the NRCA Act declare the entire island and the territorial sea as a 'prescribed area', in which specified activities require a permit, and for which activities an environmental impact assessment may be required. The major amendment made in 2015 was the substitution of the Categories of Enterprises, Construction and Development (Column A), which lists the various activities, by category, for which a permit is required.

Natural Resources Conservation (Wastewater and Sludge) Regulations 2013

These regulations cover the discharge of sewage effluent, and the operations, monitoring, and reporting mechanism of sewage treatment facilities. The Natural Resources Conservation (Wastewater and Sludge) Regulations 2013 was promulgated and has been in effect since 2013.

See section 3.2.3.1 for related water quality standards.

3.2.2.3 Wildlife Protection Act 1945 and Wildlife Protection (Amendment of Second and Third Schedules) Regulations 2016

The Wildlife Protection Act of 1945 is mainly concerned with the protection of specified faunal species and is the only statute in Jamaica specifically designated to this. This Act protects several rare and endangered faunal species, and the Wildlife Protection (Amendment of Second and Third Schedules) Regulations 2016 provides substitutions for the Second and Third Schedules of the principal Act which lists these species

The establishment of two types of protected areas, namely Game Sanctuaries and Game Reserves are authorized under this Act. A Game Sanctuary / Game Reserve is a parcel of land, body of water or area comprising both land and water within which, the hunting of animals (including birds) removal of eggs or the nest of any bird and the use or possession of any dog, gun, catapult, or any other weapon which could be used to hunt any animals or birds is prohibited. In addition, all Forest Reserves are also designated as Game Reserves and form part of the Protected Areas System of Jamaica.

This Act has undergone review particularly around increased fines and the number of animals having a protected status. Further amendments are being undertaken to address a variety of issues relating to the management and conservation of these natural resources, and the inclusion of flora. It prohibits the removal, sale or possession of protected animals, the use of dynamite, poisons, or other noxious material to kill or injure fish, and it prohibits discharge of trade effluent or industrial waste into harbours, lagoons, estuaries, and streams. Protected under the Wildlife Protection Act, *inter alia*, are six species of sea turtles.

Section 5.2.3 provides a detailed account of the fauna found at the proposed site. A summary of those species considered rare, endangered or under protection are as follows:

- Two resident endemic bird species, and similarly two bird species with special designated status by the IUCN: White-crowned Pigeon (*Patagioenas leucocephala*) and Jamaican Parakeet (*Eupsittula nana*) are both classified as near threatened species.

- One endemic amphibian, *Eleutherodactylus gossei*. No amphibians of special conservation status were identified.
- Three endemic tree lizards.
- Four old turtle nests were observed on the beach on the site. The Hawksbill (*Eretmochelys imbricata*), Critically Endangered, IUCN Redlist Status, is the species regularly seen in the parish.
- Two endemic butterfly subspecies. None of the butterfly species identified is of any special conservation needs.
- No arthropod or bat species of special conservation status designated by the IUCN.

3.2.2.4 Endangered Species (Protection, Conservation and Regulation of Trade) Act 2000 and (Amendment of First, Second and Third Schedules) Order 2021

The Endangered Species (Protection, Conservation and Regulation of Trade) Act was created in 2000 to ensure the codification of Jamaica's obligations under the Convention for the International Trade in Endangered Species of Wild Fauna and Flora. This Act governs international and domestic trade in endangered species in and from Jamaica and generally provides for the conservation and management of endangered fauna and flora.

The regulations associated with Endangered Species (Protection, Conservation and Regulation of Trade) Act were most recently amended in 2021. This included revised listings of endangered species threatened with extinction, species which could become extinct, or which have to be effectively controlled, and species which any contracting Party regulates within its own jurisdiction for the purpose of preventing or restricting over-exploitation and require the cooperation of other Parties for the control of trade in such species.

In addition to the summarised list of faunal species considered rare, endangered or under protection outlined in section 3.2.2.3, there is one endemic plant species, Swamp Cabbage (*Roystonea princeps*). However, none of the floral species encountered at the site is deemed to have any special conservation status. See section 5.2 for further detail of the flora and fauna found at the proposed site.

3.2.2.5 The Fisheries Act 2018

The Fisheries Act, 2018, is the overarching instrument relating to fishing activities within Jamaica. This Act repeals the previous Fishing Industry Act, 1975. The Fisheries Act, 2018 speaks to provision of efficient and effective management and sustainable development of fisheries, aquaculture, and other related activities in accordance with internationally recognized norms, standards, and best practices. The Fisheries Act, 2018 gives the Fisheries Division, of the Ministry of Industry, Commerce, Agriculture and Fisheries (MICAF), the responsibility for licensing fisher folk and fishing boats (whether for sport, recreation or commercial), creation and demarcation of Special Fishery Conservation Areas (formerly known as fish sanctuaries), protection of the various fisheries resources via establishment of closed seasons, and fines/penalties for illegal catching or selling of fish.

There are no SFCAs within five kilometres of the proposed project.

3.2.2.6 National Policy for the Conservation of Seagrasses 1996

This policy guides the issuing of licenses or permits for activities such as dredging, disposal of dredged material, beach development, and effluent disposal, which directly or indirectly affect seagrass communities.

3.2.2.7 Mangrove and Coastal Wetlands Protection - Draft Policy and Regulations 1996

This policy provides a review of the issues affecting wetlands in Jamaica as well as the Government's role and responsibility. Five main goals are outlined which include guidelines for wetlands development, cessation of destructive activities, maintenance of natural diversity, maintenance of wetland function and values and integration of wetland functions in planning and development.

The coastline at the study site is dominated by coastal vegetation, including mangrove areas to the northeast of the property. A detailed account of the mangrove species and communities found at site may be found in Section 5.2.2.2.

3.2.2.8 Coral Reef Protection and Preservation – Draft Policy and Regulations 1996

This document reviews the ecological and socio-economic functions of coral reefs, the issues affecting coral reefs, and the Government's role and responsibility in their protection. Five main goals are outlined which include reduction of pollutants, reduction of overharvesting of reef fish, reduction of physical damage from recreational activities, improving the response capability to oil spills, and control of coastal zone developments.

Section 5.2.4 provides greater detail regarding the occurrence of coral reef at the project site.

3.2.2.9 Coastal Management and Beach Restoration Guidelines: Jamaica

These guidelines compliment Vision 2030 Jamaica and provide a tool for coastal stakeholders, including advice at the community level to ensure coastal management is undertaken in a sustainable way with consideration of wider impacts on the environment. Different management approaches are suggested for the coastline of Jamaica, which in turn influence the site-specific interventions considered appropriate. Progressive steps to follow from project inception through to design and obtaining planning permission for projects within the coastal zone are described. A number of design outcomes are required to be assessed to ensure that the intervention does not adversely affect the environment, is designed to be resilient and does not impact other sites along the coastal zone.

The adequacy of the governance structure and institutional base is considered a key aspect and the existence of national organisations with clear mandates, roles, responsibilities, and capacities is described as vital to the successful management of Jamaica's coastal resources.

3.2.2.10 Water Resources Act 1995

The Water Resources Act (1995) established the Water Resources Authority (WRA), which is authorized to regulate, allocate, conserve, and manage the water resources of the island. It is also responsible for water quality control and to provide technical assistance for any projects, programmes or activities relating to development, conservation, and the use of water resources.

Section 25 advises that a proposed user will need to obtain planning permission, if this is a requirement, under the Town and Country Planning Act. In addition, under Section 21 it states that if the water to be used will result in the discharge of effluents, an application for a license to discharge effluents will have to be made to the Natural Resources Conservation Authority or any other relevant body as indicated by the Minister.

3.2.2.11 The Jamaica National Heritage Trust Act 1985

The Jamaica National Heritage Trust Act established the Jamaica National Heritage Trust (JNHT) and has been in operation since 1985. The JNHT provides for protection of areas, structures, and objects of cultural significance to Jamaica by declaration of any structure as a national monument where preservation is of public interest due to historic, architectural, traditional, artistic, aesthetic, scientific or archaeological importance. This includes the floor of the sea within the territorial waters or the Exclusive Economic Zone.

Findings from an assessment of historical or archaeological sites undertaken by the JNHT for the purposes of this EIA is provided in section 5.4.

3.2.2.12 Towards an Ocean and Coastal Zone Management Policy in Jamaica 2000

The Council on Ocean and Coastal Zone Management was established in 1998, with responsibility of defining a national policy for Ocean and Coastal Zone Management. The aim of this policy document is to develop a policy that will "enhance the contribution of economic sectors to the integrated management of coastal areas by developing awareness in sector line agencies and resource users." The document recognises the extensive use and resulting degradation of coastal and ocean resources in Jamaica, including coral reefs, mangroves, and seagrass beds, as well as non-living resources such as sand.

3.2.3 Public Health & Waste Management

3.2.3.1 Water Quality Standards

The NRCA has primary responsibility for control of water pollution in Jamaica. National standards for ambient marine water and freshwater are shown in Table 3-4 and Table 3-5 respectively. For drinking water, World Health Organisation (WHO) standards are utilized, and these are regulated by the National Water Commission (NWC).

Table 3-4 Draft national ambient marine water quality standards for Jamaica, 2009

Source: National Environment and Planning Agency (NEPA)

Parameter	Measured as	Standard Range	Unit
Phosphate,	P*	0.001-0.003	mg/L
Nitrate,	N**	0.007-0.014	mg/L
BOD_5	O	0.0-1.16	mg/L
pH		8.00-8.40	
Total Coliform		2-256	MPN/100mL
Faecal Coliform		<2-13	MPN/100mL

*Reactive phosphorus as P
**Nitrates as Nitrogen

Table 3-5 Draft national ambient freshwater water quality standards for Jamaica, 2009

Source: National Environment and Planning Agency (NEPA)

Parameter	Measured as	Standard Range	Unit
Calcium	(Ca)	40.0-101.0	mg/L
Chloride	(Cl^-)	5.0- 20.0	mg/L
Magnesium	(Mg^{2+})	3.6- 27.0	mg/L
Nitrate	(NO_3^-)	0.1- 7.5	mg/L
Phosphate	(PO_4^{3-})	0.01 - 0.8	mg/L
Potassium	(K^+)	0.74- 5.0	mg/L
Silica	(SiO_2)	5.0- 39.0	mg/L
Sodium	(Na^+)	4.5- 12.0	mg/L
Sulfate	(SO_4^{2-})	3.0- 10.0	mg/L
Hardness	($CaCO_3$)	127.0-381.0	mg/L (as $CaCO_3$
Biochemical Oxygen Demand	(O)	0.8- 1.7	mg/L
Total Dissolved Solids		120.0-300	mg/L
pH		7.00- 8.40	
Conductivity		150.0-600	µS/cm

Standards for industrial (trade effluent) and sewage discharge into rivers and streams are stipulated within the Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013 (Table 3-6, Table 3-8 and Table 3-9).

Table 3-6 Sewage Effluent Standards for existing plants

PARAMETER	EFFLUENT LIMIT
BOD_5	20 mg/L
TSS	30 mg/L
Nitrates (as Nitrogen)	30 mg/L
Phospates	10 mg/L
COD	100 mg/L
pH	6-9 pH units
Faecal Coliform	1000 MPN/100 ml
Residual Chlorine	1.5 mg/L

Table 3-7 Sewage Effluent Standards for plants other than existing plants

Parameter	Effluent Limit
BOD_5	20 mg/L
TSS	20 mg/L
Total Nitrogen	10 mg/L
Phosphates (PO4-P)	4 mg/L
COD	100 mg/L
pH	6-9 pH
Faecal Coliform	200 MPN/100mL
Residual Chlorine	1.5 mg/L
Floatables	not visible

Table 3-8 Sewage Effluent Standards for use in Irrigation

Parameter	Effluent Limit
Oil and Grease	10 mg/L
Total Suspended Solids (TSS)	15 mg/L
Residual Chlorine	0.5 mg/L
Biochemical Oxygen Demand (BOD_5)	15 mg/L
Chemical Oxygen Demand (COD)	<100 mg/L
Faecal Coliform	12 MPN/100mL

Table 3-9 Industrial Trade Effluent Standards

Table 3—*Trade Effluent Standards*

PARAMETER	TRADE EFFLUENT LIMIT
Ammonia/ammonium measured as NH_4	1.0 mg/L
Barium	5.0 mg/L
Beryllium	0.5 mg/L
Biological oxygen demand (BOD)	<30 mg/L
Boron	5.0 mg/L
Calcium	No standard
Chemical Oxygen Demand (COD)	<100mg/L or <0.01 kg/1000 kg product
Chloride	300 mg/L
Colour	100 TCU
Cyanide (free)	0.1 mg/L
Cyanide (Total as CN)	0.2 mg/L
Detergent	15 mg/L
Dissolved oxygen (DO)	>4mg/L
Faecal Coliform	<100 MPN/100 ml
Fluoride	3.0 mg/L
Iron	3.0 mg/L
Magnesium	No standard
Manganese	1.0 mg/L
Nitrate as NO_3	10 mg/L
Oil and Grease	10 mg/L or < 0.01 kg/1000 kg product
PH	6.5 - 8.5
Phenols	0.1 mg/L
Phosphate as PO_4	5 mg/L
Sodium	100 mg/L
Sulphate	250 mg/L
Sulphide	0.2 mg/L
Temperature	±2° of ambient
Total Coliform	<500 MPN/100 ml
Total Dissolved Solids (TDS)	1000 mg/L
Total Organic Carbon (TOC)	100 mg/L
Total Suspended Solids (TSS) (maximum monthly average)	50 mg/L
Total Suspended Solids (TSS) maximum daily average	<150mg/L
PARAMETER	TRADE EFFLUENT LIMIT
Trace Metals:	
Zinc	1.5 mg/L
Lead	0.1 mg/L
Cadmium	0.1 mg/L
Arsenic	0.5 mg/L
Chromium	1.0 mg/L
Copper	0.1 mg/L
Mercury	0.02 mg/L
Nickel	1.0 mg/L
Selenium	0.5 mg/L
Silver	0.1 mg/L
Tin	No standard
Total Heavy Metals	2.0 mg/L

3.2.3.2 Noise Abatement Act 1997

The Noise Abatement Act of 1997 was created in order to regulate noise caused by amplified sound and other specified equipment. This act has been said to address "some concerns but is too narrow in scope and relies on a subjective criterion" (McTavish). Given this, McTavish conducted a study to recommend wider and more objective criteria in accordance with international trends and standards but tailored to Jamaica's conditions and culture.

National guidelines (NRCA) used for noise levels are an adaptation from the Jamaica's National Noise Standards, 1999 and are shown in Table 3-10; values for commercial, industrial and residential areas are specified.

Table 3-10 NRCA guidelines for daytime and night-time noise in various zones

ZONE	NRCA Daytime Guideline (dBA)	NRCA Night-time Guideline (dBA)
Commercial	65	60
Industrial	75	70
Residential	55	50

3.2.3.3 The Natural Resources Conservation Authority (Air Quality) Regulations 2006

Under section 38 of the NRCA Act, regulations pertaining to air quality in Jamaica are stipulated. The National standards, known as the National Ambient Air Quality Standards (NAAQS) are categorized into two groups. Part I of the NRCA Air Quality Regulations (2006) instructs on license requirements and indicates that every owner of a major or significant facility shall apply for an air pollutant discharge license. Part II makes reference to the stack emission targets, standards and guidelines.

According to the Natural Resources Conservation Authority (Air Quality) Regulations, 2006, a "significant air quality impact", means:

(a) the increment in the predicted average concentration of sulphur dioxide (SO_2), total suspended particulates (TSP), particulate matter less than ten microns (PM_{10}) or nitrogen dioxide (NO_2) is greater than an annual average of 20 μg/m^3 or a 24-hour average concentration of 80 μg/m^3; or
(b) the increment in the predicted average concentration of CO is greater than 500 μg/m^3 as an 8-hour average or 2000 μg/m^3 as a 1-hour average.

Table 3-11 summarizes the Significant Impact Concentrations and the Jamaican National Ambient Air Quality Standards (JNAAQS) and Guideline Concentrations (GC).

Table 3-11 Significant Impact Concentrations and the Jamaican National Ambient Air Quality Standards (JNAAQS) and Guideline Concentrations (GC) for air quality

Pollutant	Avg. Period	Significant Impact Concentration (μg/m^3)	Jamaican NAAQS or GC (μg/m^3)
PM_{10}	24-hr	80	150
	Annual	20	50
TSP	24-hr	80	150
	Annual	20	60
NO_2	1-hr	N/A	400

Pollutant	Avg. Period	Significant Impact Concentration (µg/m³)	Jamaican NAAQS or GC (µg/m³)
	24-hr	80	N/A
	Annual	20	100
SO_2	1-hr	N/A	700
	24-hr	80	280
	Annual	20	60
CO	1-hr	2000	40000
	8-hr	500	10000
1,3 Butadiene	1-hr	N/A	0.04
Acetaldehyde	1-hr	N/A	1250
	24-hr	N/A	500
Acrolein	1-hr	N/A	58.75
	24-hr	N/A	23.5
Benzene	Annual	N/A	1
Benzo (a) pyrene	1-hr	N/A	0.00275
	24-hr	N/A	0.0011
Carbon Tetrachloride	1-hr	N/A	6
	24-hr	N/A	2.4
Chloroform	1-hr	N/A	1250
	24-hr	N/A	500
Ethylene Dibromide	1-hr	N/A	7.5
	24-hr	N/A	3
Formaldehyde	1-hr	N/A	162.5
	24-hr	N/A	65
Methylene Chloride	1-hr	N/A	550
	24-hr	N/A	220
Styrene	1-hr	N/A	2500
	24-hr	N/A	1000
Xylenes	1-hr	N/A	5750
	24-hr	N/A	2300
Vinyl Chloride	24-hr	N/A	1
	Annual	N/A	0.2
Arsenic	1-hr	N/A	0.75
	24-hr	N/A	0.3
Beryllium	Annual	N/A	0.0013
Cadmium	1-hr	N/A	5
	24-hr	N/A	2
Chromium	1-hr	N/A	3.75
	24-hr	N/A	1.5
Cobalt	24-hr	N/A	0.12
Copper	1-hr	N/A	125
	24-hr	N/A	50
Lead	1-month	N/A	N/A
	3-month	N/A	2
Manganese	Annual	N/A	119
Mercury	1-hr	N/A	5
	24-hr	N/A	2
Nickel	1-hr	N/A	5
	24-hr	N/A	2
Selenium	24-hr	N/A	25
	Annual	N/A	10
Zinc	24-hr	N/A	12

In 1987, U.S. Environmental Protection Agency replaced TSP with PM_{10} as the indicator for both the annual and 24-hour health-related standards. The reason for this is because exposure to PM_{10} particles may cause serious health/respiratory related issues as these particles are retained deep in the lungs. The 24-hour NEPA standards for PM_{10} are shown in Table 1 4. However, the 24-hour US EPA standards are used for $PM_{2.5}$ and TSP:

- TSP = 150 μg/m^3
- $PM_{2.5}$ = 35 μg/m^3

3.2.3.4 The Clean Air Act 1964

The Clean Air Act (1964) refers to premises on which there are industrial works, the operation of which is, in the opinion of an inspector, likely to result in the discharge of smoke, fumes, gases or dust in the air. An inspector may enter any affected premises to examine, make enquiries, conduct tests, and take samples of any substance, smoke, fumes, gas or dust that may be considered necessary or proper for the performance of his/her duties.

3.2.3.5 Public Health Act 1985

The Public Health Act is administered by the Ministry of Health through Local Boards, namely the Municipal Corporations. *The Public Health (Nuisance) Regulations 1995* aims to, control reduce or prevent air, soil, and water pollution in all forms. Under the regulations:

- No individual or organisation is allowed to emit, deposit, issue or discharge into the environment from any source;
- Whoever is responsible for the accidental presence in the environment of any contaminant must advise the Environmental Control Division of the Ministry of Health and Environmental Control, without delay;
- Any person or organisation that conducts activities which release air contaminants such as dust and other particulates is required to institute measures to reduce or eliminate the presence of such contaminants; and
- No industrial waste should be discharged into any water body, which will result in the deterioration of the quality of the water.

3.2.3.6 Public Health Act (Air, Soil and Water Pollution) Regulations 1976

Under the ambit of this act, the Environmental Health Unit, Ministry of Health, is required to review the design and plans for sewage treatment.

3.2.3.7 The National Solid Waste Management Authority Act 2001

The National Solid Waste Management Authority Act of 2001 is “an act to provide for the regulation and management of solid waste; to establish a body to be called the National Solid Waste Management Authority and for matters connected therewith or incidental thereto”. The National Solid Waste Management Authority (NSWMA) was established in April 2002 as a result of this Act to effectively manage and regulate the collection and disposal of solid waste in Jamaica, in order to safeguard public health, ensure that waste is collected, sorted, transported, recycled, reused, or disposed of, in an environmentally sound manner and to promote safety standards in relation to such waste. The SWMA also has responsibility for the promotion of public awareness of the importance of efficient solid waste management, to advise the Minister on matters of general policy and to perform other functions pertaining to solid waste management. Under the Act, solid waste can only be placed at an approved or designated site. The designated site for the western Jamaica is at Retirement, St James.

3.3 REGIONAL AND INTERNATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS

3.3.1 United Nations Convention on Biological Diversity

Signed by 150 government leaders at the 1992 Rio Earth Summit, the Convention on Biological Diversity (CBD) is committed to promoting sustainable development. The CBD is regarded as a means of translating the principles of Agenda 21 into reality and recognizes that “biological diversity is about more than plants, animals and microorganisms and their ecosystems – it is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live”.

Jamaica became a party to the CBD on April 6, 1995. Jamaica’s Green Paper Number 3/01, ‘Towards a National Strategy and Action Plan on Biological Diversity in Jamaica’, is evidence of Jamaica’s continuing commitment to its obligations as a signatory to the Convention.

3.3.2 Convention on Wetlands of International Importance especially as Waterfowl Habitat, "Ramsar Convention" 1971

The Ramsar Convention is an intergovernmental treaty that focuses on maintaining ecological wetland systems and planning for sustainable use of their resources. It was adopted on 2 February 1971 in Ramsar, Iran. The mission of the Convention was adopted by the Parties in 1999 and revised in 2005 - "the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". Under Article 2.2 it is stated:

> Wetlands should be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology” and indicates that “in the first instance, wetlands of international importance to waterfowl at any season should be included.

Jamaica became a contracting party on 7 February 1998 and has 4 sites covering a combined total of 37,847 hectares (378.47 km^2).

3.3.3 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES generally seeks to protect endangered plants and animals and owing to the cross-boundary nature of animals and plants. This protection requires international cooperation. It aims to ensure that international trade of wild animal and plant species does not threaten the survival of the species in the wild, and it accords varying degrees of protection to over 35,000 species.

This convention was drafted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN) and finalised in 1973. After being opened for signatures in 1973, CITES entered into force on 1 July 1975. Jamaica became a Party to CITES on June 22, 1997. In 2000, Jamaica enacted domestic legislation, the Endangered Species (Protection, Conservation and Regulation of Trade) Act, 2000 and Regulations to fulfil its obligations to CITES. The Management Authority for CITES in Jamaica is the Natural Resources Conservation Authority (NRCA). The Authority receives applications for permits and certificates to trade internationally in endangered species. The processing of applications is coordinated with the local Scientific Authority.

3.3.4 Cartagena Convention (Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region), 1983

Adopted in March 1983 in Cartagena, Colombia, the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, more commonly referred to as the Cartagena Convention, is the sole legally binding environmental treaty for the Wider Caribbean. The Convention came into force in October 1996 as a legal instrument for the implementation of the Caribbean Action Plan and represents a commitment by the participating countries to protect, develop and manage their common waters individually and jointly. The Convention is currently supported by three Protocols as follows:

- *The Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region* (The Oil Spills Protocol), which was adopted and entered into force at the same time as the Cartagena Convention;
- *The Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region* (The SPAW Protocol), which was adopted in two stages, the text in January 1990 and its Annexes in June 1991. The Protocol entered into force in 2000;
- *The Protocol Concerning Pollution from Land-based Sources and Activities in the Wider Caribbean Region* (LBS Protocol), which was adopted in October 1999.

3.3.5 United Nations Convention on the Law of the Sea (UNCLOS III) 1982

The United Nations Convention on the Law of the Sea (UNCLOS), also referred to as the Law of the Sea Convention and the Law of the Sea treaty, defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources. UNCLOS III supersedes the Convention on the Territorial Sea and the Contiguous Zone (entered into force on 10 September 1964), as well as the Convention on the Continental Shelf (entered into force 10 June 1964), and both agreed upon at the first United Nations Convention on the Law of the Sea (UNCLOS I). Jamaica was the fourth country to ratify the UNCLOS III of 10 December 1982 on 21st March 1983. As of August 2013, 166 countries have joined in the Convention.

3.3.6 Convention on Fishing and Conservation of the Living Resources of the High Seas 1958

This convention considers that the development of modern techniques for the exploitation of the living resources of the sea has increased man's ability to meet the need of the world's expanding population for food and has exposed some of these resources to the danger of being over-exploited. It was done at Geneva on 29 April 1958.

3.3.7 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter

This instrument was adopted at the Inter-Governmental Conference on the Convention on the Dumping of Wastes at Sea, in London, United Kingdom in November 1972 and is commonly known as the London Convention. The London Convention, one of the first international conventions for the protection of the marine environment from human activities, came into force on 30 August 1975. Since 1977, it has been administered by the International Maritime Organization (IMO).

The London Convention prohibits the dumping of certain hazardous materials and specifies that a special permit is required prior to dumping of a number of identified materials and a general permit for other wastes or matter. In 1996, Parties adopted a Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (known as the London Protocol) which entered into force in 2006. It is expected that this Protocol will eventually replace the 1972 Convention. It stressed a "precautionary approach" and introduces a different approach to regulate the use of the sea as a depository for waste materials. Article 4 outlines the prohibition of dumping wastes or other matter with the exception of those listed in Annex 1 of the document.

3.3.8 International Convention on Oil Pollution Preparedness, Response and Co-operation 1990

The International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC Convention) is an international maritime convention that sets measures for the preparation for and response to marine oil pollution incidents. The OPRC Convention was drafted within the framework of the International Maritime Organization (IMO) and entered into force in 1995. Jamaica is one of 107 parties to the convention (as of July 2013).

4.0 PROJECT DESCRIPTION

4.1 PROJECT FEATURES AND DESIGN

4.1.1 Hotel

The proposed design is expanded across the site with buildings with 1-7 storeys. The total floor area is 81,544.15 m^2. The built areas comprising of 2 Hotels with 700 Rooms, Spa, Specialty Restaurants, Technical Area, 3 Beach Bars, 3 Pool Bars, Coco Café, 2 Barefoot Grill, 3 Towel Gazebo, 2 Wedding Gazebo, Pools Toilets, Temazcal, Water Sports, 2 Resort Access and Service Access. There are a total of 672 Parking and 15 coach Parking.

The height for hotels 1 & 2 levels is 3.5m with exception for ground level 1 & 6 which is at 5m. The spa is on 2 levels with the first level at height 3.5m from floor level and 8m from ground floor level. The specialty restaurants floor level is 6m from ground water table level. The Technical Area is separated by 2 buildings, 1 with 2 storeys & the other at 1. The two storey Technical area has a height of 5m high on level 1 and 4.45 on level 2. The technical area with one storey is 5.80m from F.F.L. to roof beam.

Figure 4-1 through to Figure 4-4 show the proposed project layout, Master Plan, sections and elevations and conceptual images of the proposed resort.

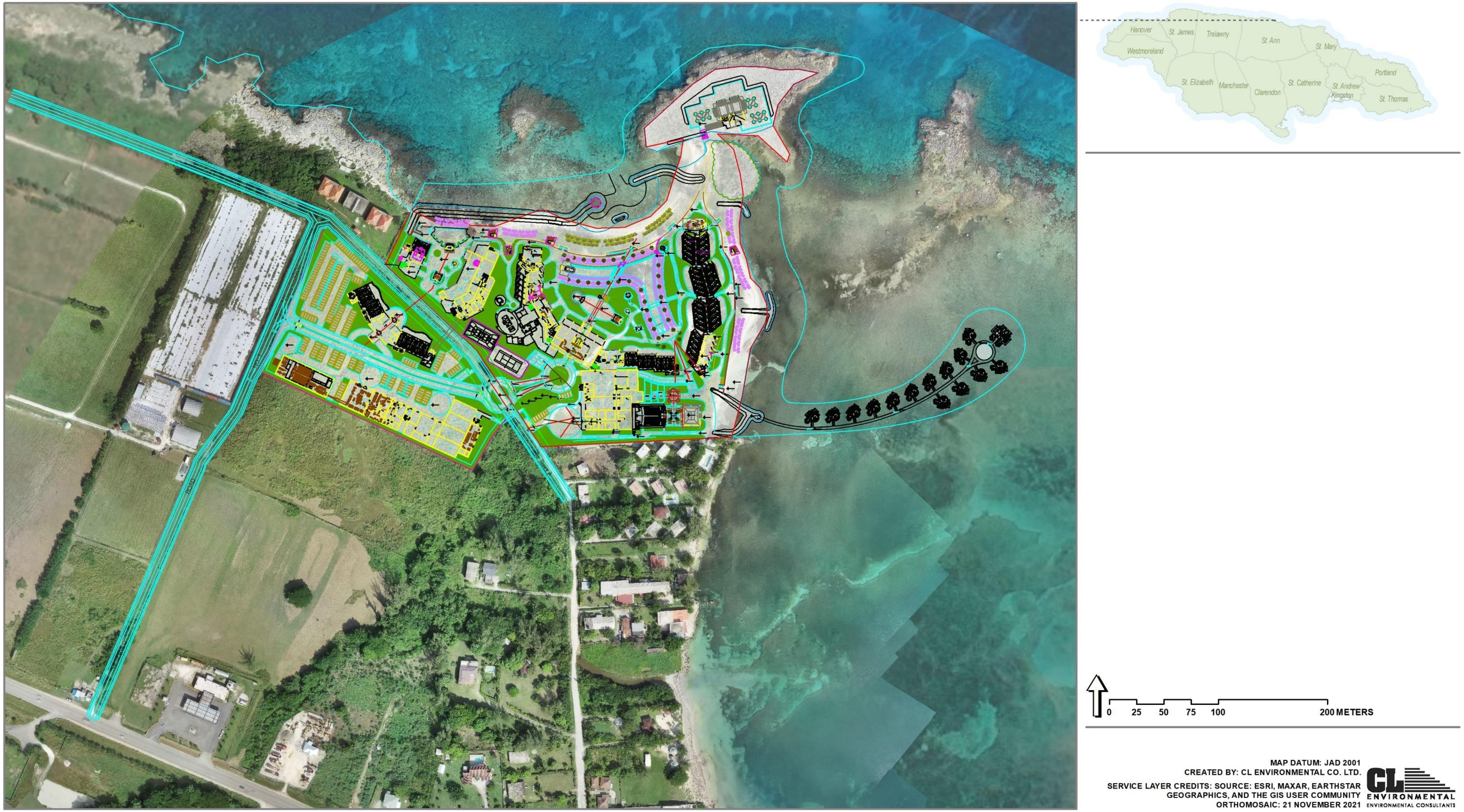


Figure 4-1 Proposed project layout

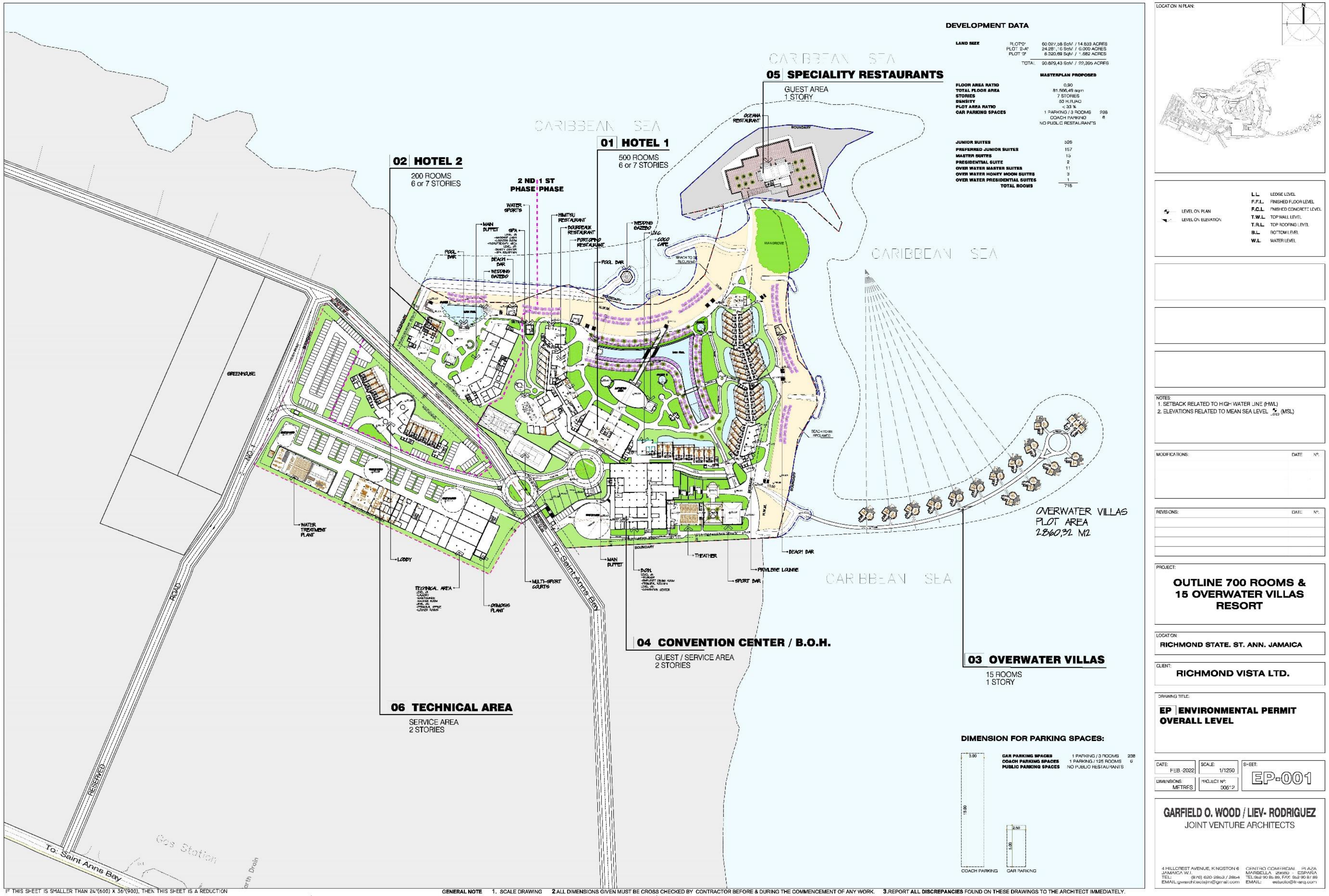


Figure 4-2 Project master plan

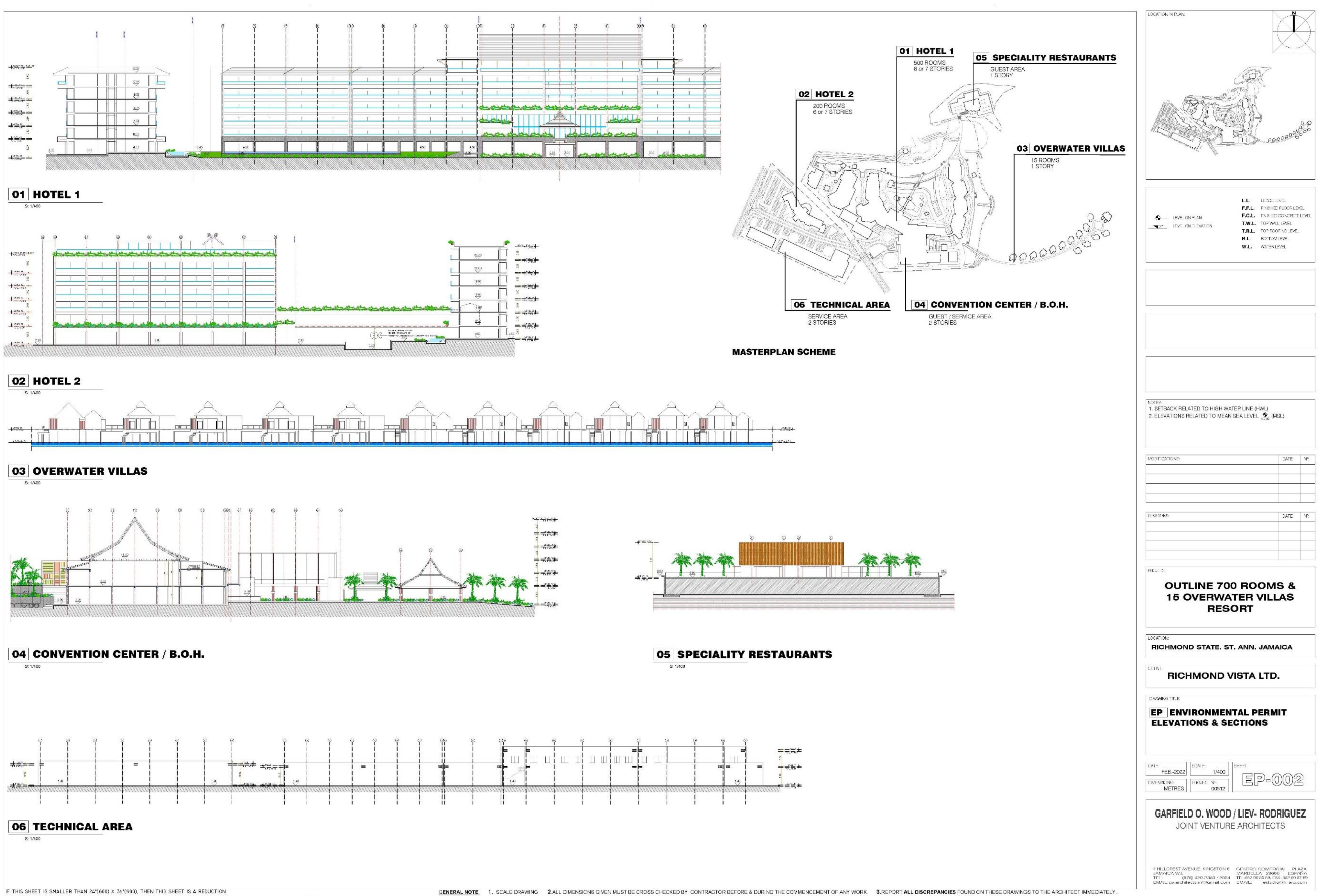


Figure 4-3 Project master plan elevations and sections

CONCEPTUAL IMAGE 1

CONCEPTUAL IMAGE 2

CONCEPTUAL IMAGE 3

CONCEPTUAL IMAGE 4

Figure 4-4 Conceptual images of the proposed resort

4.1.2 Overwater Rooms

4.1.2.1 Overview

Fifteen (15) overwater villas will be constructed toward the south-eastern most boundary of the property. The proposed height from sea level is 3.5m and the height from floor to roof slab is 3m. All electrical, telecommunication, plumbing/water, wastewater, air conditioning and fire protection related utilities will be routed under the boardwalk in watertight piping. These utilities will be supplied from the main Hotel property.

4.1.2.2 Structural Elevation for Overwater Rooms

The proposed Sea Rooms should be set at an elevation that limits the potential for flood under extreme events such as hurricanes. The protection is provided by the "airgap" according to the guidelines for piers and jetties (McConnell, Allsop, and Cruickshank, 2004). The floor elevation should be set based on:

1. Static Water Level: This refers to the High Astronomical Tide (HAT), Sea Level Rise (SLR), and Inverse Barometric Pressure (IBR)
2. Height of the Wave Crest (nMax) – in deep water the water elevation can be determined using an equation as follows:

$$\eta_{MAX} = \frac{H_{MAX}}{2} \exp\left(\frac{2\pi}{L_m}\frac{H_{MAX}}{2}\right)$$

However, the water at the Sea Rooms is shallow so MIKE21 SW&HD were used to obtain crest elevations of the waves.

Floor levels were developed for a 25-year hurricane and swell wave conditions. Hurricane conditions would cause the greatest increase in the static water level and combined with the large waves, there is potential for extreme flooding to occur. However, swell waves can also cause a notable increase in the wave heights. Therefore, we took a two-level approach to setting the Sea Room floor elevations: the lower level is closer to sea level and could be a platform for entering and exiting the sea. The building elements placed on this lower platform should be mobile as this level would be flooded during a hurricane as its proposed deck floor level is +1.25m above MSL. The upper level would not be flooded during hurricane conditions as the FFL is +2.95m above MSL (Table 4-1). Figure 4-5 is a sketch showing the two-floor approach described above.

Table 4-1 Recommended Floor Levels

Hazard	*Components*	
Hurricane	• Static water level	• 1.60m
	• Height of wave crest	• Variable: 0.6 - 0.75m
	• Allowance for services	• 0.6m (~2ft)

Hurricane Flooding Protection: +2.95m MSL

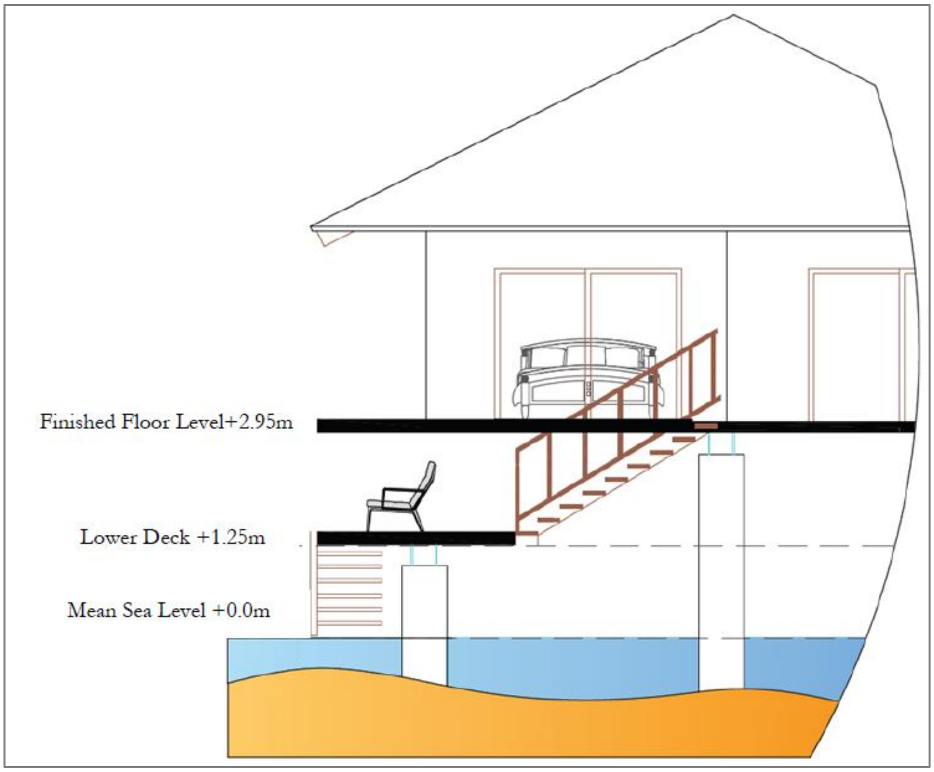


Figure 4-5 Sketch showing Recommended Floor Levels

4.1.3 Beach Works

4.1.3.1 Design Parameters

For the design of the structures, the maximum wave heights incident on each structure for a different wave forcing were extracted from the MIKE21 model. For this design, we must consider the wave conditions on the structures under:

1. Daily wave conditions;
2. Swell events; and
3. Hurricane conditions.

The use of a return period or design event such as the 1 in 50-year or 1 in 100-year essentially defines the kind of design conditions that will, on average, occur or be exceeded once every 50 years or every 100 years. It is important to understand risk and consider the chance of occurrence of a particular storm condition during the lifetime of a structure so that the associated risk of damage can be understood.

Table 4-2 gives the exposure risk (probability) over a project lifespan for different return period events. For example, a project lifespan of 50 years (Design Life =50) has a 99% chance of a 1:10-year event occurring, a 64% chance of a 1:50-year event occurring and a 39% chance of a 1:100-year storm event occurring.

Table 4-2 Probability of occurrence for various return periods and design life

Storm Event Return Period (years)	Design Life (years)			
	25	50	100	200
10	93%	99%	100%	100%
25	64%	87%	98%	100%
50	40%	64%	87%	98%
100	22%	39%	63%	87%
200	12%	22%	39%	63%
500	5%	10%	18%	33%

4.1.3.2 Design Overview

The proposed shoreline enhancement plan includes the creation of a large, usable, accessible sandy beach area, which would be sufficiently protected from incoming waves without appearing ‘over-built’. Considerations of the proposed design are:

1. Excavation of the existing shoreline and grading to an appropriate slope to create a wide sandy beach area that lends itself to many recreational uses.

2. The creation of a perched/dry beach along the north-western shoreline approximately 2m above MSL. This will be protected by a revetment and retaining wall at the back of the revetment. The crest height of the revetment will be +2m above MSL and a crest width of 3 D50 stones wide (≈3.3m).

3. At the north-eastern beach, there will be two groynes and a small breakwater. This beach will allow guests to enter the sea and be able to snorkel and wade in a water depth of -1m MSL.

4. Beach nourishment: As there is little appropriate sediment presently on the shoreline, the beach will have to be created through sediment nourishment. Appropriately sized sediment will be placed on the beach to create (1) a beach crest of 1.5m above MSL, and (2) a beach slope of 1/12 from the crest seaward. This is necessary to create a pleasant underfoot experience for people wading in the nearshore.

5. The eastern beaches will be anchored by three groynes with a crest height of +1m above MSL. This section of the shoreline will have a wading channel approximately 1.5m in depth for the guests to swim comfortably and to encourage water circulation.

Table 4-3 summarizes the details of beach works to take place.

Table 4-3 Summary of Beach Works

Activities	*Structure Seafloor Area*
Perched Beach • 130m long perched beach, +2m MSL • 3m wide boardwalk • 0.3m thick retaining wall @ +2.5m MSL • 146m long revetment to protect perched beach, +2.0m MSL with a 1:2 slope	*1,645m²/0.41 acres*
Northeast Beach • +1.5m MSL nourished beach with a 1:12 slope • +2.0m 30m groyne with a Gazebo • +0.75m 10m breakwater • +1.5m 68m groyne with a 1:1.5 slope	*4,785m²/1.18acres*
Peninsula • +3.0m high revetment with a crest width of 3m and a length of 137m protecting +6.0m high seawall	*No impact on seafloor*
Pebble Beach • +1.0m nourished beach with a 1:6 slope	*734m²/0.18acres*
Eastern Beach & Overwater Suites • 225m of nourished sandy beach with a 1m crest and a 1:14 slope • Two groynes and one T-groyne with a crest height of 1m, crest width of 3m and side slopes of 1:1.5 • Swimming channel with a width of 14m and a depth of -1.5m • Overwater suites channel -1.5m • 10m wide channel at -1.5m depth connecting east and west beaches	*22,444m²/5.55acres*

4.1.3.3 Ground and Floor Elevations

The low-lying flat site will be completely inundated during an extreme hurricane and the property needs to be raised. The hurricane simulations with sea level rise projections for climate change indicated a 50-year inundation level of 2.4 to 2.6m. Based on this, a minimum ground elevation of +2.8m is proposed and a minimum floor elevation of +3.0m. In addition, a wall around the entire development is proposed as a solid method of protection against erosion from waves accompanying the surge. A typical cross-section through the proposed beach and hotel building is shown in Figure 4-6.

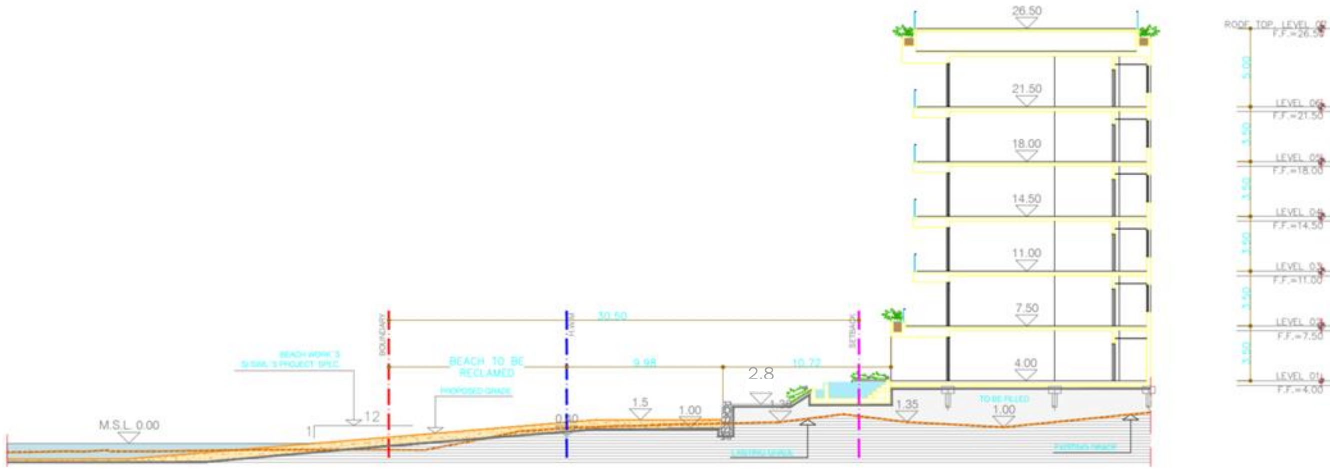


Figure 4-6 Typical cross-section of proposed beach and hotel building showing ground levels and finished floor levels

4.1.3.4 Building on the Peninsula

The peninsula is exposed to extremely high waves as offshore offers no protection and the seabed is deep close to the shoreline. Using the outputs of wave conditions at the shoreline during the 50-year condition, an assessment was carried out to understand the overtopping impact on the area. Firstly, a seawall is proposed along the shoreline with a revetment at its base to reduce some overtopping in milder wave conditions. This wall, properly designed and constructed, will withstand immediate impacts from incoming waves. However, even with this wall, the buildings need to be set back so that during a storm the overtopping waves do not damage the buildings. The distance over which this mass of water travels before reaching the ground was determined to be approximately 11.5m. This was based on the speed of the incoming waves and using parametric equations. A safe distance of 15m was therefore recommended. The following design parameters were derived:

- +5.5m fill level for the peninsula
- 15m setback from northern boundary for construction zone

Rock will be excavated in order to build the retaining wall foundations. After the retaining wall is built, a 5.75m-high infill will be conducted within the perimeter and properly compacted. In principle, there will be no need for deep foundations since the structure being built on the peninsula is only one storey high. There will be a shallow excavation done to create a flat surface for the proposed revetment. The armour stones will be washed before being placed on the peninsula.

Regarding drainage, infiltration wells will be built which will help prevent flooding and keep the construction area dry during construction. During the operational phase, at least one of these wells will remain for rain water infiltration purposes.

Figure 4-7 to Figure 4-9 illustrate the recommendations for development on the peninsula.

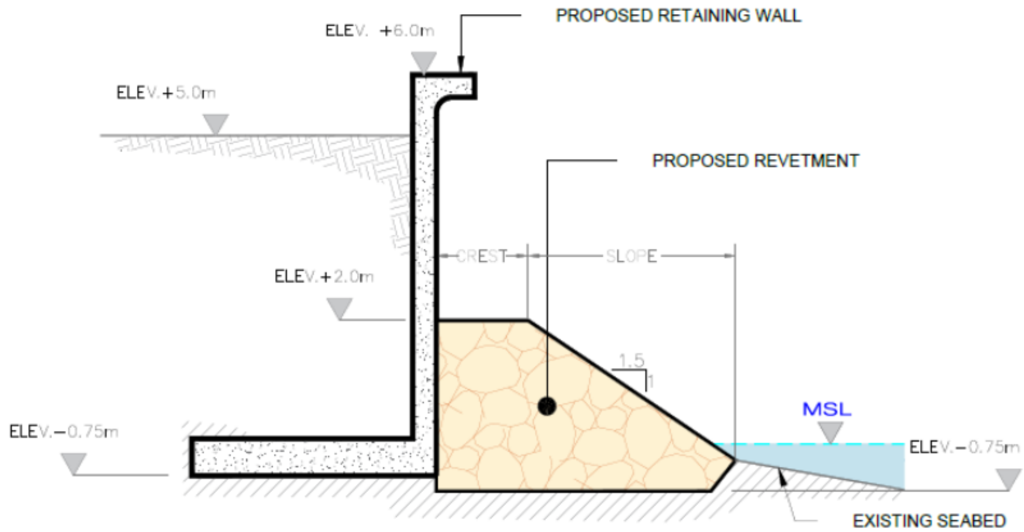


Figure 4-7 Typical cross-section for revetment and seawall for peninsula

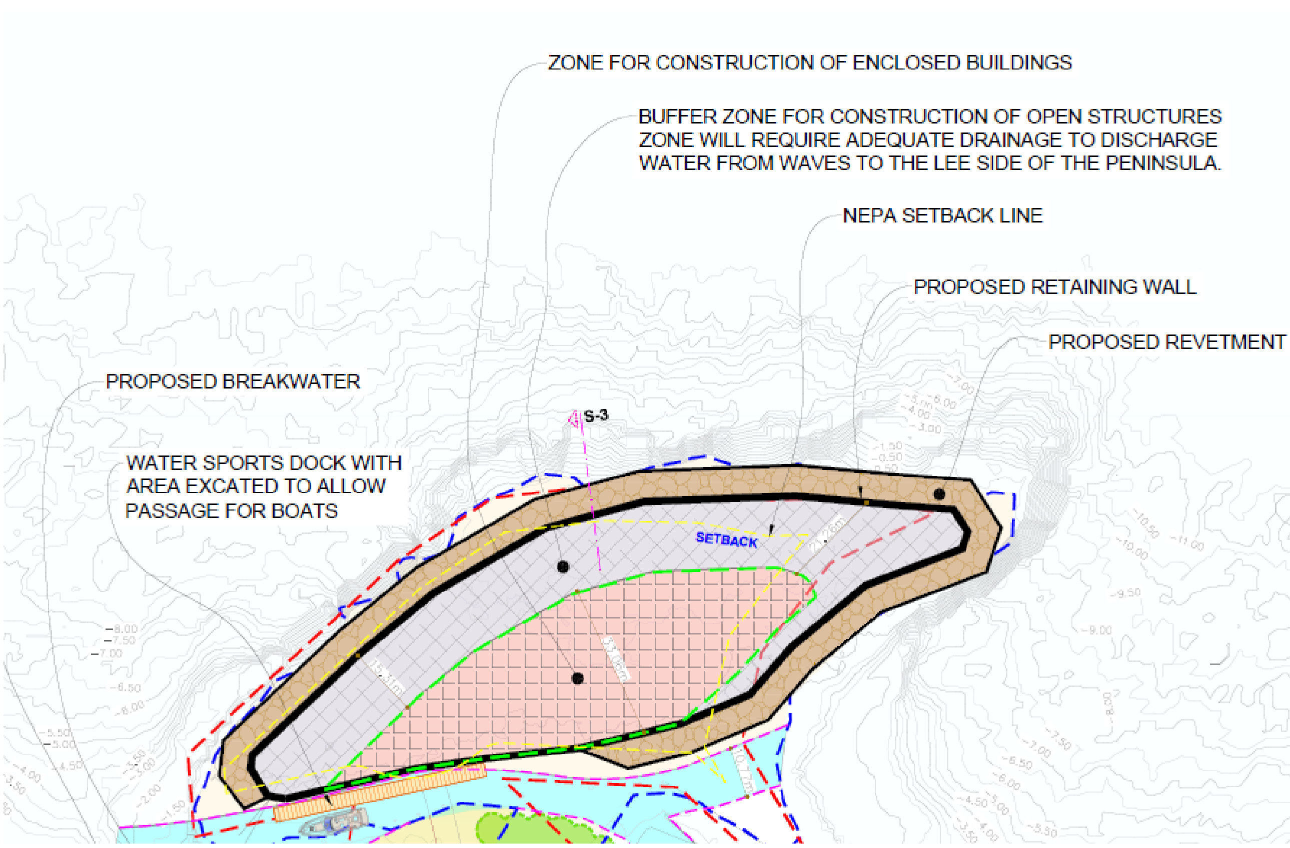


Figure 4-8 Recommended setback area for building on peninsula

Figure 4-9 Final architectural plan for building on the peninsula within the recommended setback limits

4.1.3.5 Sand Characteristics for Beach Nourishment

To further predict the behaviour of the beach with the structures in place, the formula developed by Ahrens and Hands (1998) was used. Their research describes the use of nonlinear wave theory to predict cross-shore sediment movement under waves in shallow water. This synthesis of wave theory and sediment movement initiation criteria allows much of the present understanding of cross-shore sediment movement to be determined. The beach stability is determined by looking at all the possible ranges of wave height and period extracted along the proposed beach slope/toe and by varying the mean grain size diameter. The variation of parameters will cause the beach to either accrete, transition or erode. Where the beach is in accretion mode it can be concluded that the beach is sheltered enough, and the grain size is ideal. Where the beach is in transition mode it can be anticipated that the beach will fluctuate through the year and the shoreline may reshape; although the structure layout is acceptable, adopting a coarser grain size could be recommended to limit beach fluctuations. Where the beach is in erosion mode it would be recommended to refine the footprint of the structures and adopt a coarser grain size for nourishment.

The wave parameters on the lee side of the proposed emergent breakwaters during swell waves, especially wave conditions exceeding 12 hours per year (99.86th percentile), were used to assess the stability of the beach. These wave conditions ranged from H=0.60m, Tp= 7.0s under existing conditions at the toe of the beach nourishment to H=0.20m, Tp= 7.0s under proposed conditions at the toe of the beach nourishment. The state of the beach toe under the input conditions is illustrated in Figure 4-10. As shown, with the protective structures in place the beach is well within the Accretion Region of sediment movement under swell conditions as highlighted by the blue circle. The existing conditions (or shoreline condition without the protective structures in place) were also input to the calculation spreadsheet and when plotted on the graph (shown as an orange square) categorizes the beach as “transitioning” i.e., may erode or not. As such it can be concluded that the proposed structures sufficiently reduce wave heights during swell conditions to the extent that the existing shoreline moves from the “transition zone” to the “accretion zone”.

It is recommended that the sand used to enhance the beach have a mean grain size of at least 0.35mm, ranging from 0.35mm to 0.5mm. In addition, the silt content should be low, ideally less than 0.5%. Higher silt content will result in cloudy water as the waves gradually clean the sand and can create a hardened surface over time. Other characteristics, such as carbonate content and colour are generally aesthetic, and are subject to preference.

Beach Erosion / Accretion			
Parameters	Units	Existing Shoreline	Proposed Shoreline
Hso	m	0.60	0.20
Tp	s	7.0	7.0
d50	mm	0.35	0.35
p sand	kg/m^3	1922	1922
p water	kg/m^3	1025	1025
rel pho		0.88	0.88
Lo	m	76	76
Hso/Lo		**0.0078**	**0.0026**
Hb	m	1.07	0.49
db		1.4	0.6
Ns (Ahrens)		**3493**	**1584**
Ns - Upper Transition		5654	13708
Ns - Middle Transition		4231	10256
Ns - Lower Transition		2098	5087
John P. Ahrens and Edward B. Hands			
Paper # 75 ICCE 1998			

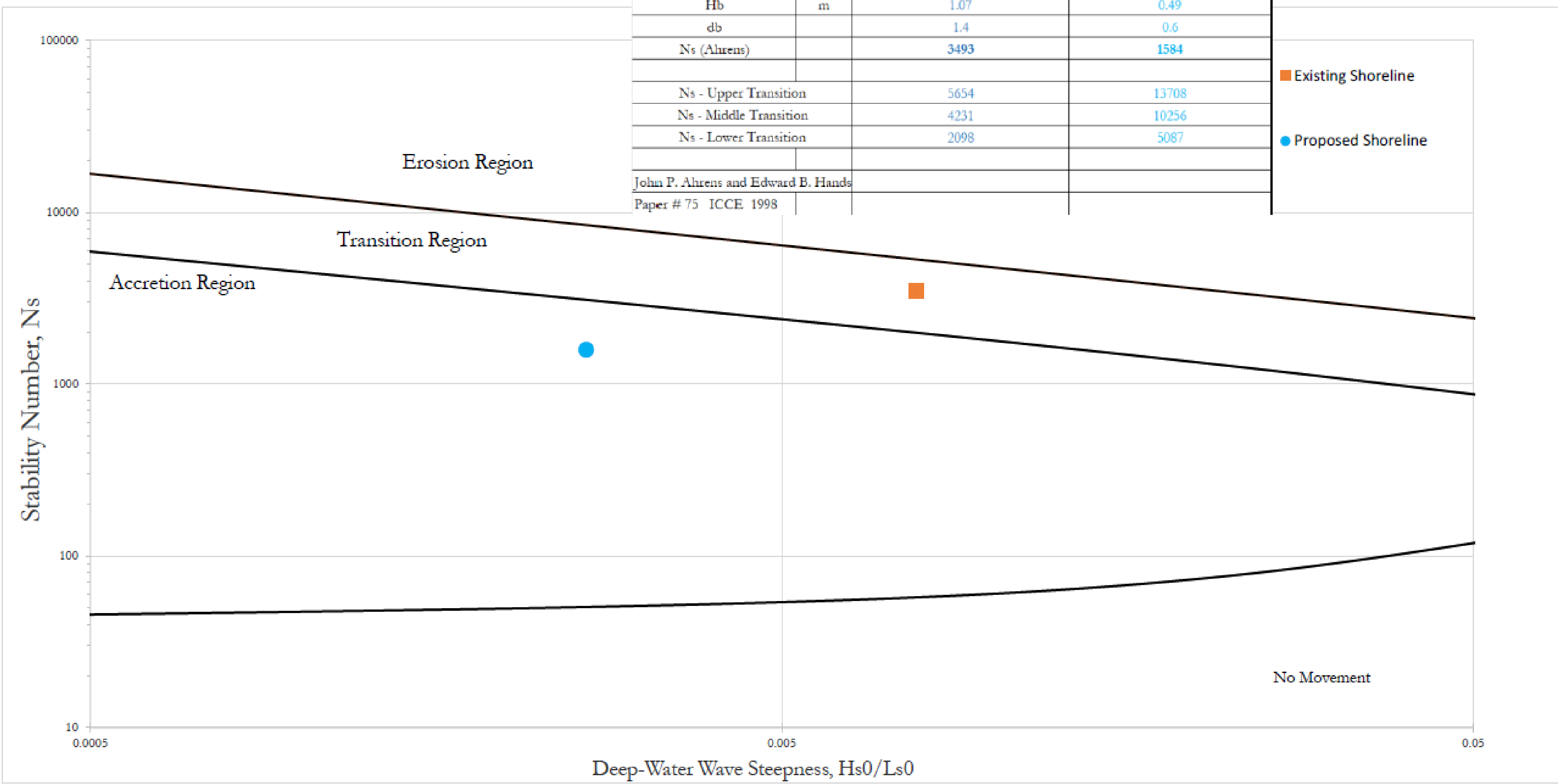


Figure 4-10 Sediment erosion and accretion zones as developed by Ahrens and Hands (1998)

4.1.3.6 Structural Stability and Specifications

This section describes the analysis performed to determine the structural stability of the proposed structures using appropriate stone sizes and median sand grain size. Using the wave modelling results, the structures (eight structures) were designed to retain sand placed on the shoreline and to encourage sand accretion over time. The use of boulders is proposed to provide wave force protection for structures designed to withstand the 1 in 50-year hurricane condition.

Armour Stone Size for Emergent Groyne

In the Rock Manual (2007) two sets of equations for the determination of rock stability in breakwaters armour layers are presented. One set is the original formula presented by Van der Meer (1988), valid for deep water conditions. This set uses the parameters Hs and Tm. The other set is an adaptation of these formulae, using the parameters H2% and Tm-1,0, and is recommended for shallow water conditions. Tests by Van Gent et al. (2003) have led to a calibration coefficient slightly different than the original Van der Meer values. And more recently, work by Verhagen and Mertens (2015) reanalysed the datasets of Van der Meer and Van Gent, corrected some of the numbers, and explained part of the differences. Their paper - Riprap stability for deep water, shallow water, and steep foreshores, shows that, in combination with the shallow water wave parameters H2% and Tm-1,0 there is no need to use different formulae for deep and shallow water. The effect of the foreshore can be incorporated by adding a correction factor based on the Iribarren number for the foreshore. This implies that the stability formulae found in the Rock Manual (2007) can be used in all cases, provided the wave boundary data at the toe of the breakwater are determined very accurately.

The design wave height for the 1 in 50-year event is listed in Table 4-4 for each of the structures. These parameters were used in the design calculations to simulate design storm conditions.

The computations of the Van Gent formula for Very Shallow Water (Table 4-5) showed that stones of 670 kg to 3,355 kg in mass (D_{50} of 0.64 m to 1.1 m) are required to sustain only minimal damage during the 50-year storm event. For simplicity, during construction and for ease of procurement, similar ranges are recommended for all armour structures.

Table 4-4 Design wave heights at each of the proposed structures

Structure	Label	50-year-max			
		Hs	Storm Surge	Water Level	Water Depth
Western Perched Beach Groyne	WPG	1.950	2.200	0.500	2.700
Western Gazebo Groyne	WGG	1.950	2.200	0.500	2.700
North Eastern Groyne	NEG	1.560	2.200	0.600	2.800
Eastern Beach North Groyne	EGN	1.560	2.400	0.400	2.800
Eastern Beach T Groyne	ETG	1.560	2.300	0.900	3.200
Eastern Beach Southern Groyne	ESG	1.560	2.200	1.100	3.300
Peninsula	P	1.950	2.200	0.000	2.200

Table 4-5 Design table used to determine armour stone size for the proposed armour stone structures

Structures (Label)	D50 (m)	range (m)		M50 (kg)	range (kg)	
Western Perched Beach	**1.10**	0.98	1.23	**3355**	2357	4603
Western Gazebo Groyne	**0.89**	0.79	0.99	**1785**	1254	2449
North Eastern Groyne	**0.76**	0.68	0.85	**1112**	781	1525
Eastern Beach North Groyne	**0.64**	0.57	0.72	**668**	469	917
Eastern Beach T Groyne	**0.64**	0.57	0.72	**668**	469	917
Eastern Beach South Groyne	**0.64**	0.57	0.72	**668**	469	917
Peninsula	**1.10**	0.98	1.23	**3355**	2357	4603

4.1.3.7 Summary of Beach Design Specifications

The design specifications of the final recommended option are as follows:

- The perched beach will be +2m above MSL.
- The back of beach area on the north-eastern beach will be excavated and graded. The finished elevation of the crest of the beach was set to +1.5m above MSL with a slope of 1 in 12.
- The eastern beach will have a beach crest height of +1.0m MSL and a slope of 1:14.
- The entire shoreline and nearshore is to be cleared of existing rock, rubble, and debris and seagrass will be relocated.
- The existing beach will be nourished with 10,077m^3 of marine-grade sand with a mean grain size ranging from 0.35-0.5mm and a silt content less than 0.5% for the western and eastern beaches.
- 3,720m^3 of manufactured sediment will be placed within the wading zones.
- All structures are to be constructed atop a layer of geotextile at their base. The armour stone density should be 2500 kg/m^3 at a minimum. The size specifications for all structures are in Table 4-5 above.

The detailed engineering plan is shown in Figure 4-11 and Figure 4-12.

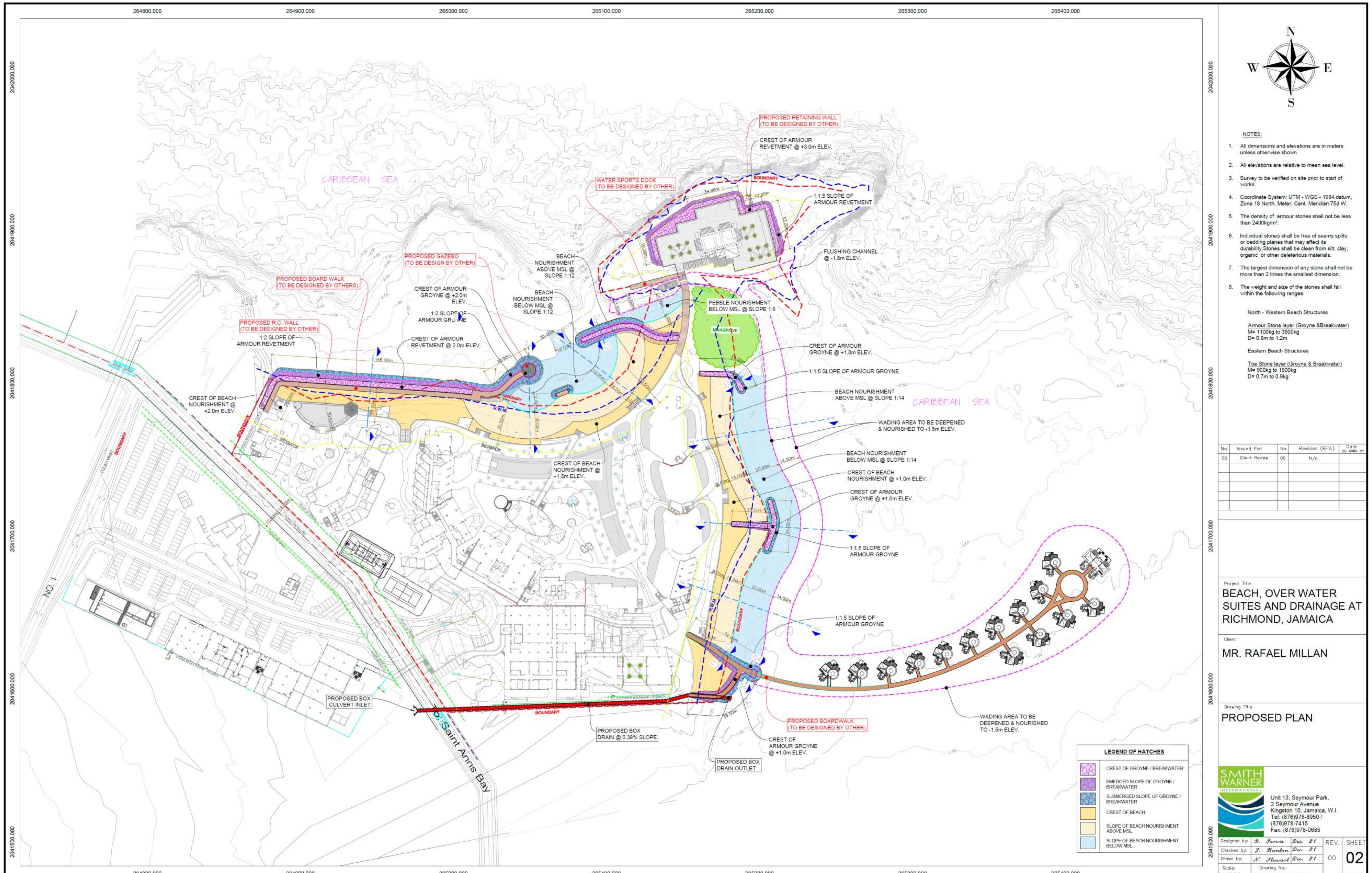


Figure 4-11 Proposed detailed engineering design showing the coastal works

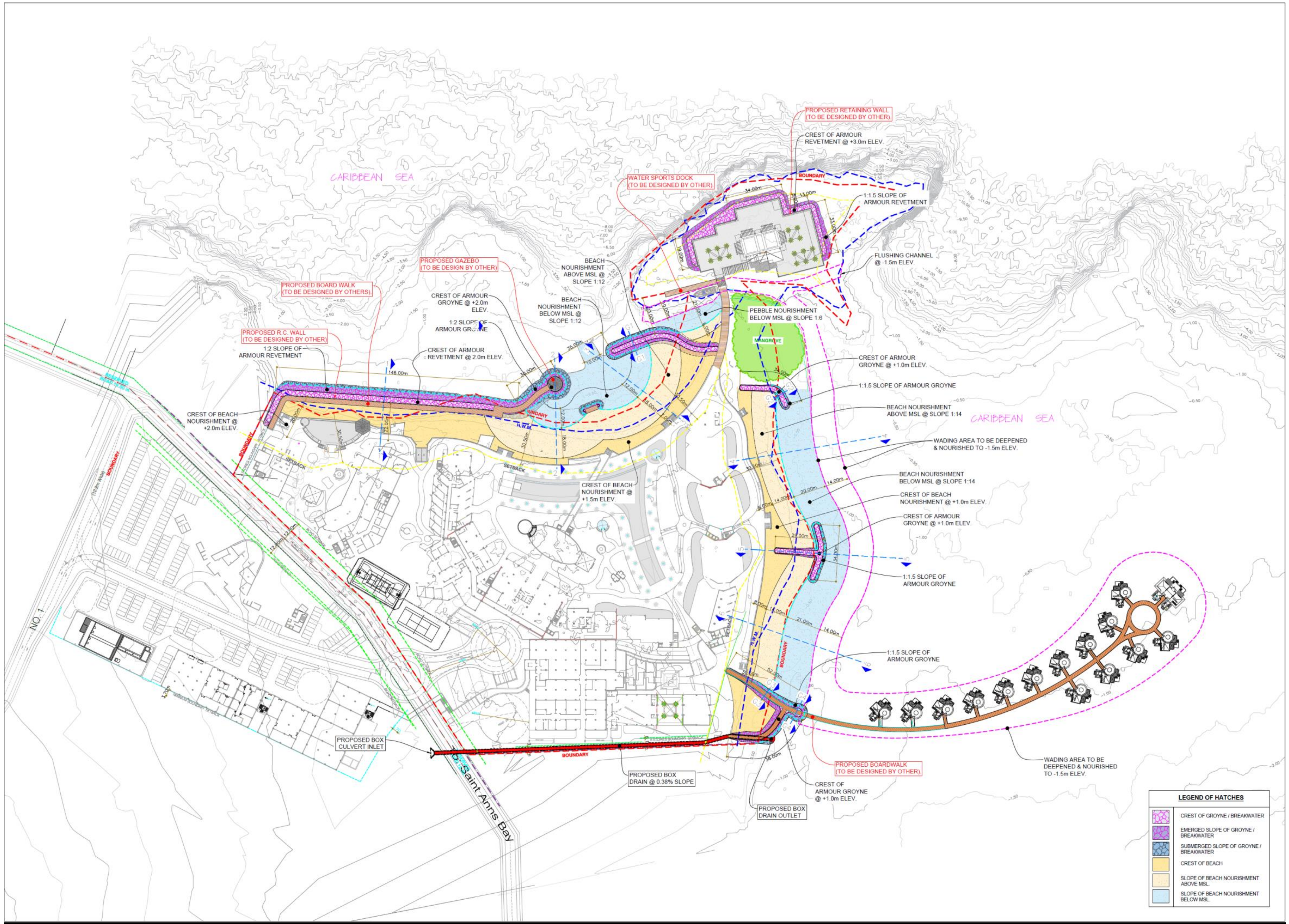


Figure 4-12 Proposed detailed engineering design showing the coastal works (11x17 version)

4.2 AUXILIARY PROJECT ACTIVITIES

4.2.1 Wastewater Treatment Plant

The location of the Wastewater Treatment Plant (WWTP) can be seen in Figure 4-2. The WWTP will be located at the southwestern-most boundary of the project site.

The WWTP process, along with plan and cross-sectional views of the WWTP are shown in Figure 4-13, Figure 4-14 and Figure 4-15.

All wastewater generated by the hotel will be channelled and treated by the hotels WWTP. Wastewater from the overwater rooms will be collected via hanging pipes and pumping manifolds and routed under the deck in watertight piping toward the WWTP to undergo treatment.

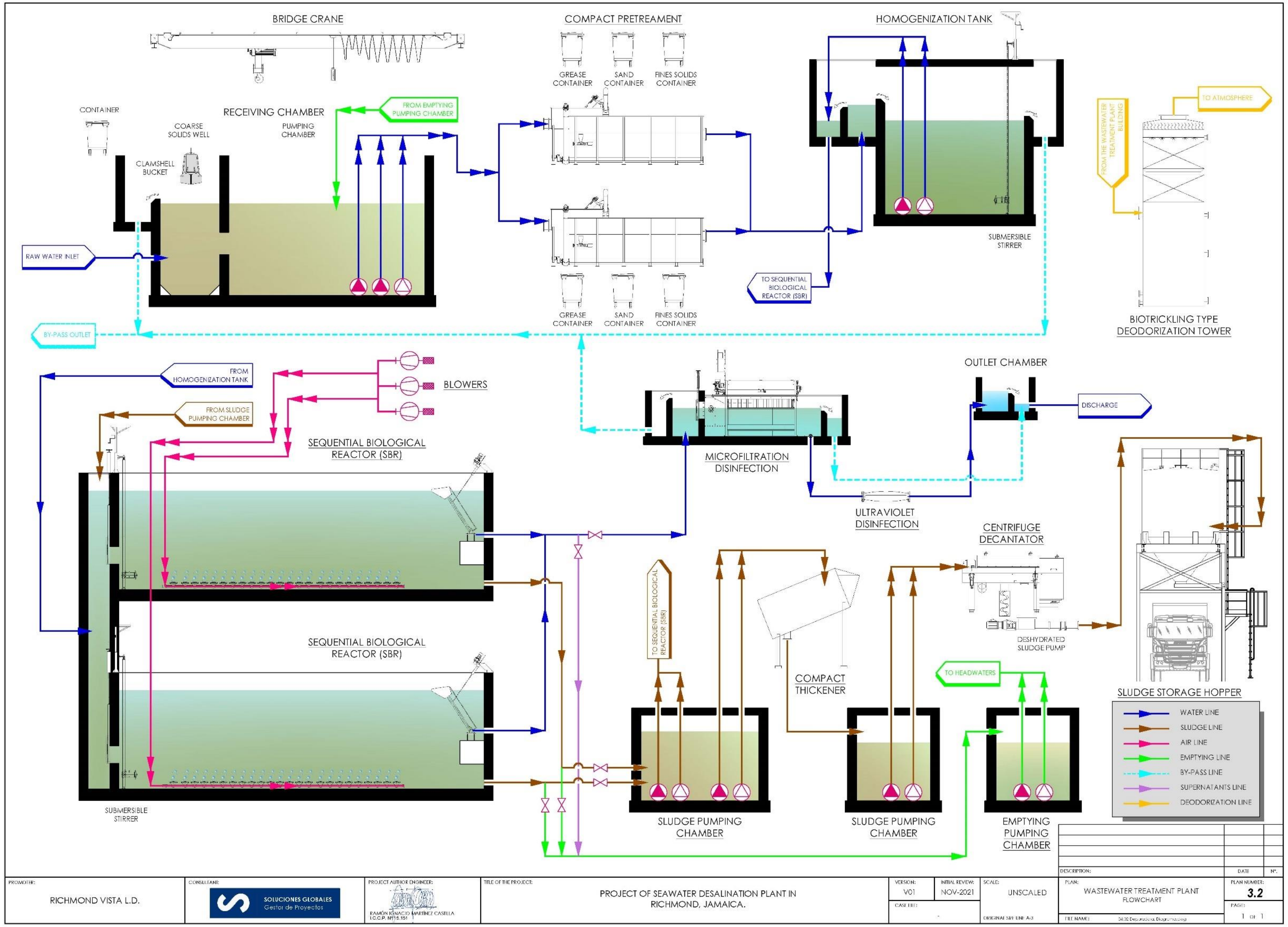


Figure 4-13 WWTP Process

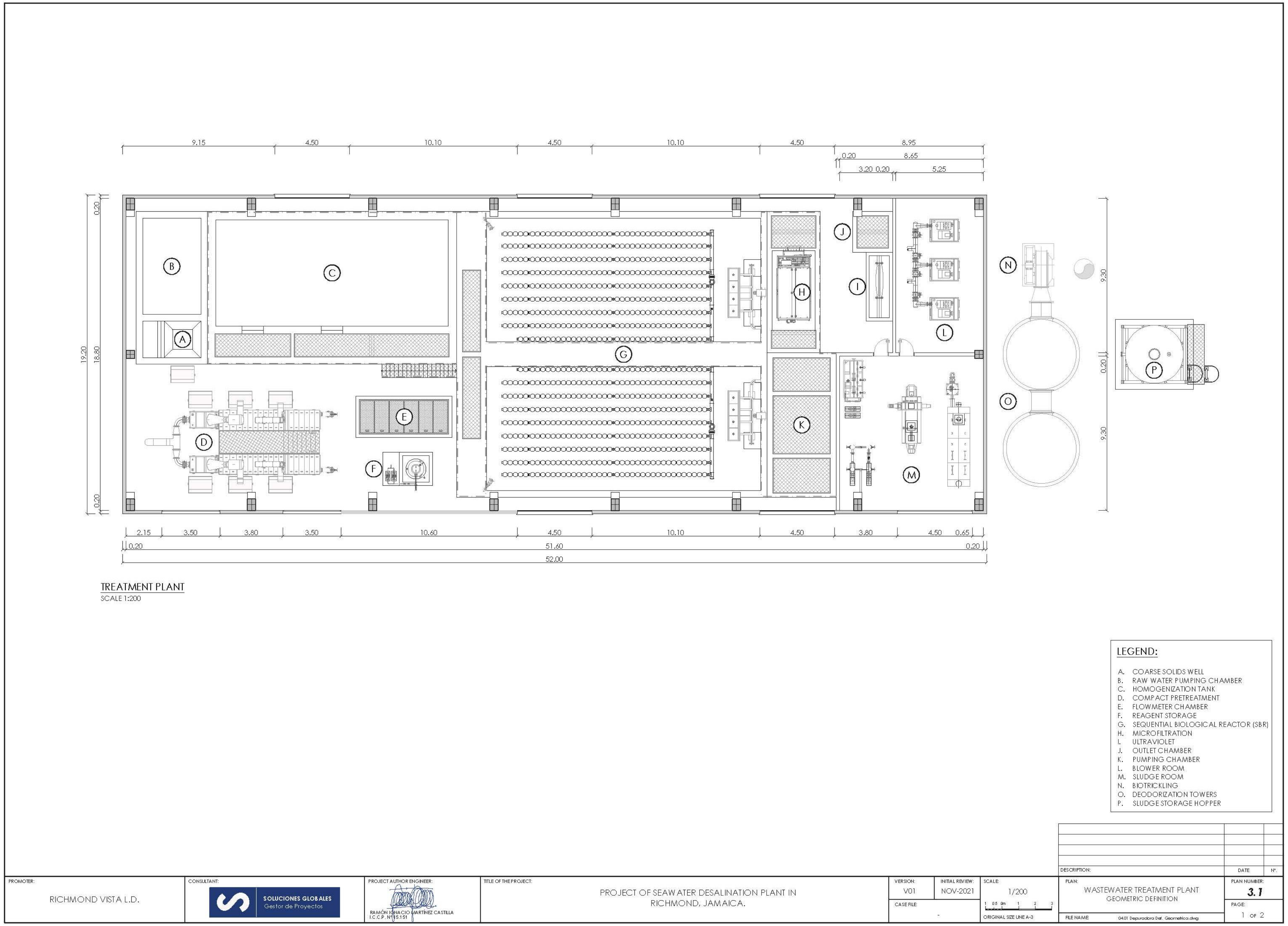


Figure 4-14 Plan View of WWTP

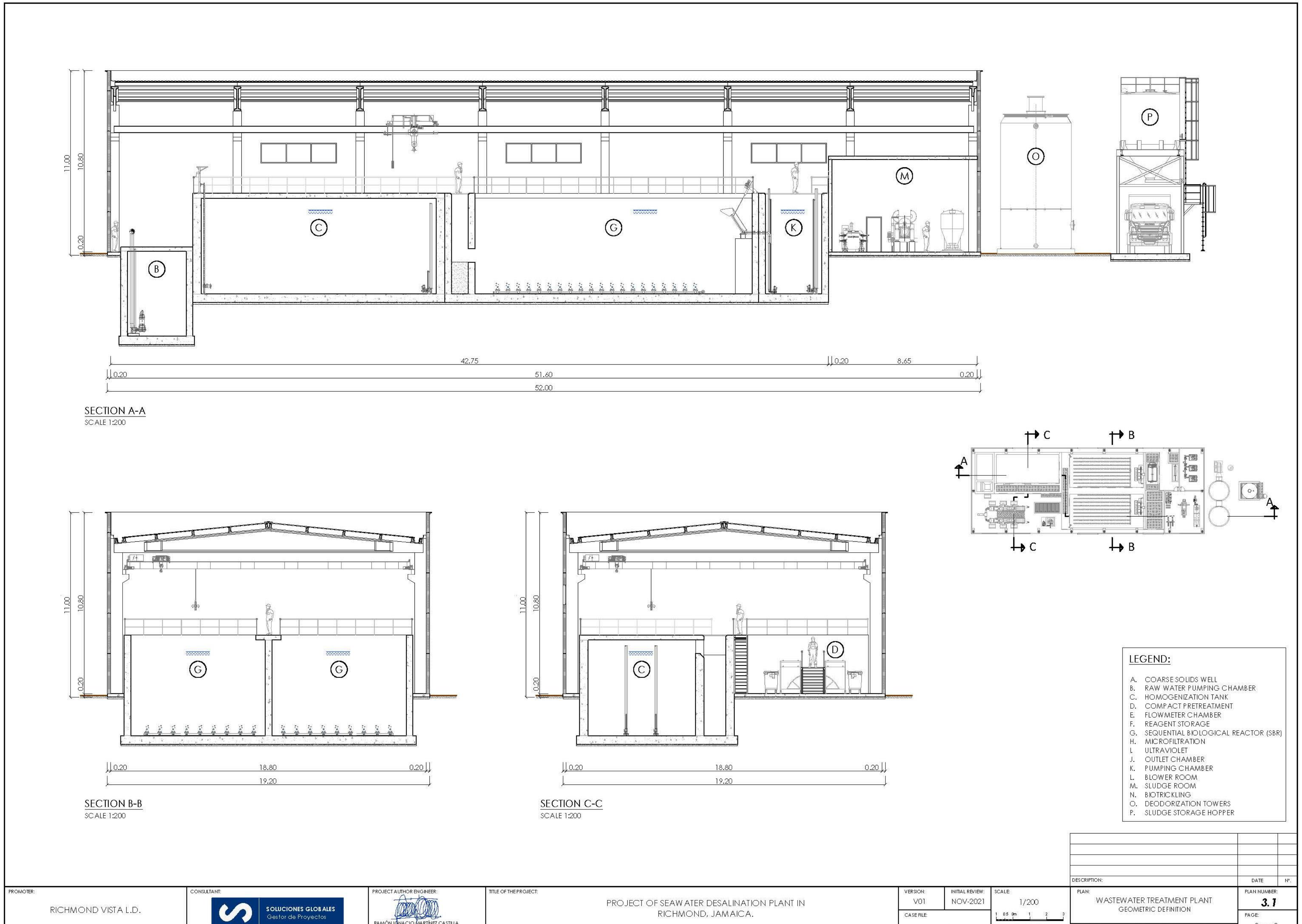


Figure 4-15 Cross Sectional View of WWTP

The projected treatment line is as follows:

- Coarse solids pit
- Compact pre-treatment pumping
- Compact pre-treatment
- Homogenization tank
- Pumping to biological treatment
- Biological treatment type SBR
- Effluent disinfection

The sludge generated in the process, will undergo the following treatment process:

- Mechanical thickener
- Pumping to centrifugal decanter
- Centrifugal decanter
- Dehydrated sludge pumping
- Hopper storage.

4.2.1.1 Water Usage and Flow Rates

In order to meet the water needs seawater abstraction wells will be used. The water pumped from these wells will be treated in a desalination facility. The daily extraction volume considered for each well is 450 m^3/day for potable water production, so it represents a daily extraction capability about 2,700 m^3. The daily drinking water requirement is 1,072 m^3/day, for which the installation of 3 reverse osmosis lines working in parallel is foreseen. In order to compensate for maintenance stops and unforeseen events, a capacity of 3x400 m^3/day is adopted, i.e. 1.20 m^3/day and if a desalination plant efficiency of 45% is estimated (the value will be checked in later sections), to obtain 1,200 m^3 of drinking water, then 2,700 m^3/day must be extracted.

As far as the treatment flow rate is concerned, the expected capacity of the seawater desalination plant was assumed (i.e., 1,200 m^3/day). Table 4-6 shows the influent water quality characteristics, while gives the effluent water quality as stipulated by the Natural Resources Conservation Authority.

Table 4-6 Influent water quality parameters.

INLET WATER CHARACTERISTICS		DESIGN
- AVERAGE DAILY FLOW	m³/day.	1.200,00
- FLOW RATE		
* Average Flow, Qmed	l/s	13,89
* Average Flow	m³/h.	**50,00**
* Peak Flow coefficient (Kp)		2,00
* Peak Flow, Qp	l/s	27,78
* Peak Flow, Qp	m³/h.	**100,00**
* Maximum Flow coefficient (KM)		5,00
* Maximum Flow, Qm	l/s	69,44
* Maximum Flow, Qm	m³/h.	**250,00**
- BDO		
* Average concentration	mg/l.	220,00
* Daily pollutant load	kg/day.	264,00
* Specific pollutan load	g/h/d	10,96
- EQUIVALENT INHABITANTS	h.eq.	4.400,00
- COD		
* Average concentration	mg/l.	500,00
* Daily pollutant load	kg/day.	600,00
* Specific pollutan load	g/h/d	24,91
- TSS		
* Average concentration	mg/l.	720,00
* Daily pollutant load	kg/day.	864,00
* Specific pollutan load	g/h/d	35,87
- VSS (estimated)		
* Average concentration	mg/l.	500,00
* Daily pollutant load	kg/day.	600,00
- N.T.K.		
* Average concentration	mg/l.	40,00
* Daily pollutant load	kg/day.	48,00
* Specific pollutan load	g/h/d	1,99
- N-NH4		
* Average concentration	mg/l.	28,00
* Daily pollutant load	kg/day.	33,60
* Specific pollutan load	g/h/d	1,39
- P-total.		
* Average concentration	mg/l.	8,00
* Daily pollutant load	kg/day.	9,60
* Specific pollutan load	g/h/d	0,40
- Mixed liquor temperature	ºC	25

Table 4-7 Effluent water quality parameters

OUTPUT PARAMETER LIMITS		
		DESIGN
TREATED WATER CHARACTERISTICS		Normal
- BOD <	mg/l	20
- TSS <	mg/l	20
- COD <	mg/l	100
- N total <	mg/l	10
- PO4 <	mg/l	4
- pH		6-9
- Faecal Coliforms	UFC/100 ml	200
- Residual clhorine	mg/l	1,5

4.2.1.2 Coarse Solids Pit

The raw water of the hotel complex reaches a first chamber in the WWTP, where the coarse solids pit is situated. When the first screen becomes clogged or becomes significantly dirty, it will be lifted for cleaning, so that the second screen will continue to prevent solids larger than 50 mm from passing into the pumping chamber. These screens protect the pumps from larger solids, partially preventing wear and clogging, thus improving the operation of the WWTP. When water overflows through the bypass weir, the force of the water will drive the sieve pulley and the sieving mechanism will start to operate. Therefore, there is no need for an electrical connection to this equipment. After this screen, a second weir is located, on which an ultrasonic flowmeter will be installed, in order to be able to know the relieved flow at all times (or to obtain historical data of the same). The outlet pipe of the general by-pass is connected further on with the relief after the pretreatment, and with the WWTP by-pass network.

4.2.1.3 Compact PreTreatment Pumping

Adjacent the coarse solids pit is the pumping chamber. Its function is to raise the water to the level where the compact pretreatment equipment is located. For this purpose, 2+1 submersible pumps (one as a back-up) will be installed, with a unit flow of 125 m^3/h. A set of valves will allow the pumped water to be conveyed to either of the two compact units provided, as required.

4.2.1.4 Compact PreTreatment

In the next step of the process, we will carry out the roughing of fine solids as well as desanding/degreasing. To carry out both processes, a compact pretreatment unit has been designed. Since two treatment lines are foreseen at this point in the process, each unit has a maximum treatment flow of 125 m^3/h. Thus, at average flow only one unit will operate, and only when the inlet flow exceeds 2.5 times the average flow, i.e., 125 m^3/h, will the second treatment line come into operation. As far as the fine solids removal is concerned, it will be carried out by means of a screwed screen of 3 mm of passage span, with housing mounted compaction, including a solids transport and compaction system, provided with cleaning in the compaction zone and with a dehydration and compaction degree of solids between 30 and 45%.

The desanding area will consist of a longitudinal desanding tank with a removable cover, an air injection system for the separation of organics from the sand and aid in the flotation of grease and supernatants, a support structure with adjustable legs and accessories for fastening the sand extraction augers. The sand conveying augers will be made of hollow shaft and their work is discontinuous, achieving a good dewatering of the sand at low speed and minimum erosion of the propellers. Sand extraction will be carried out by means of a combination of a horizontal screw conveyor plus another inclined screw conveyor that will discharge the collected sand into a container with a capacity of 800 litres. To perform the degreasing operation, the equipment includes a lateral degreaser parallel to the sand trap with a special high performance floating screw of 300 mm diameter, for a better dewatering of grease and flotsam. Grease and floatants are automatically discharged and fall by gravity into a container with a capacity of 800 litres.

4.2.1.5 Homogenization Tank

After passing through the compact pretreatment, the water will be conveyed by gravity to a homogenization pond. This pond has two main effects: it homogenizes the contamination load of the water before it is sent to the biological process, so that any possible peak of punctual contamination (for example, when washing machines are drained, or due to discharges from kitchens), will be cushioned and diluted by the volume of water contained in this pond. The second effect is to accumulate the water that cannot be treated at that moment in the following points of the process. It must be taken into account that the biological process is planned in cycles, and not continuously, so it is necessary to accumulate the water at certain times, to pump it to the biological process during the filling cycles of the same.

4.2.1.6 Biological Treatment

Inside the homogenization pond, pumps will be installed to drive the water, in a controlled manner, to the biological process. The bottom of the tank will have a certain slope towards the point where the pumps will be installed. Two reactors of identical dimensions (7.5 meters wide, 16 meters long and 5 meters high) will be built in parallel. The water pumped from the homogenization pond will be conveyed alternatively to each reactor, depending on the timing and the number of cycles adopted. The installation will therefore be highly flexible and adaptable. We adopted a biological reactor of activated sludge with prolonged aeration and low load, carrying out the oxic, anoxic and decantation processes in the same enclosure. This is known as an SBR (sequential batch reactor) process.

4.2.1.7 Effluent Disinfection and Discharge

As for the water treated by the SBR biological reactors, taking into account that a total of 6 cycles per day are foreseen, and that the extraction time per cycle is estimated at one and a half hours, this means a daily total of 9 hours of treated water extraction. As the average daily flow rate is 1,200 m^3/day, the actual effluent flow rate is about 134 m^3/h. To disinfect the treated water, and taking into account the above-mentioned hourly flow rate, an ultraviolet (UV) disinfection reactor will be installed in the piping. Given that we are dealing with an installation located inside a building, the space saving of this solution, compared to others such as the chlorination channel, makes its installation advisable. The treated effluent will be channelled to a tank to be used to store water for irrigation of landscaped areas around the hotel property. Chlorination of the effluent inside this storage tank will be conducted.

4.2.1.8 Sludge Line

The sludge generated in the process will undergo the following treatment process:

- Mechanical thickener
- Sludge dewatering and storage

Mechanical Thickener

The emptying cycles of each of the two SBR reactors imply that this emptying operation takes place 6 times a day. Taking into account that the sludge line is expected to operate around 5 days a week and 7 hours/day, while the sludge purges of the biological reactors occur 7 days a week, a pond will be built to accumulate the sludge, and to be able to dose it on the days and hours of operation of the sludge line. To avoid caking and dead zones, the tank will be equipped with agitation. The sludge will be conveyed to the thickening equipment by means of a pumping unit consisting of two (1+1 standby) 8 m^3/h screw pumps. Prior to its entry into the thickening equipment, it is necessary to condition the sludge with the addition of polyelectrolyte. To carry out this task, according to the calculations made, an automatic polyelectrolyte preparation equipment with a capacity of 500 l/h will be installed.

The mixing of the sludge and the already prepared (diluted) polyelectrolyte takes place in an apparatus that we could call “flocculation reactor”, which is actually a Venturi mixer that guarantees an efficient in-line flocculation, without additional energy consumption. The sludge is thickened in a rotary mechanical thickener with a nominal flow rate of 7 m^3/h and a nominal load of at least 56 kg MS/h. The sludge is transported inside the drum due to its inclination, as well as the combined action of the drum's rotational movement and its internal design. The expected dryness of the sludge output of this equipment is in the range of 3.5 - 4.5%.

Dewatering and Sludge Storage

The thickened sludge falls by gravity into a thickened sludge buffer tank located on the lower level. The sludge will be conveyed to the dewatering equipment by means of a pumping equipment consisting of two (1+1 standby) 2 m^3/h helical screw pumps with frequency inverter. To carry out this task, according to the calculations made, the 500 l/h automatic polyelectrolyte preparation equipment foreseen for conditioning prior to thickening will be used, since its capacity is sufficient to service both pieces of equipment. A pump (plus a reserve pump) with a capacity of 200 l/h will be used for dosing. For an autonomy of 15 days, 2 bags of 25 kg of pure product should be stored. For dewatering, a 2 m^3/h centrifugal decanter and a solid load of 70 kg DM/h are foreseen. The dryness of the dewatered sludge at the outlet of the centrifuge, according to the suppliers, under the working conditions foreseen in the design, will be 22%. The dewatered sludge will be pumped by means of a pumping equipment consisting of a 1.5 m^3/h helical screw pump. The sludge will be stored in a 10 m^3 capacity hopper, with an expected autonomy of just over 9 days.

4.2.1.9 Deodorization

Since the site of our WWTP is located very close to the hotel facilities, in order to prevent the appearance of odours during the purification process, the installation will be confined inside a building, facilitating the treatment of the confined air before its emission into the atmosphere. The system foreseen is the installation of a biotrickling system, in which the contaminated air is passed through a filled bed on which microorganisms specialized in the neutralization of odorous agents are cultivated. To feed the microbiology, a nutrient-rich solution is pumped counter current, which will drain over the packed bed. Considering 6 renewals/h of the air contained in the building, it is calculated the need to install an equipment with a capacity to treat 58,000 m^3/h of air, which will be captured at different points from inside the building through a blower.

4.2.1.10 Energy Consumption

The WWTP facilities are estimated to demand an installed power of 596.99 kW.

4.2.2 Seawater Desalination Plant

Potable water for hotel operations will be provided via desalination of seawater. The location of the Seawater Desalination Plant (SWDP) can be seen in Figure 4-2. The SWDP will be located at the southern-most boundary of the project site.

The water balance layout, along with plan and cross-sectional views of the SWDP are shown in Figure 4-16, Figure 4-17 and Figure 4-18.

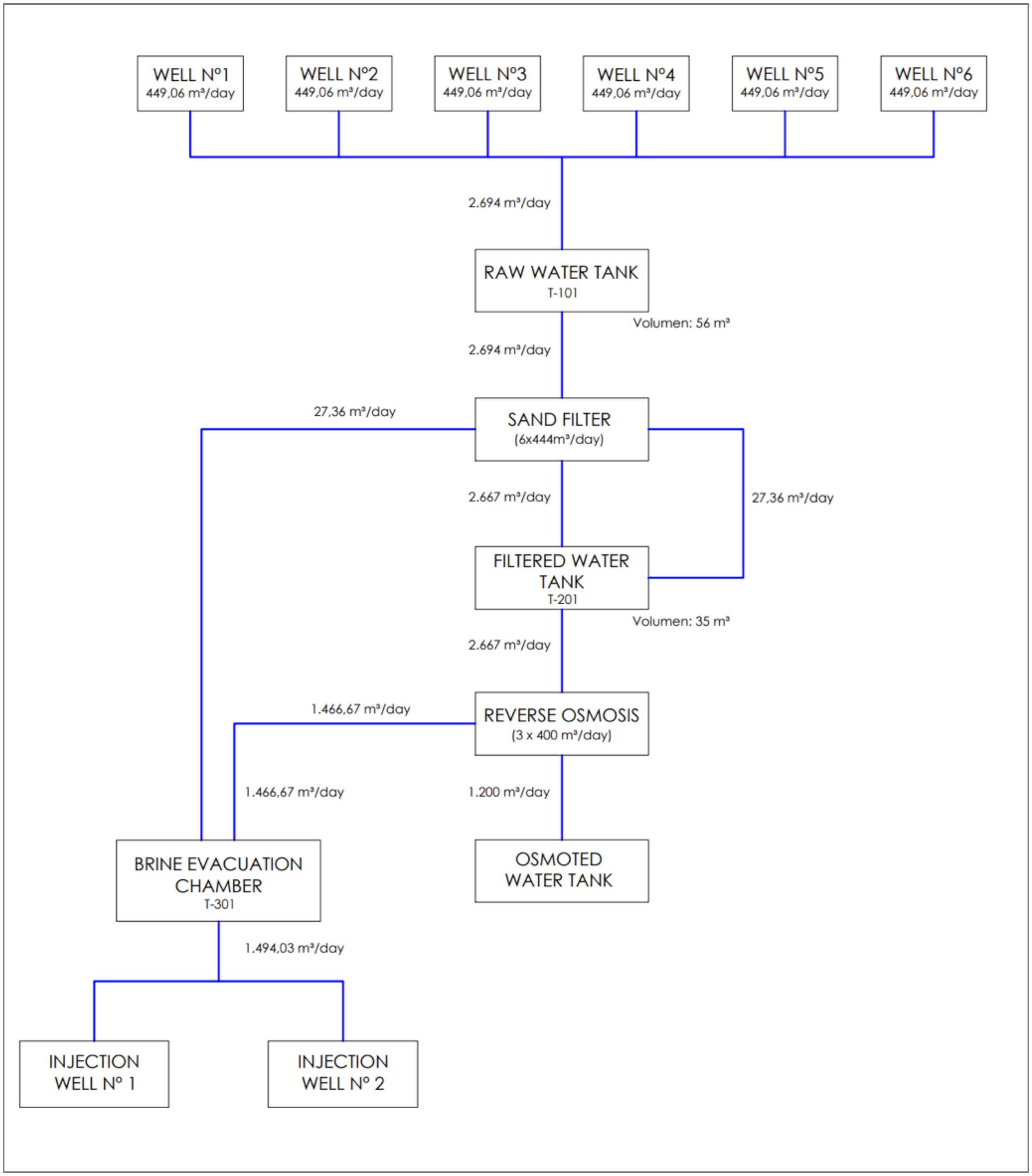


Figure 4-16 Water Balance Layout Process

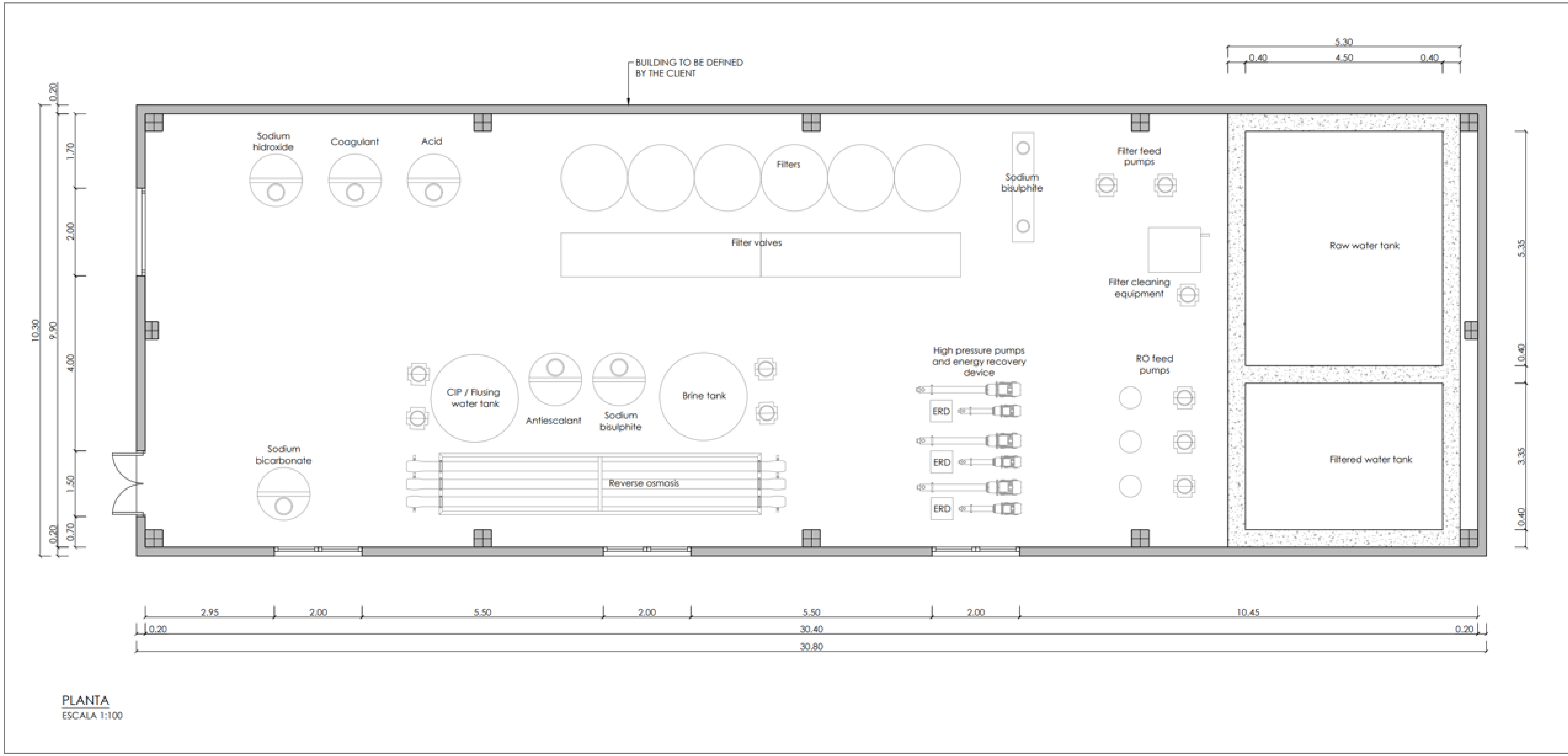


Figure 4-17 Plan View of SWDP

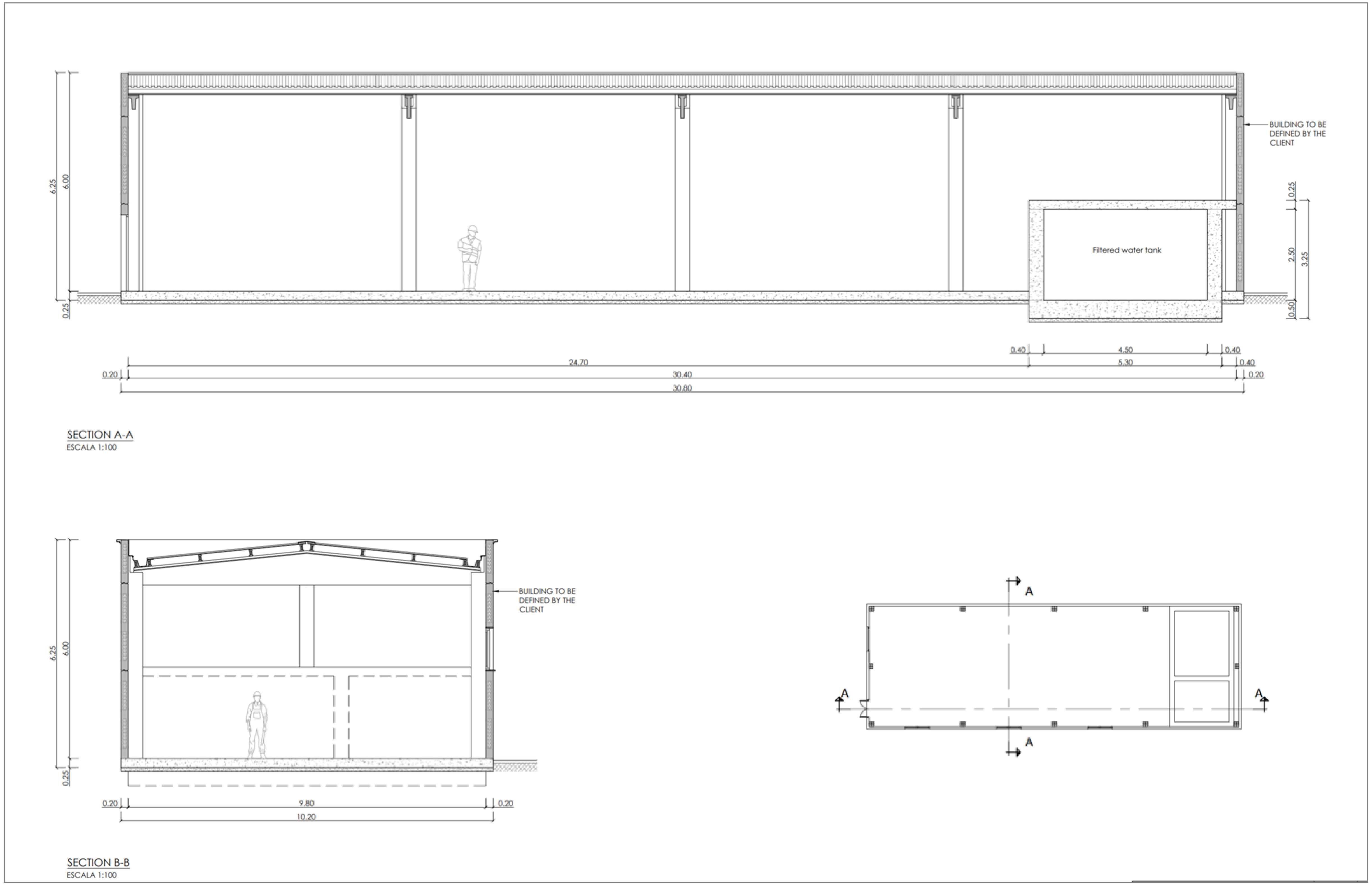


Figure 4-18 Sectional View of SWDP

4.2.2.1 Seawater Abstraction Wells

The hotel complex has six (6) wells to collect water from the subsoil. These wells are distributed throughout the surface of the complex. The abstraction wells will be located in the parking area in front of the industrial building, inland at the south of the property (Table 4-8, Figure 4-19).

All the wells are 50 m deep, and they are jacketed with a 300 mm diameter PVC pipe, perforated in their deepest 38 m, and smooth in the 12 m closest to the surface. Furthermore, outside the pipe, the well has a gravel coating.

The daily extraction volume considered for each well is 450 m^3/day for potable water production, so it represents a daily extraction capability about 2,700 m^3. As previously stated, the daily drinking water requirement is 1,072 m^3/day, for which the installation of 3 reverse osmosis lines working in parallel is foreseen. In order to compensate for maintenance stops and unforeseen events, a capacity of 3x400 m^3/day is adopted, i.e., 1.20 m^3/day and if we estimate a desalination plant efficiency of 45% (the value will be checked in later sections), to obtain 1,200 m^3 of drinking water we must extract about 2,700 m^3/day. Each well of the extraction wells has a 30 kW pump installed, which would send water to the to the intermediate tank (described in the following section), at a 120 m^3/flow. They would work in an alternating way along the day, falling just shy of 4 h/pump, controlled by a flowmeter and level switch to avoid surpassing the authorized daily volume of abstracted water.

Table 4-8 Coordinates of Abstraction and Rejection Wells

Well Type/Number	X	Y
Abstraction Well 1	726122.4828	700018.7819
Abstraction Well 2	726095.8480	700030.5514
Abstraction Well 3	726070.3764	700041.8068
Abstraction Well 4	726040.9971	700054.7890
Abstraction Well 5	726013.2421	700067.0535
Abstraction Well 6	725984.7306	700079.6522
Rejection Well 1	726123.7846	700085.0399
Rejection Well 2	726022.1237	700179.0852

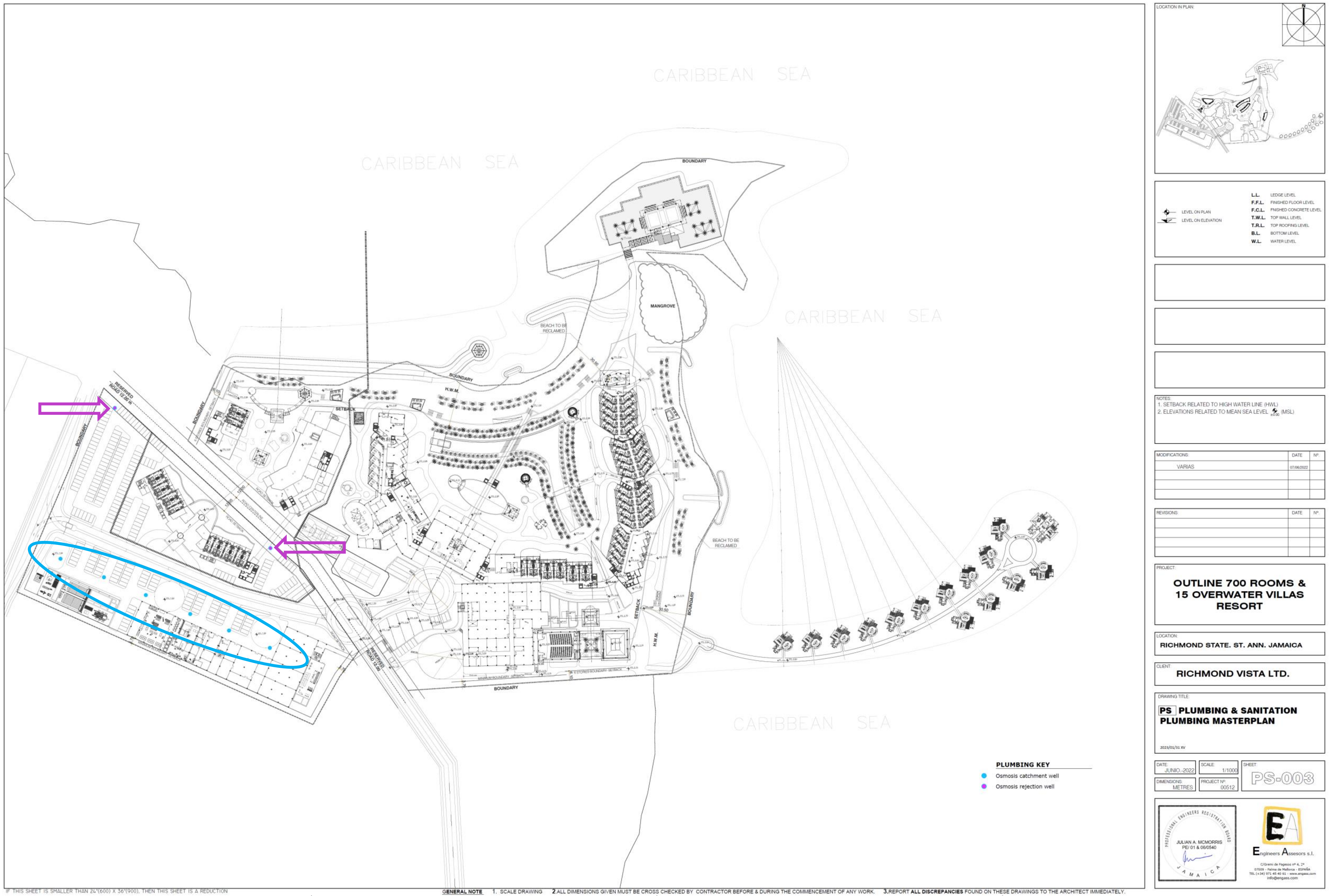


Figure 4-19 Map showing locations of abstraction and rejection wells

4.2.2.2 Well Water Quality

Typical seawater analytical parameters have been adopted for this report. These parameters are as follows:

Table 4-9 Well water quality parameters

Parameter	Units	Value
pH		7,39
Electrical Conductivity	microS/cm	54.867,50
Salinity	ppt (mS/cm)	36,22
TDS	mg/l	35.102,50
Turbidity	Units	4,00
Temperature	°C	30,47
TSS	mg/l	13,44
Disolved oxygen	mg/l	4,57
DBO	mg/l	0,60
COD	mg/l	446,67
Clorure	mg/l	19.565,50
Nitrate (NO3)	mg/l	0,80
Phosphate (PO4)	mg/l	0,26
Hardeness (CaCo3)	mg/l	6.820,00
Sulphate	mg/l	3.202,50
Sodium	mg/l	9.466,67
Iron	mg/l	0,16
Manganese	mg/l	0,05

4.2.2.3 Raw Water Tank

Raw water drawn by the well pumps will be stored in the raw water tank (T-101), placed inside the desalination building, as an annex to the main building. This tank has the following characteristics:

- Construction material: Reinforced concrete
- Usable storage volume: 55 m³ - Length: 4.50 m - Width: 3.50 m - Height: 2.00 m
- Retention time: up to 30 min at nominal flow.

In addition to providing retention time to the process and equalizing any flow variation in the input water, any large solids which could have been swept along from the wells will be settled in this tank. Periodically, these solids will be removed in order to keep the tank clean and avoid the proliferation of biological life. A chlorine dosage by sodium hypochlorite addition in tank T-101 or in the pipe to pre-treatment filter has been foreseen, for the purpose of applying a shock dose if any kind of biological contamination appeared, or to prevent its apparition all at once.

4.2.2.4 Pre-Treatment

Raw Water Pumps

From tank T-101, saltwater is sent to sand filters, pumped by “raw water pumps” P-101- A/B. Each one of them has the capacity to pump the nominal plant flow. These pumps have the following characteristics:

- Units: 2 (1 of them on stand-by)
- Unit flow: 111.11 m^3/h
- Pressure: 1,0 bar
- Power: 11 kW

All pipes around these pumps will be made of PVC-40Sch, and valves will be of PVC #150.

Ultraviolet Disinfection

After pump discharge, the first treatment applied to water is UV disinfection. In this case, it is installed prior to filtration to prevent microbiological growth in the filters. The UV equipment has the following:

- Units: 1
- Reactor material: HDPE
- Flow: 112 m^3/h
- Power: 15 kW
- Regulation: Automatic

All piping will be made of PVC-40Sch, and valves will be of PVC class #150.

Pre-Treatment Filters

In order to filter all water towards the reverse osmosis process and withhold the small solids and colloids that could remain in the water, a water filter system will be placed. These filters, named SF-101-A/B/C/D/E/F, have the following characteristics:

- Units: 6 filters
- Nominal flow rate per unit: 20 m^3/h
- Material: GRP
- Unit diameter: 1.52 m
- Filtration velocity at nominal flow rate: 10.15 m/h

- Filtration velocity when 1 filter is cleaning: 12.18 m/h
- Filter bed: Sand – anthracite/green sand.

A filtration velocity this low has been chosen since we want to do a coagulation over the filter surface. Coagulant is dosed in the main feed pipe to allow the flocculation of colloids, which will be compiled in larger piles, and their retention in filter, in order to improve the quality of the water heading towards the reverse osmosis process. Filtered water is stored in the "Filtered water tank", T-201. All pipes and valves carrying water to or from the filters will be made of PVC-40Sch, and valves will be of PVC class #150, whereas pipes and valves needed for the conveying of air will be made of iron casting respectively.

Filter Wash System

When the sand in the filters becomes dirty and filters start to clog up, additional pressure is needed for the water to go through the sand, wasting more energy from pumps than necessary. In order to prevent this issue, when a differential inlet-outlet filter pressure is reached or after a predetermined period, filters are washed. Filter cleaning is carried out in a sequential process by conveying a combination of air and water through the filters. A brief description of the typical filter cleaning phases is the following:

- Filter bed expansion: Water from tank T-201 is pumped by "cleaning filter pump" P-101 in a counter current configuration in the first dirty filter, at a high enough speed to expand the filter bed without causing losses of sand or anthracite. This filter bed expansion makes it possible to separate the bulk of the retained filth.

- Shaking: P-201 stops and a small amount of water is drained from the filter. Blower B-201 insufflates air inside the filter, also in a counter current configuration, to induce an intensive shaking of the filter medium and to separate the dirt adhered to the sand.

- Washing: After the shaking phase, blower B-101 stops and pump P-101 sends more water in counterflow, once again resulting in an expansion of the filter bed and the carry-over of the detached dirt.

- Rinsing: In this phase, raw water goes through the filter in a co-current configuration, settling the filter bed. In all the previously described phases, dirty water coming from the filter wash is sent through the drainage network. When the rinsing phase is completed and clean water is obtained, water is once again sent to T-201, prompting the cleaning of the next filter. "Cleaning filter pump" P-101 has the following characteristics:

  - Units: 1 - Nominal flow rate: 20 m^3/h
  - Pressure: 2 bar
  - Power: 2,2 kW

"Cleaning blower" B

  - 101 has the following characteristics:

- o Units: 1
- o Nominal flow air rate: 100 m^3/h
- o Differential pressure: 0,15 bar
- o Power: 3 kW

Filtered Water Tank

All filtered water from SF-101-A/B/C/D/E/F filters is stored in a tank, placed in the building where the reverse osmosis process takes place, and has the following characteristics:

- Construction material: Reinforced concrete
- Usable storage volume: 34 m^3
- Length: 4,5 m
- Width: 3,5 m
- Height: 2,5 m
- Retention time: up to 20 min at nominal flow

The retention time available with tanks T-101 and T-201 is close to 50 minutes.

4.2.2.5 Reverse Osmosis

Reverse osmosis is the centrepiece of the proposed treatment. It consists of applying a high pressure to force water through a semi-permeable membrane that retains salts almost completely. By doing so, two outlet streams are generated: a permeate flow, composed of water without salts; and brine, water that accumulates all retained salts in addition to the salt contained in the inlet stream. As this kind of separation by membranes is very sensitive to environmental and operation conditions, some parameters such as flow, pH, temperature, conductivity, pressure… must be controlled. The more stable the feed conditions are, the better the system will work. The proposed system is made out of three parallel streams, each one carrying 33% of the nominal flow rate. Should one of them cease working because of maintenance work, the other one would generate desalted water for the resort's consumption.

Both streams start in T-201, from where water is drawn by "reverse osmosis feed pumps" P-201-A/B/C. These pumps supply pressurized water to "high pressure pumps" P-202- A/B/C, preventing undesirable situations such as cavitation problems before feeding to the reverse osmosis process occurs. Returning to the subject of P-201 pumps, the pressurized water receives some chemical reagents dosage to prepare the water for the next process. These reagents mainly adjust the water's pH, add an antiscalant to prevent precipitation phenomena on the osmosis membranes, or neutralize the concentration of free chlorine the water might have. P-201 pumps have the following characteristics:

- o Units: 3
- o Nominal flow rate: 37,05 m^3/h
- o Pressure: 2,0 bar
- o Power: 11 kW

After the chemical reagents injection, water goes through the CF-201-A/B/C “reverse osmosis cartridge microfilters”. These filters have a 5 microns clear passage width and play a security role, preventing any particle with a larger size from reaching the membranes. CF-201 microfilters have the following characteristics:

- o Units: 3
- o Nominal unit flow rate: 37,05 m³/h
- o Clear passage width: 5 microns
- o Body material: PVC
- o Design pressure: 6 bar

Before the last pressure increase, the water parameters are measured in order to have information about the water and prepare it for the reverse osmosis process. These parameters are analysed and measured with a set of analysers (pH-meter, redox transmitter, SDI, conductivity transmitter) that ensures the water characteristics are optimized for its further treatment. After parameter measurement, if the water is not of appropriate quality, it will be automatically returned to T-201 for reconditioning. In each treatment line, water is once again divided into two streams. The main one is sent to P-202-A/B/C pumps respectively for its pressurization to the 55-60 bar needed in the reverse osmosis treatment. The secondary stream is diverted toward an energy recovery device (ERD). The brine produced by the reverse osmosis process amasses not only almost all of the salt contained in the inlet stream, but also all the pressure applied to the stream except that which is lost as a result of friction inside the pressure vessels. This energy in the form of pressure can be reused by exchanging it with the inlet stream. This way, the brine is depressurized as the inlet stream becomes pressurized. This pressure exchange occurs inside the ERD. Pressure equivalent to the friction head loss inside pressure vessels is supplied with a booster pump connected to the exchanger. When the secondary stream pressure matches that of the mainstream, both streams are reunited and introduced in the pressure vessels, where the reverse osmosis treatment takes place. The designed reverse osmosis process has the following characteristics:

- o Number of lines: 3
- o Processes per line: 1
- o Stages per process: 1
- o Pressure vessels per line: 5
- o Membranes per pressure vessel: 8
- o Recovery rate: 45 %

Permeate nominal flow rate per line: 400 m³/day Depressurized brine is sent to the “brine tank” T-301 for its further injection in soil, whereas the permeate flow undergoes remineralization. All high-pressure pipes and valves are made or duplex stainless steel 40sch, with #1500 flange able to withstand sea water and operation pressure, while low-pressure pipes and valves and pipes are made of PVC 40Sch, with #150 class flanges.

4.2.2.6 Water Remineralization

Following the withdrawal of salts in the permeate flow it acquires a corrosive character. This water could eventually dissolve the metallic pipe compounds and/or cause health issues derived from continued use. To prevent this from happening, sustaining remineralization until the water acquires a slightly incrustation nature. For remineralization, a sodium carbonate slurry is dosed into the water and the water is ready to be stored for consumption.

4.2.2.7 Flushing and CIP Cleaning

From time to time, usually once a year, the membranes will be exposed to aggressive cleaning agents without being extracted from their pressure vessels. This process is known as CIP (clean in place) and it consists of submerging the membranes in a chemical preparation at 37ºC, as a means of dissolving all incrustation that had been generated. For this process, a tempered cocktail of chemical reagents is prepared and pumped towards the osmosis process, displacing all water left, salted or not, leaving the membranes submerged for several hours. Furthermore, when a stop occurs in the reverse osmosis process, be it scheduled or accidental, pressure vessels become depressurized and a stream of clean water is poured out over its surface, sweeping along the accumulated salts. This phase is known as flushing, and it serves to prevent incrustations and precipitates which could damage membranes or the process as a whole.

Once the salts have been flushed, the reverse osmosis treatment becomes operational again. The water used in the flushing process must be clean, but an exceptional quality is not required. Therefore, the water initially produced in the reverse osmosis treatment is used for this purpose while the treatment is picking up the pace, instead of throwing it down the drain. Given the ad hoc approach of the CIP process, instead of relying on 2 installations, one of which would be seldom used, both the CIP and flushing processes will be managed with the same equipment (tank and P-401-A/B pumps) As can be easily seen, when a flushing or a CIP cleaning process is being carried out, the reverse osmosis stream undergoing the treatment won't be operative, thus not producing water. Water generated via CIP or flushing will be drained along with the brine. The T-401 "CIP (and flushing) tank" for water accumulation has the following characteristics:

- Units: 1 - Material: GRP
- Usable storage volume: 3'5 m^3
- Diameter: 2 m P-401-A/B "CIP pumps", have the following characteristics: - Units: 2 (1 of them in standby)
- Nominal flow rate: 50 m^3/h
- Pressure: 6 bar

All pipes and valves belonging to the CIP-flushing system will be made out of PVC 40Sch, with #150 class flanges.

4.2.2.8 Chemical Reagents

The utilization of the following chemical reagents has been planned in the design of the proposed process:

Sodium Hypochlorite

It will be used as a disinfectant and bactericide at the entrance of SWDP, with the capacity to dose chlorine, either in low doses to avoid biological contamination in the process or applying a higher, shock dose if strong contamination was observed at the entrance. Moreover, a dosage of chlorine in safe drinking water produced has been planned in order to prevent the proliferation of algae or any other form of biological life in the storage or distribution of water to the consumption points. The sodium hypochlorite dosage has the following characteristics:

- Pure product dose: 4 mg/l
- Dosing pump type: Membrane with 10 to100% regulation
- Nominal dosing flow rate: 4 l/h
- Storage volume: 1.000 l
- Storage autonomy: Up to 7 days

Coagulant

The water entering SWDP could be sweeping along large solids, which are easily removable through decantation or filtration, and smaller colloidal solids, which, by their nature, are more complex to retain. In the case of removing them in the reverse osmosis process, continuous blockages would be prompted, forcing repeated cleanings that would reduce the efficiency of the plant. By means of the controlled addition of this reagent, the colloids would be grouped into larger piles, thereby becoming easier to remove. The typical coagulants are metallic salts such as alumina sulphate or ferric chloride. The coagulant dosage (fusing alumina sulphate), has the following characteristics:

- Pure product dose: 25 mg/l
- Dosing pump type: Membrane with 10 to100% regulation
- Nominal dosing flow rate: 4,5 l/h - Storage volume: 1.000 l
- Storage autonomy: Up to 7 days.

pH Reducers

These are strong acids, such as hydrochloric acid (35%) and sulphuric acid (96 or 98%), that allow for adjustment, of the pH value at the entrance reverse osmosis treatment by the dosage of small amounts of reagent. The acid dosage has the following characteristics:

- Pure product dose: 20 mg/l
- Dosing pump type: Membrane with 10 to100% regulation
- Nominal dosing flow rate: 6,5 l/h
- Storage volume: 1.000 l
- Storage capacity: Up to 7 days

pH Increasers

These are strong bases, generally sodium hydroxide (15%, 20% or 50%) which, by being added in line, allow for adjustment of the pH value by increasing it at the entrance of the reverse osmosis treatment. The sodium hydroxide 50% dosage has the following characteristics:

- Pure product dose: 20 mg/l
- Dosing pump type: Membrane with 10 to100% regulation
- Nominal dosing flow rate: 3,1 l/h
- Storage volume: 1.000 l
- Storage capacity: Up to 7 days

Antiscalant

These are specific chemical formulations, suitable for the water entering the reverse osmosis process, which are used when the formation of precipitates inside the membranes is foreseen. They are also known as dispersants, since they disperse the ionic species that form the salts, causing a high oversaturation in the medium before precipitates are formed. The antiscalant dosage has the following characteristics:

- Pure product dose: 5 mg/l
- Dosing pump type: Membrane with 10 to100% regulation
- Nominal dosing flow rate: 0,5 l/h - Storage volume: 100 l
- Storage capacity: Up to 7 days

Sodium Bisulphite

This chemical compound is used to neutralize the possible excess of free chlorine that may arrive from the initial disinfection. This neutralization is necessary because when this free chlorine comes into contact with the membranes, it denatures them irreversibly (“death by chlorine”). The sodium bisulphite dosage has the following characteristics:

- Pure product dose: 6 mg/l
- Dosing pump type: Membrane with 100% regulation
- Nominal dosing flow rate: 2,50 l/h
- Storage volume: 1,000 l
- Storage capacity: Up to 7 days

4.2.2.9 Potable Water Tank and Net Connection

Treated water is sent to any of the tanks at the hotel.

4.2.2.10 Brine Storage

Brine will be stored in a specific tank (“brine tank” T-301) from which it will be injected via pumping into two of the injection wells. The wells chosen for the brine injection are the two furthest from the extraction wells. For the injection, a smooth PVC 40Sch Ø200, will be installed inside the well with protection at the bottom so that the brine does not rise through the gravel layer outside the well, salinizing the water intended to be drawn. This tank's main purpose is not to guarantee a retention time, as was the case with the raw water and filtered water tanks, but rather to collect the effluents from the washing water of the filters and mix them with the brine, ensuring a minimum volume that enables the pumps to be primed. This tank has the following characteristics:

- Material: GRP
- Storage capacity: 10 m^3
- Diameter: 2.0 m
- Height: 3.5 m

4.2.2.11 Brine Discharge

The brine produced is a waste to be disposed of. In order to do this, there are 3 possible solutions that deserve to be subjected to in-depth studies:

1. Discharge in open sea by means of an underwater emissary that takes advantage of marine currents to accelerate the dissolution of the brine.
2. Discharge to the coast, in the breaking zone so that the waves dissolve and mix the brine with the marine environment.
3. Injection in wells. In this way, brine is injected into wells dug into a permeable substrate which allows the infiltration of the liquid.

For **Options 1 and 2**, a pipeline will be constructed and the brine discharged to the marine environment. **Option 3** involves injection of the brine into 2 wells on site. For the injection, 2 horizontal pumps will be installed to push the brine through 2 additional wells. These brine injection wells will be located on the northern side of the property, at least 80 m form the closest abstraction well (Figure 4-19). **Option 3** is the preferred option for brine discharge.

In order to reduce the salinity of the brine to reinject, this stream will be mixed with the surplus raw water from the extraction wells. That mixture will be done in the previously described brine tank T-301. These pumps have the following characteristics:

- Units: 2 (one in standby)
- Unitary flow rate: 65 m^3/h
- Pressure: 2,5 bar
- Power: 11 kW.

Pipes and valves used for brine injection will be made of PVC 40Sch, with #150 class flanges.

4.2.2.12 Energy Consumption

For the complete installation of water extraction from the wells, treatment and brine injection, an installed power of 440 kW is calculated. The energy cost per m^3 of permeate water produced is 3.13

kWh/m³ of which 2.45 kW/m³ is the cost associated exclusively with desalination, without including either pre-treatment, brine capture or injection.

4.2.3 Concrete Batching Plant (construction phase)

4.2.3.1 Specifications

The batching plant to be used will be the Frumecar model, double silo system. The process entails the combination of water, aggregates and cement. The temporary batching plant facility will generate a total of approximately **75,000 cubic metres** of concrete during the construction phase of the project. Table 4-10 shows the breakdown of raw materials and quantities to be used in the process.

Table 4-10 Raw materials and quantities to be used in the process

Description	Units	Quantity (m³)	Total Quantity
Cement	Ton	0.400	30,000
Additive	Gallon	0.800	60,000
Sand	M³	0.720	54,000
Gravel	M³	0.580	43,500

The batching plant will operate for approximately 20 months (or until project completion). The facility will be constructed and operated within curtilage of the property. The raw materials consist of the following:

- Bulk cement – to be purchased from Caribbean Cement Company Ltd. and stored in silos.
- Aggregate – To be purchased from the Lydford Mines in St. Ann and stored in well-defined
- containment areas, separated via walls and covered with tarpaulin.
- Water – To be supplied by the National Water Commission (NWC). Estimated total volume of water to be used in the process throughout the entire construction phase of the project is 4,000 m³.

Concrete wastewater will be generated from washing out trucks and pumps, including water from rinsing off chutes, equipment and truck exteriors. In order to prevent concrete wastewater from entering waterways, storm drains and groundwater, a special designated concrete washout area will be constructed. A hole will be dug where concrete wash water will be discharged and left to dry for 1 – 2 weeks. The dried concrete will then be broken up and removed via excavators, loaded into dump trucks, and transported to an authorized disposal facility.

Table 4-11 shows the batching plant specifications. The batching plant will be located toward the western most boundary of the site (JAD2001 coordinates: 726025.051E 700127.831N), on a land area of 5,525 m² (Figure 4-20 and Figure 4-21). Figure 4-22 depicts the batching plant.

Table 4-11 Batching Plant Specifications

Technical Specifications	Units	Quantity/Particulars
Production	m3/h	50
Cycle	m3/h	1
Dry Numbers	u	4
Hopper Layout		Square
Dry Storage Capacity	m3/h	25
Cement Silos	u	2
Cement Storage Capacity of each silo	Tn	112
Water Meter		Yes
Screw Conveyor Diameter	mm	219
No. Charge Ways	u	1
Mixer		Verticale Axle FTR-1500
Dy Storage		Optional
Control Cab		Provided
Pneumatic Installation		Provided
Electrical Panel		Provided
Computer Equipment		Provided
Total Power	Kw	84
Power Input	Kw	72

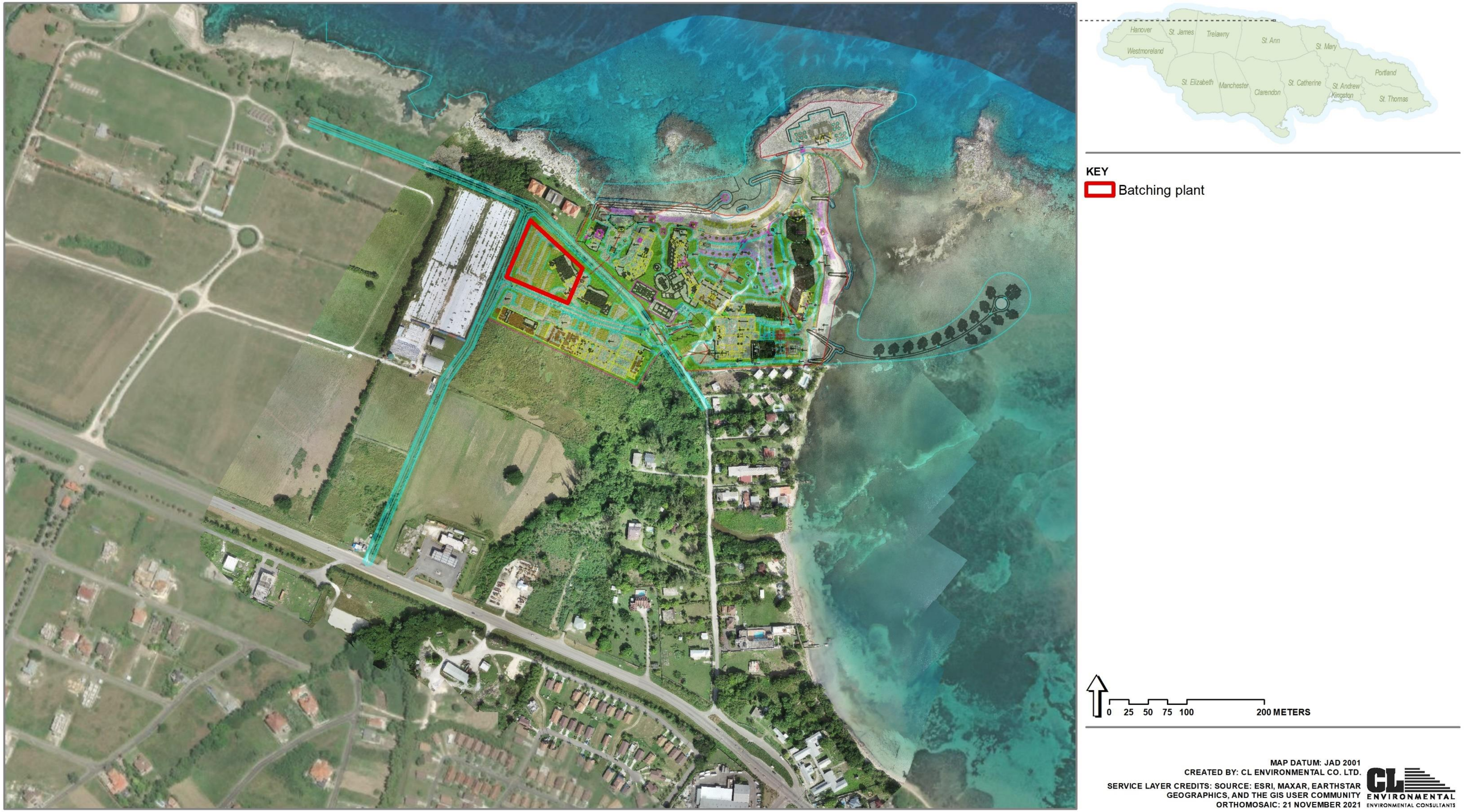


Figure 4-20 Map showing the location of the batching plant and surroundings

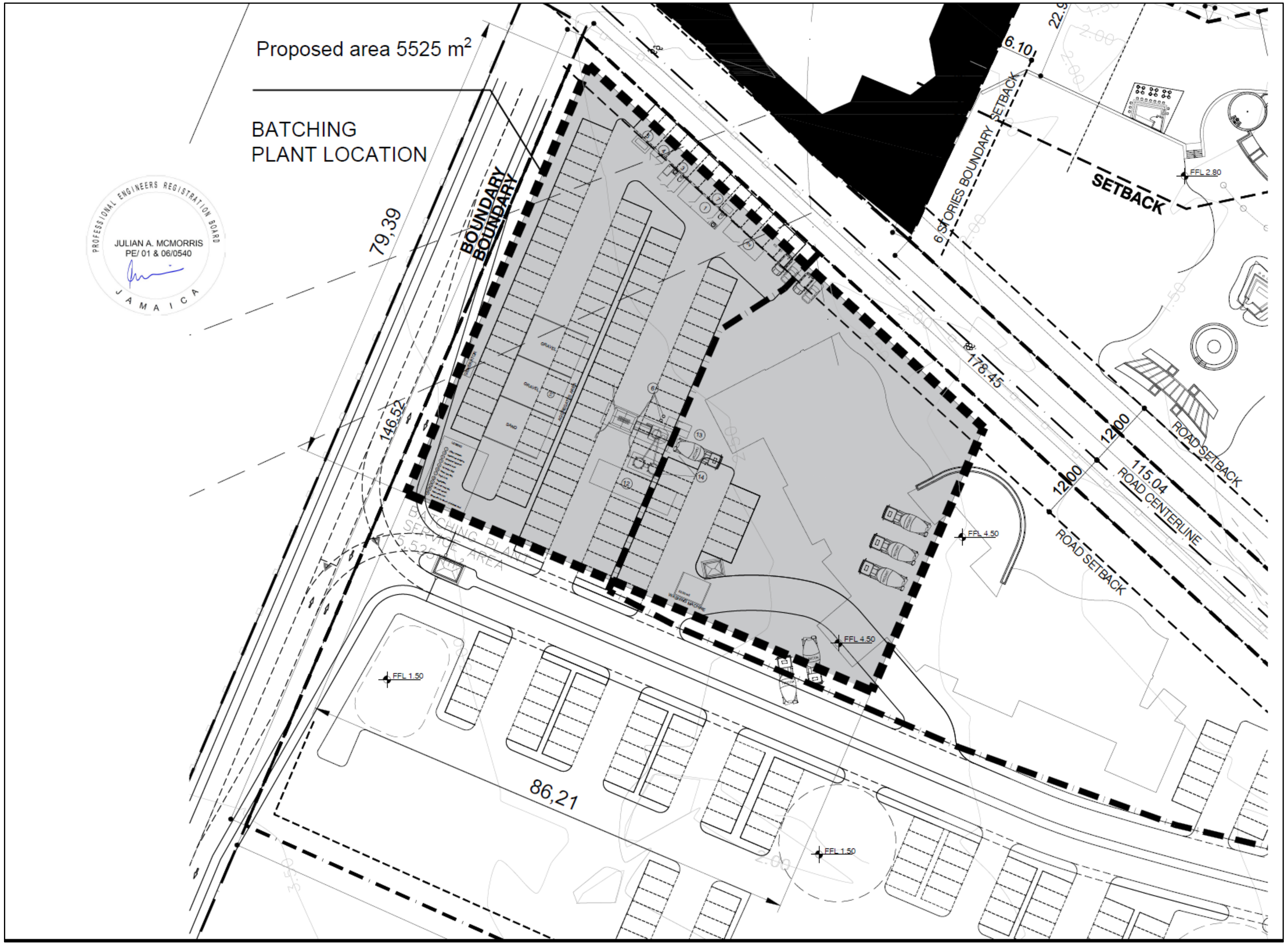


Figure 4-21 Map showing zoomed in location of batching plant

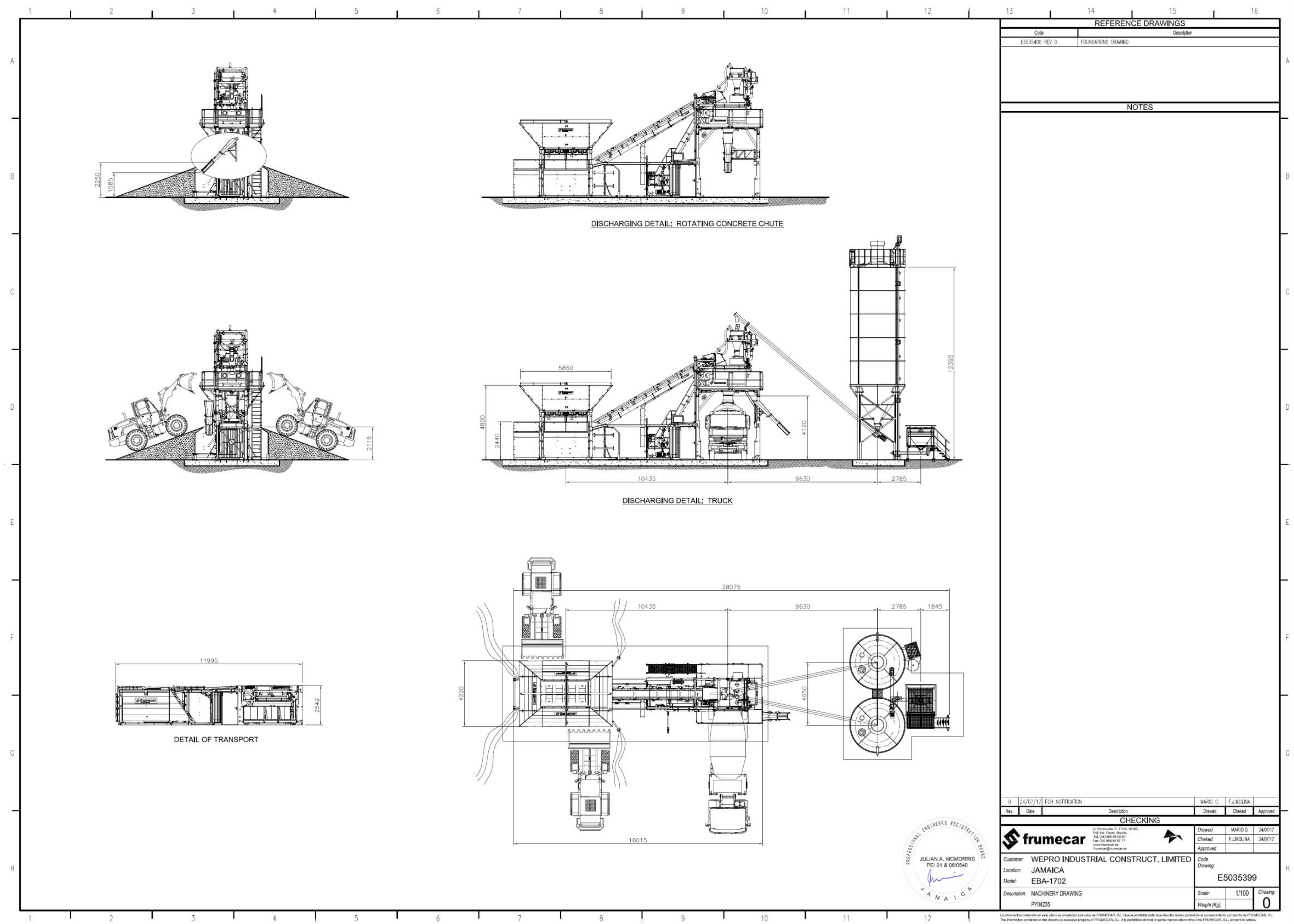


Figure 4-22 Temporary Frumecar Batching Plant

4.2.3.2 Dust Control

The following mechanisms are part of the batching plant process which will aid in minimizing dust emissions from operations.

Cement

Cement is received in sealed trucks and "blowed" into the two silos using high performance and press pipes specifically designed for this procedure. The system has an electronic valve that measures and controls the flow, which is stopped if an emergency occurs. The storage of cement is using an independent double silo system. Each silo has 4 fluidizer filter that make one way only for the cement dust, avoiding any leak to the exterior. The maintenance of this filter is done every week.

The process for the usage of the cement once is blow into the silos for the production of the concrete is using spin pipe sealed directly to the wet mixer. This system is sealed and protected and guarantee no loss of product or quality occur during the process.

Management of Aggregate Stockpiles

This material is received in trucks covered with tarpaulin and is stored in specific areas prepared for its management. These specific areas isolated with concrete slab and walls avoiding any contamination with mud, water or the land. The material is mainly stone or sand, without any treatment or chemical added, as it is found in any natural mine.

This material is delivered to the aggregate hopper using a backhoe that load the raw material. This material can carry with it some dust, but mainly it is wet avoiding this issue. In any case, this dust is just the normal dust of moving sand.

Once is in the hopper; the electronic machine carries the raw material into the wet mixer to be mixed with the other components using a continuous load system.

Vehicular Activities and Speed Limit

All trucks transporting aggregate to the site must be securely covered with tarpaulin. A speed limit of 25 km/hr (15 mph) must be maintained on site to avoid and abate dust emissions from access roads. Where necessary, flag persons stationed at the main entrance will regulate the movement and speed of vehicles on site. Speed limit signage will also be placed around the site.

Wetting Activities

Consistent wetting of site grounds, aggregate stockpiles and access roads will be conducted to keep dust levels at a minimum. The frequency of wetting throughout the day will depend on weather conditions (temperature, rainfall, wind speed etc.), but it will be a point of duty that whenever previously wetted areas have dried out, then re-wetting of said areas reoccur immediately. This frequency of wetting will be increased on hotter and more windy days.

Dust/Particulate Monitoring

Air quality monitoring will be conducted on the site. Coarse particles are airborne pollutants that fall between 2.5 and 10 micrometres in diameter. Sources of coarse particles include crushing or grinding operations and dust stirred up by vehicles traveling etc. These respirable particulates (PM10) will be measured at various locations at property boundaries and neighbouring residential communities. At least one monitoring station (location) will be established upwind of the proposed site. The results of the data collected will be compared with National Environment and Planning Agency Standards.

4.2.3.3 Emergency Response

Identification of Emergency Situation

Identification of potential emergency situations and accidents will be carried out through the Risk Assessment process for all new contracts / introduction of new working methods. Identification of methods, risks, hazards and controls (based on site / job specific risk assessments) may also be documented in new contract proposals as requested by the Company/Owner. These will include method statement, legislation and PPE required. Proposal documents will also include identification of environmental issues covering potential noise, land, water and air pollution

The purpose of risk assessment is to identify the significant risks in the workplace and then control those risks at an acceptable level and to comply with the EHSS Plan and Manual

All aspects of the work activity are reviewed for Risk Assessment. Where hazardous chemical risks are encountered, C.O.S.H.H. (Control of Substances Hazardous to Health Regulations) Assessment Procedures are followed and where other risks are to be assessed, the policies in the EHSS Plan and Manual will be implemented – this includes key aspects such as working from height, confined spaces, manual handling, contact with waste, use of equipment and environmental risks. Health & Safety requirements may also be supported by an external H&S consultancy.

Where appropriate, detailed method statements are also produced for particular contracts / site operations. These method statements include scope of work, job specific instructions, risk assessment, accident and near miss reporting, tool box talks, PPE and equipment information and sign-off / acknowledgement sheets.

Emergency Response activities include spillage / contamination control measures. If an emergency situation or accident occurs in relation to the collection, processing and shipment of waste / recycling by contractor emergency response activities will be implemented accordingly.

Response to Emergency Situation

Activities that are higher risk may include:

- Fires, explosions;
- Storms, hurricane or other unexpected weather conditions;
- Major chemical spillage or leakage;

- Accidents as a result of equipment failure
- Admixtures, and cement scope

In the unlikely event of an emergency situation arising that has an adverse environmental impact, emergency response actions (as documented in site folders, risk assessments and material safety data sheets), will be implemented.

Upon satisfactory completion of the emergency response, appropriate paperwork / documentation as required by NEPA is to be raised and submitted. In parallel with this, post-accident evaluation will be carried out and appropriate corrective and preventive action implemented.

Corrective and preventive action must be documented on an Accident Report Form and should include details of the emergency situation / accident, root cause, environmental impact, corrective and preventive actions, responsibilities and timescales. A review of the effectiveness of action should also be documented.

Test and Review of Emergency Preparedness and Response Procedures

The test and review of the Emergency Preparedness and Response process is carried out in accordance with batching plant contractor Emergency Response procedures. This may include the test / review of elements of disaster recovery, training / performance of emergency response personnel, building evacuation, internal and external communication, availability of risk / hazard information and effectiveness of (planned) mitigation and response actions. The majority of these processes are tested and verified each time emergency situation arises.

In addition to the above, response to simulated emergency situations is also tested through periodic (at least annual) exercises overseen by the Chief Operating Officer, where appropriate.

4.2.3.4 Maintenance and Operations

Engines and Mechanisms

a. Check the oil levels (by portholes and stopper reducer).
b. Check if there is an oil leak.
c. Change reducers oil maximum every 2 years.
d. Grease the bearings of plant mechanisms before first plant set up and 40 h of operation (weekly).
e. Lubricate grease points on electric motors (if any) every 40 h or once a week.

Twin Shaft Mixer

a. Exhaust internal cleaning. At least twice a day and if there is more than 30 min of stop of machine.
b. Checking of oil levels:

- Reduction gears oil: type ISO-150.
- Oil pressure system oil: type ISO-HP46 (yellow colour).
- Bearings grease: grade UNI XM 2.
- Seals lubrication:
    - i. Type NGL2 (filling up or topping up must be done by the appropriate connection – see

instructions manual table 10 A. It's absolutely forbidden to fill the grease tank by disassembling its cover).

ii. Type 00 in case of zones with very low temperatures. Same recommendations for filling.

c. Change oils every 4000 working hours or at least every 2 years.

d. Before to the first put in function, keep the reduction gears caps open in order to free inside air until oil reach its working level.

e. Checking of transmission belts regarding wear and tension.

Pneumatic Installation and Compressors

a. Check the oil level of compressor head weekly.
- If it's necessary, fill up with oil type 15W-50.
- Change oil each 3 months.

b. Check the compressor filter.
- Fill up with the same oil than we used for the compressor head. SAE 80-90.
- According to the environment dust, change the oil every 3 months.

c. Clean the filter each week. Drain the decantation glass of the pneumatic panel and compressor every 2 days (every day if the temperature or humidity conditions require it).

d. Check the work pressures of the pneumatic lines:
- Regularly pneumatic drives – 6 bar.
- Regularly cement filter – 5-6 bar (max)
- Regularly fluidization pads de los silos –. 4 bar.
- Review weekly fluidization pads piping and if they have cement the solution is in the maintenance book.

Electric Installation

a. Check tension of emergency stop system cables.

b. Check the running of emergency buttons.

Scales

a. Check the hoses.
- See that there are no cracks or fractures.
- Check they are not tightened or hardened to not distort the measures.
- Check that the scales are free from obstacles, fixed or rested elements.

b. Review vent pipes are cleaned (once per week).

Conveyor Belts

a. Tighten the belts and centre them periodically, especially first working months. Later monthly checking.

b. Check that the rollers turn free and without dirt weekly.

c. Check the adjustment and wearing of scrapers.

d. Cleaning collection hoppers, trays under the tape and covered rollers, avoiding the accumulation of aggregate material.

4.2.4 Drainage

This section contains excerpts from the standalone Drainage Report (Smith Warner Internatonal Ltd., 2023) *prepared for the proposed development by Smith Warner International Ltd.*

4.2.4.1 Design Criteria

The general site drainage for the project was designed according to specific guidelines set out in the "Guidelines for Preparing Hydrological and Hydraulic Design Reports for Drainage Systems of Proposed Development Applications" (Ministry of Transport, Works and Housing, 2015).

The following guidelines were adopted:

- On site drainage will be designed to accommodate a minimum of the 10-year return period.
- The main drains (box culvert) will be sized to accommodate the 25-year return period flow.
- Building drainage will discharge surface flows into interconnected infiltration wells.
- Where required, flood peak discharge attenuation techniques will be employed to limit the discharge of urban runoff where downstream interests outside of the project site might be affected.
- Minimum and maximum velocities in storm drains shall be 1.0m/s and 3.5m/s, respectively.
- Tail water in receiving water bodies will be as follows:
    - Drains and culvert: normal depth for design flow.
    - Ponds, lakes, and rivers: Normal high-water depth; and
    - Sea and shoreline discharge: Mean High Water.

The design strategy is to follow the existing slope of the land and channel surface runoff to the shoreline of the property where it will discharge to the sea. The International Plumbing Code Handbook (Woodson, 2006) is a plumbing code and standard that sets minimum requirements for plumbing systems in their design and function, and that sets out rules for the acceptances of new plumbing-related technologies. Guidelines within the plumbing code were used to determine the minimum pipe and conductor sizes as well as the minimum slopes allowable based on the pipe size.

4.2.4.2 Stormwater Conductors and Drainpipes

It is recommended that the 1 in 100-year event (346 mm/24hr) be used to calculate the flows generated from the property roof. It is recommended that all roof drains should have strainers extending not less than 102mm (4'') above the surface of the roof immediately adjacent to the roof drain. This will aid in prohibiting debris items (such as leaves, plastics, and rocks) from entering the roof drains. The design for the strainers should be guided by the criteria stipulated within Section 1105 of the International Plumbing Code (IPC) guidelines which indicated that strainers should have one available inlet area, above roof level, but not less than one and one-half times the area of the conductor of leader to which the drain is connected. For example, a 250mm and 125mm strainers should be used for a 100mm and 50mm conductors respectively.

4.2.4.3 Onsite Drainage (Internal Site Catchment Area)

It is proposed that the site will be raised to a minimum ground elevation and finish floor elevation of +2.8 and +3.0 meters above mean sea level respectively. This site will be properly graded to facilitate proper drainage from north to south. Storm runoff will sheet flow across the property into infiltration wells. The infiltration wells are interconnected via a pipe network which will allow overflow, if necessary, from one well to the next. There are also two overflow pipes from the last infiltration wells on the eastern and northern section of the proper that passes through the groyne structures and empties into the Caribbean Sea. Theses outfall pipes will provide emergency release for the infiltration well system during extreme event that is outside the design parameters and or in the event there is any failure to several infiltration wells. It is being further recommended that suitable measures such as the use of grasscrete pavers and green spaces be maximized to reduce runoff.

Figure 4-23 shows the layout of the proposed infiltration well and pipe network for stormwater runoff on site.

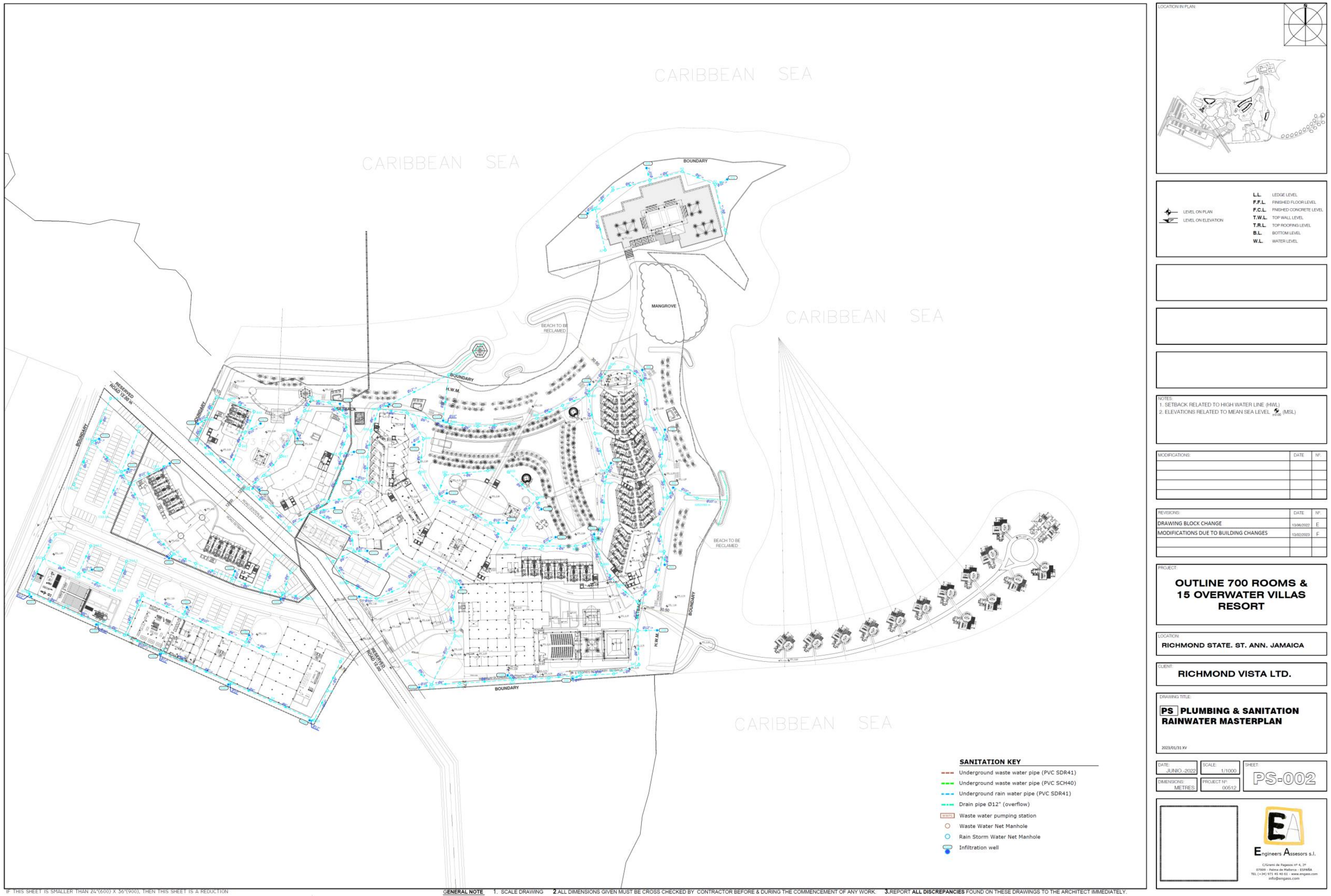


Figure 4-23 Layout of the proposed infiltration wells and pipe network for stormwater runoff on site.

4.2.4.4 Drainage Master Plan

The objective of the drainage design is to successfully manage the heavy flows from the property by reducing/eliminating the potential for flooding, scour, debris deposition and poor water quality discharge along the shoreline or into the Caribbean Sea. The drainage master plan includes a covered U Channel along the south-eastern property boundary and a series of interconnected infiltration wells with two outlets to the Caribbean Sea. This combination of elements is being proposed to handle the flows generated from the wider catchment associated with the proposed Richmond development and the flows within the property boundary.

The proposed drainage master plan is as follows:

1. Stormwater runoff generated from the wider catchment will follow the natural slopes and grade of the land in a north-eastern direction where it will enter a covered U channel (box drain).
2. The stormwater will then flow in a south-easterly direction along the south-eastern property boundary and discharges into the Caribbean Sea.
3. Stormwater generated from the building roof and other areas within the property boundary will be directed to infiltration wells.
4. The infiltrations wells are interconnected and follow proposed slopes and grade of the property in a northern direction towards the Caribbean Sea.
5. The interconnected infiltration wells will culminate into two final infiltration wells located along the eastern and northern property boundary.
6. The final two infiltration wells are design with overflow pipes that leads to the Caribbean Sea through the proposed groynes. These pipes will provide a release for the infiltration system in the event several infiltration wells should fail and or a storm event occurs that’s outside the design criteria.

Covered U-Channel Box Drain

The proposed covered U channel to manage the stormwater generated from the wider catchment has a minimum width of 1.5m and a depth of 1.25m which will then discharge the flows into the Caribbean Sea. Summarised in Table 4-12, it should be noted that a freeboard of 25% was considered for the covered U channel (box) drain and the drain was within the stipulated flow velocity of 1 to 3.5 m/s. The flow capacity of the proposed channel was determined to be 4.39 m3/s, which is enough to accommodate the calculated 1/25-year return period rainfall event for a post development condition.

Figure 4-24 shows a plan layout of the outer catchment drainage plan while Figure 4-25 shows the section and details of the Covered U (box) drain.

Table 4-12 Summary of the proposed covered U channel drain to manage the flows generated from the wider catchment associated with the proposed development

Box Channel	Values	Units
Length of channel	170	m
Elevations		
Lower elevation	0.00	m
Upper elevation	0.65	m
Slope	0.38%	
Mannings Coefficient	0.012	
Width	1.50	m
Depth	1.00	m
Depth + freeboard	1.25	m
R	0.4	m
P	3.5	m
A	1.5	m^2
Velocity	2.9	m/s
Flow	**4.39**	m^3/sec
Tt	0.034	hours
Design Flow – 25-year return period	**4.26**	m^3/sec
Design Acceptability	**OK**	

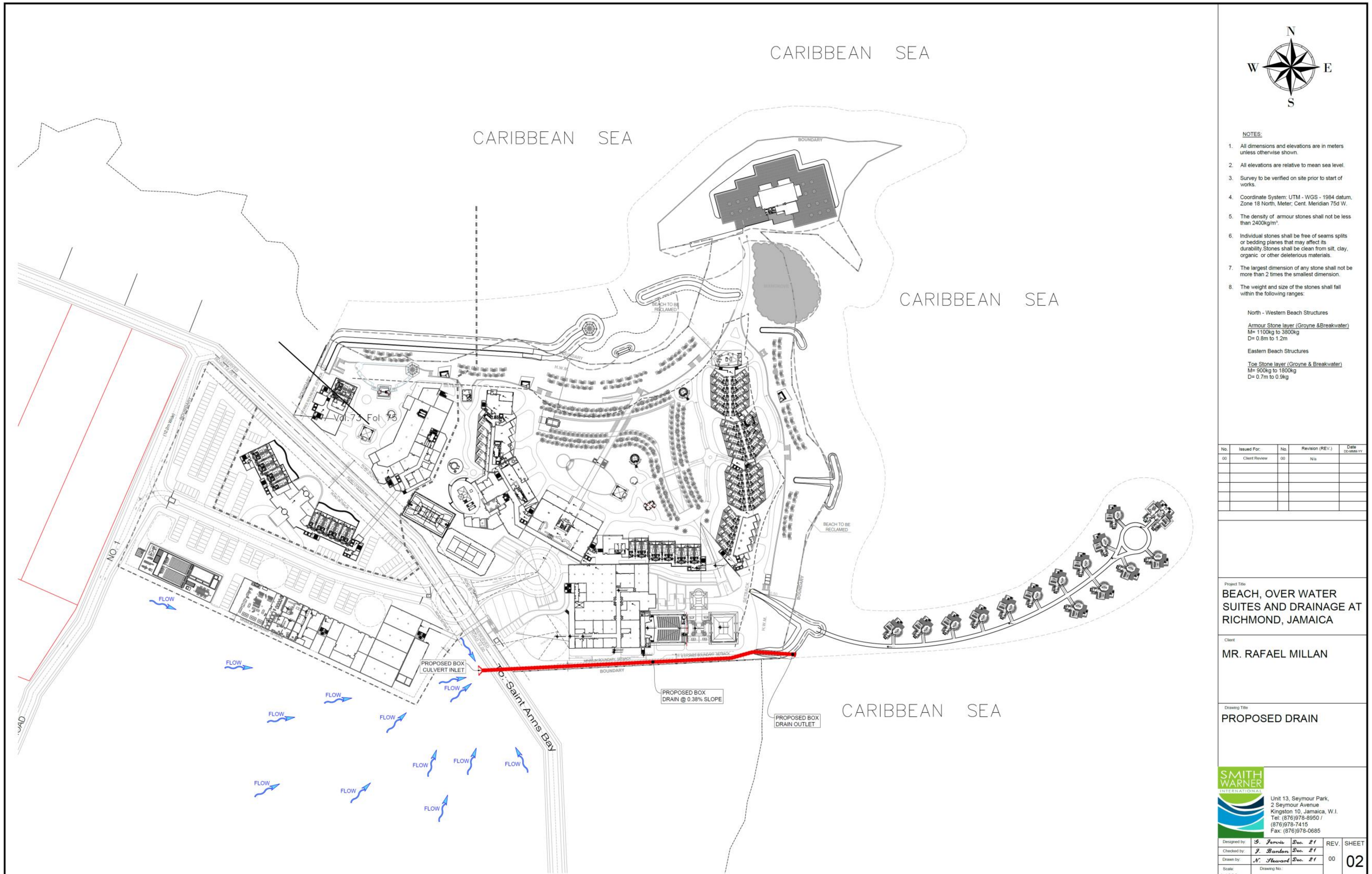


Figure 4-24 Plan layout of the outer catchment drainage plan

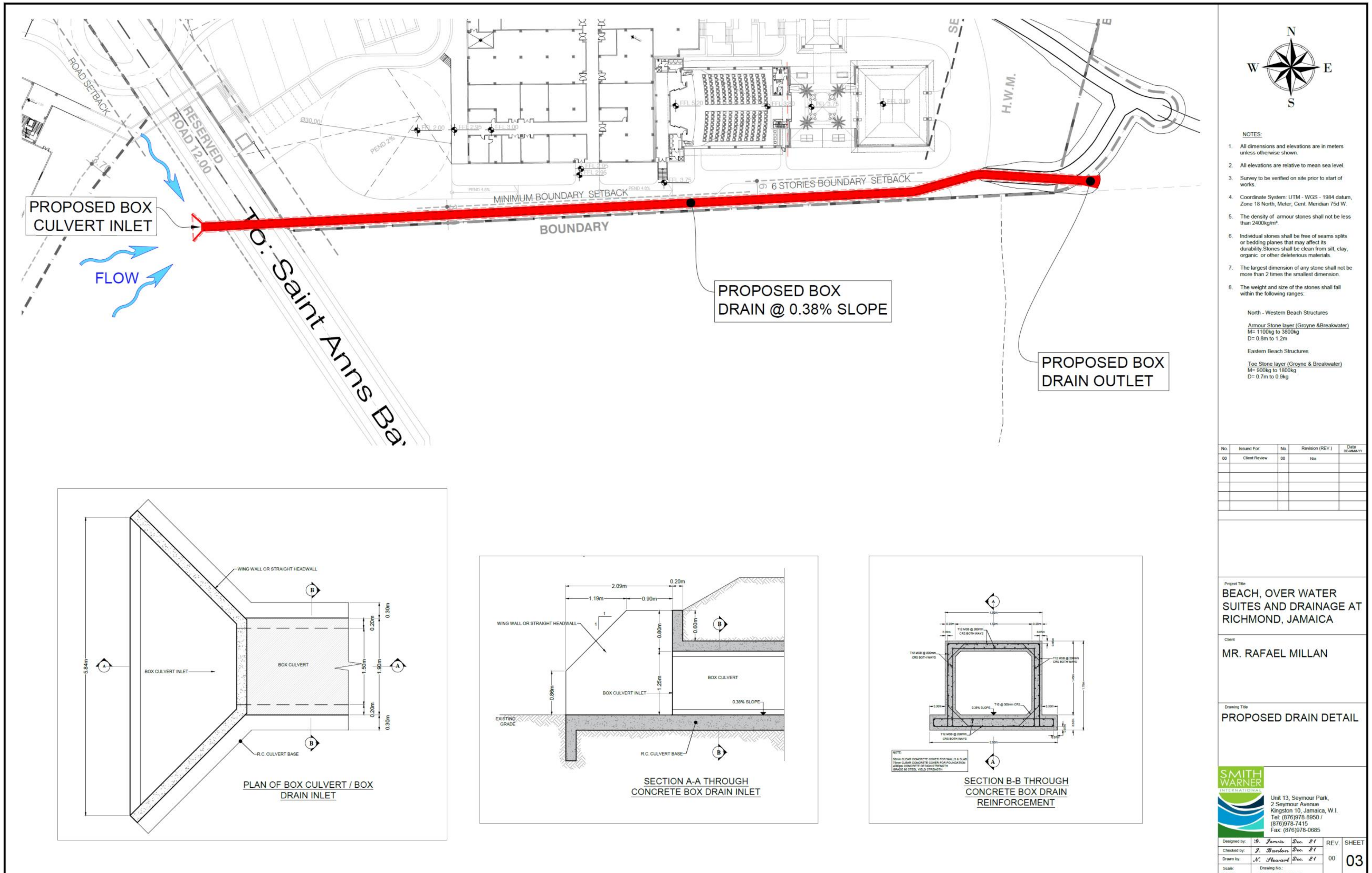


Figure 4-25 Section and details of the Covered U (box) drain.

4.2.5 Electricity

Electricity supply will be obtained from the Jamaica Public Service Company Limited. The electricity demand for the resort when completed is estimated at 2,500 KWhr/day.

4.2.6 Water

Potable water for hotel operations will be provided via desalination of seawater as described in Section 4.2.2.

4.2.7 Fire Protection Systems

Fire Protection Systems around the hotel property will include; Automatic detection and alarm systems, emergency lighting and signals, Type III portable manual fire extinguishers, water sprinkler system and automatic kitchen hood fire extinguishers.

4.2.8 Solid Waste

Garbage disposal areas will be clearly identified to adequately contain the daily solid waste from the building areas including the Hotels buildings, restaurants etc. Appropriate recycling methods will also be explored the minimize the overall waste for disposal and appropriate storage and systems for wet and dry garbage. Garbage collection and disposal will also be organized with an authorized solid waste company to have regularly schedule pickups.

4.3 CONSTRUCTION METHODOLOGY

4.3.1 Hotel

4.3.1.1 Foundation

Reinforced concrete piles connected with caps on the base of the pillars will be utilized. The caps shall be mutually braced in all directions using beams. The foundations for smaller structures shall be laid on Pre-Cast Foundation Slabs, in accordance with the structural engineer's criteria. The foregoing is subject to the Geotechnical Report.

4.3.1.2 Structure

Reinforced concrete slabs with hanging beams and reinforced concrete pillars will be utilized. The stairs are also made from reinforced concrete and shall be built together with the structure.

4.3.1.3 Masonry

External Partitions: Structure built from 40x20x20 cm grey concrete blocks, to be subsequently finished, including HM-20N/mm^2 concrete filling and rebar.

Exterior: Structure built from 40x20x20 cm grey concrete blocks, to be subsequently finished, including HM-20 N/mm^2 concrete filling and rebar

The perimeter enclosure shall be built in accordance with the "Masonry" specifications of these quality specifications, with the approval of the structural engineer.

Interior:

Division between room and between client areas: Structure built from 40x20x20 cm grey concrete blocks, to be subsequently finished, including HM-20 N/mm^2 concrete filling and rebar.

Division between bathroom and bedroom in rooms: Structure built from 40x15x20 cm grey concrete blocks, to be subsequently finished, laid with 4:1 river sand and cement mortar.

Divisions between rooms:
Indoor partitions:

- Division between suites and rooms: Structure built from 40x20x20 cm grey concrete blocks, to be subsequently finished, including HM-20 N/mm^2 concrete filling and rebar.
- Indoor divisions between rooms: Structure built from 40x15x20 cm grey concrete blocks, to be subsequently finished.

4.3.1.4 Roofing

Pitched Roofs:

Built from 50 x 150 m/m wooden beams with 60cm spacing between their centre-lines, placed on the edge of the eaves on a metal plate and under the ridge cap, on a 15x20x40 concrete block wall, and fitted with concrete tie beam and metal plates.

MDF treated with a waterproofing asphalt membrane: In this way the fibreboard would have no contact with water or humidity. This option combined with correctly installed shingle could be sufficient.

Fiberglass Shingles.

A shade will be chosen that can be easily purchased for repairs in addition to supervising the installation. Installation courses should be given to the staff supervising installation. One badly fitted shingle will allow water to filter into the woof.

Flat Roofing: Vapour barrier flat roof on concrete slab + lightweight concrete with a slope, with an average thickness of 10cm + 4cm thermal insulation + 5cm Cement mortar. Double asphalt membrane. Low roofs good waterproofing and decorative elements in various colours to make the roof aesthetically pleasing.

Open hallways and terraces: Lightweight concrete with a slope with an average thickness of 3cm, cementitious waterproofing with at least 24-hour watertightness tests. Floor should be laid as soon as test is complete to avoid damage to the waterproofing. The waterproofing of open hallways may be prevented.

4.3.1.5 Coverings

Exterior coverings:

Facade: 20mm thick trowelled and screeded render on the entire surface. The façade shall have an ornamental finish: fibre cement siding finish.

Division between rooms and the facade corridor. Local white stone finish in accordance with height plans.

Interior coverings:

- Vertical finishes: 20mm thick trowelled and screeded render on the entire surface
- Plastered ceilings: Trowelled 20mm thick render on horizontal surfaces.
- For veneering and tiling: 20 mm thick screeded render applied with a scratch coat for subsequent tiling.

All trowelled smooth finishes must be finished with mould-proof render for a smooth, perfect finish.

4.3.1.6 False Ceilings

A certified anti-mould drywall or sheetrock will be used in all areas exposed to humidity. Consideration will be given to using Durock with plaster in areas exposed to strong winds. In addition to the foregoing, special attention must be paid to the structure and gauge to be used as all thicknesses and gauges are not the same, nor do they have the same uses.

4.3.1.7 Insulation

- Rooms: Acoustic flooring with impact noise reduction and a 10mm acoustic underlay sheet placed below the flooring. Such acoustic sheet must be covered with levelling and protective mortar, no thinner than 5cm.
- Roofing: 4cm thermal insulation.

4.3.1.8 Waterproofing

- Containment walls (concrete and blocks): Asphalt undercoat, air-blown asphalt layer applied at an average weight of 3 kg/m^2, reinforced with 160 g/m^2 non-woven polyester felt, applied with blowtorch, duly affixed and blown permeable and dimpled sheet. As an alternative, a cement-based waterproofing agent could be used in accordance with the previously approved data sheet.
- Showers: waterproofing of showers up to at least 1 metre high applying two layers of polymer modified bicomponent cementitious mortar for waterproofing.
- Planters: waterproofing by applying two layers of polymer modified bicomponent cement-based mortar for waterproofing and a duly affixed and blown permeable and dimpled sheet.

4.3.1.9 Tiling and Plating

Flooring

The surfacing of the stairs must be carefully selected. The surfacing used must be appropriate and not alternate in the various areas. The paving stones must also be carefully selected. A standard colour must be chosen, and stones must be 10cm thick for traffic and 7cm thick for pedestrians. Lay concrete slabs similar to those laid on the sun decks underneath the paving stones with black washed sand. Avoid using bullnose tiles. Do not lay porcelain floor tiles over loose mortar, only levelled mortar. In areas of light traffic, assess its durability and confirm if a thicker tile (4cm thick + 4cm of mortar) will be sufficient.

Woodwork

ROOMS:

- Twin door: Single-leaf hinged solid wood RF-30 fireproof main door of standard measurements in accordance with plans, fitted with frame and sub-frame with exterior 10cm and interior 6cm joint covers, finished with leisure oil; including hinges, stopper, electronic lock for use with card and a stainless-steel door closer; with a design on outer side and smooth finish on inner side.
- Windowless sliding, solid wood door of the measurements specified in the plans, fitted with frame, sub-frame and with exterior and interior 6cm joint covers, finished with leisure oil with a design on both sides, in addition to decorative finishes, a lock and a stainless steel door handle.
- Door shared between rooms forming an overlapping structure of two standard 203x32x6cm hinged leaf (1+1), one of which is acoustic with an automatic inner rubber door seal and the other RF-30 fire proof. Both made of solid wood and fitted with a frame, sub-frame and 6cm joint covers. Finished with leisure oil and with a design on the side facing the room and smooth on the other side; in addition to decorative finishes, a lock and a stainless steel door handle.
- Bedroom wardrobes: Front of built-in wardrobe of the size specified in the plans, with windowless sliding doors with a upper and lower adjustable roller and anti-derailment system; including frame, sub-frame and joint covers in solid wood and leaves with design on both sides, wooden trim and leisure oil finish. Inside of wardrobe is lacquered in white and formed by set of 4 drawers, horizontal and vertical shelves on a 2cm thick board, including a metal bar to hang clothes.

- Secrets box: 1 hinged fire-proof RF-30 door for room services, made from MDF with a smooth design. The outer side must be coated with 8mm thick cement boards reinforced with silicone and cellulose fibres, tongued & grooved and with a smooth inner finish, fitted with frame, sub-frame and 2cm thick joint covers and a cylinder lock without handle.

- Balcony lattice panelling: Privacy lattice panelling for bathtubs made from an aluminium sub-frame and fixed or adjustable boards depending on height.

COMMUNAL AREAS:

- Separating doors between client and service areas: Single-leaf hinged solid wood RF-30 fireproof access door to services areas, stairs, etc., fitted with frame and sub-frame with exterior 10cm and interior 6cm joint covers, finished with leisure oil; including hinges, stopper, lock, handle and a stainless steel door closer; with a design on both sides and a perimeter seal.

- Utility room: Single-leaf and windowless hinged fire-proof RF-30 door for utility rooms in corridors, made from MDF with a smooth design. The outer side must be coated with 8mm thick cement boards reinforced with silicone and cellulose fibres, tongued & grooved and with a smooth inner finish; fitted with frame, sub-frame and 7cm thick joint covers and a cylinder lock without handle.
- Lattice panelling for open corridors: Lattice for protection from rain made from a wooden sub-frame and fixed or adjustable boards, depending on height.
- Service area access door: Single-leaf hinged solid wood RF-30 fireproof access door to services areas, stairs, etc., fitted with frame and sub-frame with exterior 10cm and interior 6cm joint covers, finished with leisure oil; including hinges, stopper, lock, handle and a stainless steel door closer; with a design on both sides and a perimeter seal.

- The structural engineer should stipulate the length of the beams.

4.3.1.10 Aluminium Carpentry

Rooms:

- Balcony: aluminium double-leaf sliding door fitted at the balcony exit, lacquered in the same colour as the outdoor woodwork, and prepared for the installation of Climalit glass.

Communal areas:

- Carpentry for vertical work: Anti-Hurricane aluminium 70x120cm windows fitted with hinged or fixed panes and frame, sub-frame and joint covers, lacquered in a colour similar to the outdoor woodwork and installed in Public Areas. All aluminium must be prepared for the installation of glass.
- Roofing/porches: Aluminium structure with 70 x 30 mm lacquered hollow sections and aluminium purlins prepared to support the glass roofing.

4.3.1.11 Metal Carpentry and Locksmithing

All metal structure, Metal pillars, diameter in accordance with calculations. These pillars must be concrete instead of metal due to construction aspects, and with a prestressed beam.

4.3.1.12 Glasswork

Rooms:

- Bathrooms: Single-leaf hinged non-porous and completely smooth glass safety door for room showers and toilets with a translucent effect and colourless in 10mm of acid.
- Glass to be fitted on balcony: 6+12+6 Climalit glass

Communal areas:

- Exterior communal areas: Glazing with Stadip laminated safety glass made of two sheets of 6mm thick colourless glass bonded together with colourless Polyvinyl Butyral interlayers.

- Indoor areas: 6mm colourless glass
- Roofing Glazing with tempered glass made of two sheets of 5mm thick colourless glass, bonded together with colourless Polyvinyl Butyral interlayers.

4.3.1.13 Exterior Areas

Foundations

- Sunroom: Filled with 25cm thick lifts in addition to: laid, spread and compacted to 95% of the standard proctor, and 12cm thick concrete slabs with 8mm steel B-500S mesh reinforcement. Mesh size 15x15cm, proportional price for joints, sawing and trowelling. Use a geotextile mesh over the existing material before filling and compacting with a slope down towards drains in order to drain the surface and to ensure water does not filter into and damage the filling and to allow settling. Mechanical help is also required to prevent cracking.
- Pool and Swim up: on piles, caps and reinforced concrete slabs and B-500S rebar in accordance with calculations.

- Parking lots: Filled with 25cm thick lifts: laid, spread and compacted to 95% of the standard proctor.

Structures

- Swimming Pool and Swim Up: Reinforced concrete walls and B-500S rebar in accordance with calculations. Concreted foundation slab, Sika Swell s-2 sealants for joints and Sika Swall A swellable profile, walls built up with high resistance concrete.
- Walkway through the swamp. Try to mobilize walkway in an area with ground that is more stable.
- Water features and fountains:
- Wooden bridge: laminated load-bearing wooden or metal beams (depending on structural design), with hardwood floor, wooden lattice front, with a wooden beam roof + 19mm MDF board + FiberGlass Shingles.

Waterproofing

- Planters: Waterproofing of decorative fountains with asphalt overlay fabric, applied with blowtorch prior manual asphalt priming, applied on the entire surface and turning the top of the overlay fabric up to 30cm. Installation of fiberglass mesh for subsequent rendering.

Masonry

- Walls and enclosure of the plot: Built from 40x20x20 cm grey standard hollow concrete blocks to be coated.

Flooring

- Sunroom and walkways: The options proposed are coral stone or another similar stone that is easy to maintain. Choose good quality with few pores.
- Manhole covers must be metal and only the cover and the lateral wall support must be visible, not the manhole itself.

- Outdoor parking: Hot bitumen mixture on draining surface course with a 20x10cm concrete curb, cast in place or pre-cast and of a very good quality. 5cm thick asphalt sheet. The curbs must be constructed before the asphalt and must include a water curb or gutter.

Coverings

- Swimming Pool and Swim Up: coating on swimming pool basin. The pool trim must be of the same material as that of the sundeck and not cast-in-situ.
- Enclosure wall: Rendered and screeded with waterproof mortar.

Carpentry and Locksmithing

- Enclosures: Wrought iron grill in accordance with details.
- Metal doors for customer and service access.
- Various random metal elements in accordance with design (e.g. railings).

4.3.2 Beach Works and Overwater Rooms

The construction of the following structures is proposed:

- Five (5) rock groynes
- Two (2) rock revetments
- One (1) perched beach
- One (1) ~1.5m deep flushing channel
- One (1) water sports jetty
- One (1) emergent breakwater
- Two (2) concrete retaining walls

4.3.2.1 Construction Prep Work

This stage of the construction requires the identification of an access route for the carting of construction material to the site as well as waste material from the construction process. The access route will be aligned with the existing entrance for the hotel, then follow the eastern and western property boundaries to the beach. The stockpile area will be prepared with a suitable working surface of compacted gravel fill. The stockpile area will be used for:

- Site office,
- Storage of equipment when not in use,
- Storage of imported or manufactured sand,
- Storage of boulders,
- Storage for waste material heading to landfill,
- Drainage area of excavated material site.

Where necessary temporary construction pad/access road (typically 5m wide at the crest) will be built from the shoreline in a seaward direction. The access road will help with the delivery and removal of material and will serve as a work platform for the mechanical placement of stone for the proposed structures. The temporary access roads will be built in the proposed areas for modification, while avoiding sensitive benthic substrates as much as possible. Where contact with corals/seagrass is unavoidable, the intention is to relocate or transplant those corals/seagrasses before construction begins. A schematic of the proposed access roads is shown below in Figure 4-26.

The structures on the western and eastern beach can be built directly from land with no need for temporary pads except for the emergent breakwater.

A temporary pad will also be needed to construct the overwater suites.

Figure 4-26 Proposed construction layout showing temporary access roads (in green) for the Richmond Development

4.3.2.2 Structure Construction

Boulders can be used in the works without further scale model testing or field investigations, although specific physical, chemical, and structural laboratory tests will be required for the stone material. Once an appropriate quarry is located, the required numbers and sizes of stones can be sourced and stockpiled. It is imperative that the quarry(ies) selected for use in boulder supply be inspected to ensure that they are certified to operate and are operating in a manner that is respectful of the environment.

A stockpile of armour stones will be created. The size and quality of individual armour stones will be checked against a sample. The samples are armour units of the correct geometry and structural properties and must be free of fractures and impurities. These armour stones will be displayed prominently near the stockpile area at the quarry and on site to allow for ease of comparison, thereby allowing easy identification of stones that meet the requirements of the technical specifications. Stones that are smaller than the sample stone or contain more imperfections will not be used in the structures.

During this stage of the construction, the boulders will be placed according to the design. For this process, an excavator will be used to progressively place the boulders from shore. The armour units will be placed on the existing grade without excavation of the seabed. The rocks will first be placed to an elevation suitable for moving the equipment from land to the extents of the works. When returning, rock structures will be shaped and brought to the required elevation by either removing the rock layers or adding additional layers to meet design requirements. Spotters in the water will assist the heavy equipment in accurate placement of the armour units. The slopes and elevations of the armour layer will be demarcated with visual aids to guide the placement of boulders and to ensure they are properly interlocked.

4.3.2.3 Excavation and Grading

The second stage of works involves the excavation of the existing shoreline up to the vertical wall proposed by the architects. There will also be excavation in the nearshore to remove the rocks and cobbles to make it easier for guests to walk. This will also slightly deepen the nearshore area to make it easier for adults to wade.

4.3.2.4 Dredging of Wading Area and Flushing Channel

The seabed will be dredged using a bucket excavator. To do this, boulders will be used to create a temporary construction pad in areas that are too soft for excavators. The excavated material will be carted to the drainage stockpile area. After that, the boulders used for the construction pad will be removed. The foreshore will be mechanically and hydraulically dredged (by excavator and suction pump). An excavator with a hammer will be used to create the flushing channel through the peninsula. The channel will be sloped and excavated in accordance with the design.

4.3.2.5 Drainage of Dredge Spoil

The material dredged from the wading area will be brought to the stockpile area with trucks and/or discharge pipes. The material will be dewatered in a settling pond constructed in the same area as the stockpile. After the dewatering of the dredge spoil is complete, the suitable material will be used for backfilling the back of the beach and the filling behind the revetment of the perched beach.

4.3.2.6 Pile Driving for Overwater Suites and Water Sport Jetty

The piles will be placed either by driving with a hammer attached to a crane or excavator or by a coring with an auger. Detailed geotechnical surveys will be carried out to determine which of these methods is more suitable. Regardless of the method, a temporary construction pad will be necessary to execute this operation. This pad will be made of only granular material below the sea level to minimize introduction of silt within the area. In addition, 600mm diameter HDPE pipes spaced 20m apart will be placed along the access pad to facilitate flushing. This access pad is anticipated to remain in place for a period of around six months and will then be removed.

The construction of the super structure for the Sea Rooms will be primarily masonry and carpentry work above sea level. Platforms and scaffolding will be put in place to facilitate this construction. Debris from these operations will be brought onshore daily and disposed of appropriately.

4.3.2.7 Beach Creation

Once the appropriate slope into the water has been attained through excavation and grading, the beach will be nourished with appropriately sized sediment. The sand will then be mechanically placed on the beach to match the lines and grades of the design, and finally smoothed manually by labourers.

Marine sand will be required for the beach nourishment exercise, while the wading areas will require manufactured sand to be placed on the seafloor. The materials will be brought to the site from a certified/approved source. All acquired sediment will be placed on the proposed beach and shaped accordingly. The silt content should be low, ideally less than 0.5%, and great care should be taken when spreading to minimize loss of material.

4.3.2.8 Architectural Details

The water sports dock, gazebo and any other amenity desired by the client will be the last of the beach works.

4.3.2.9 Equipment and Materials

The structures can be built onsite using mainly conventional land-based equipment such as loaders and excavators. The armour stones for the structures will be stockpiled at locations on land within the project site. The stones will be carried out to the various structure locations via a loader and placed with an excavator. The revetment material can be placed with excavator only. To complete the proposed works, the following equipment and materials will be needed:

Equipment

- Two (2) Medium Size Excavators – For removing, loading, placing, and handling boulders, fill, sand, and other materials
- Two (2) Front End Loaders – For loading, removing, placing, and transporting material onsite.

- Two (2) Long Reach Excavators – for clearing of silty areas and hydraulic removal and transport of sandy/silty material
- Cement Mixer – to mix concrete
- Trucks – transportation of material
- Small site boat – access and management of turbidity barriers

Materials

- Boulders (Source: local quarries)
- Sand excavated from a terrestrial source or manufactured from limestone (Source: Bahamas or St Elizabeth, Jamaica)
- Fill Material (Source: on site or local quarry)
- Filter Fabric

4.4 PROJECT PHASING AND SCHEDULING

The hotel resort will be developed in two (2) phases: i) the First Phase will include 500 hotel rooms and 15 over water suites; ii) the Second Phase will include 200 additional hotel rooms.

Phase 1 is estimated to have a total construction time of 24 months, and Phase 2 is expected to have a total construction time of 24 months. Phase 2 is expected to be implemented 24 – 48 months after Phase 1 is operational, but is dependent on market conditions.

4.5 EMPLOYMENT

The work force for the site will at peak time be approximately 1,000 trade men and labourers during construction. This should create approximately 3,800 indirect and induced jobs during construction.

Once fully operational, the hotel expects to employ approximately 1,600 persons (Phase I – 670 pers. and Phase II – 930 pers). This should create approximately 6,080 indirect and induced jobs. To the extent practicable, the Client will utilise local skills and labour for construction and operation of the hotel.

4.6 OPERATIONS

4.6.1 Energy Conservation Strategies

Jamaica has one of the highest electricity rates in the Caribbean, and hotels are generally energy intensive. The proposed project will incorporate several energy saving practices and technology to conserve on energy use and reduce costs. These will include:

- All rooms will be lit by Light Emitting Diodes (LED) technology.
- The other areas of the hotel will be LED type or low power consumption CFL (Compact Fluorescent Lamp).

- In every room there will be sensors that cut off the supply of air conditioning and some electrical circuits in the room when no detected any presence.
- The room air conditioning will be stopped in the event of a window/patio door opening although the sensor might indicate a presence.
- All air conditioning pipe will be coated with 1 inch of thermal insulation to reduce heat loss and therefore more efficient operation of the air conditioner.
- Solar power will be incorporated as part of the development's energy conservation strategies.

4.6.2 Water Conservation Strategies

Jamaica over the years have been experiencing water shortages especially during the summer months due to droughts. This has become more acute as the years pass by; therefore, water conservation strategies have become more critical.

This Project has incorporated water conservation features with the use of low consumption equipment. These include:

- Dual flush toilets with half (0.8 us gals) and full flush (1.6 us gals). This compares well with toilets in the 1980s that used approximately 3.5 us gals or traditional ones that used up to approximately 7 us gals.
- The faucets that will be used have water reducer (aerators) incorporated. This has the effect of restricting the maximum flow rate from the faucet. Typically, low flow bathroom faucets range from 0.5 – 1.5 us gpm (1.9 – 5.7 l/min).

In addition to these conservation features, treated wastewater effluent from the wastewater treatment plant will be used for irrigation around the property.

4.7 DECOMMISSIONING

At the time of decommissioning, the following activities will aim to satisfy the health, safety and environmental issues associated with the closing of the construction site in a manner which mitigates any adverse environmental impact.

1. Advanced notification (2 weeks) to relevant local authorities (NEPA, St. Ann Municipal Corporation) of near completion of construction and potential change in status of the site.
2. Final notification to relevant local authorities (NEPA, St. Ann Municipal Corporation) of completion of construction and change in status of the site to that of an operational hotel resort.
3. Notification to property neighbours and the immediate surrounding residential community will occur 1 week before decommissioning activities commence.
4. Security personnel will be present at all times, as it would be during normal construction phase until the decommissioning has been completed. Signage will be clearly posted at the entrance of the facility alerting the public that the facility is "Closed" and the area is "Restricted."
5. Vehicular and pedestrian access will be restricted to only personnel necessary to carry out the activities associated with decommissioning activities. Flag persons will continue to remain at

the entrance to regulate any heavy equipment entering or exiting the site as during the construction period.

6. All access will be via the posted security personnel and recorded in the security log.
7. All equipment and material during construction will be removed from the site. This will include the boulders acting as a temporary access road to construct the overwater rooms/coastal structures as well as all debris and equipment in the marine environment and shoreline used in the searoom construction process (anchors, debris, rebar, scrap metal etc.)
8. Administrative office structures will be transported off the property (no permanent structures would be constructed)
9. Portable toilets and hand wash facility leased would expire and returned to the operator
10. All material stockpiles will be utilized in the construction process and the remainder removed from the site.
11. All solid waste and debris on site and in the marine environment will be removed and disposed of by licenced contracted municipal waste operators at an approved disposal site.

The estimated timeline for decommissioning activities is 1-2 months after each construction phase is completed.

5.0 DESCRIPTION OF THE ENVIRONMENT

5.1 PHYSICAL ENVIRONMENT

5.1.1 Topography and Bathymetry

5.1.1.1 Topography

As depicted in Figure 5-1, elevations gently increase from 0 metres at the shoreline towards the west. Heights do not exceed 4.5m at the site with most of the site being less than 2 metres. Slope is generally gentle (less than 2.5%) across the site; however higher percent slope rises of up to 20% are seen on the northern bay (Figure 5-2). Aspect in the southwestern section of the property is primarily northeast and east and north along the northern bay, while the eastern section of the property has highly varied aspect (Figure 5-3).

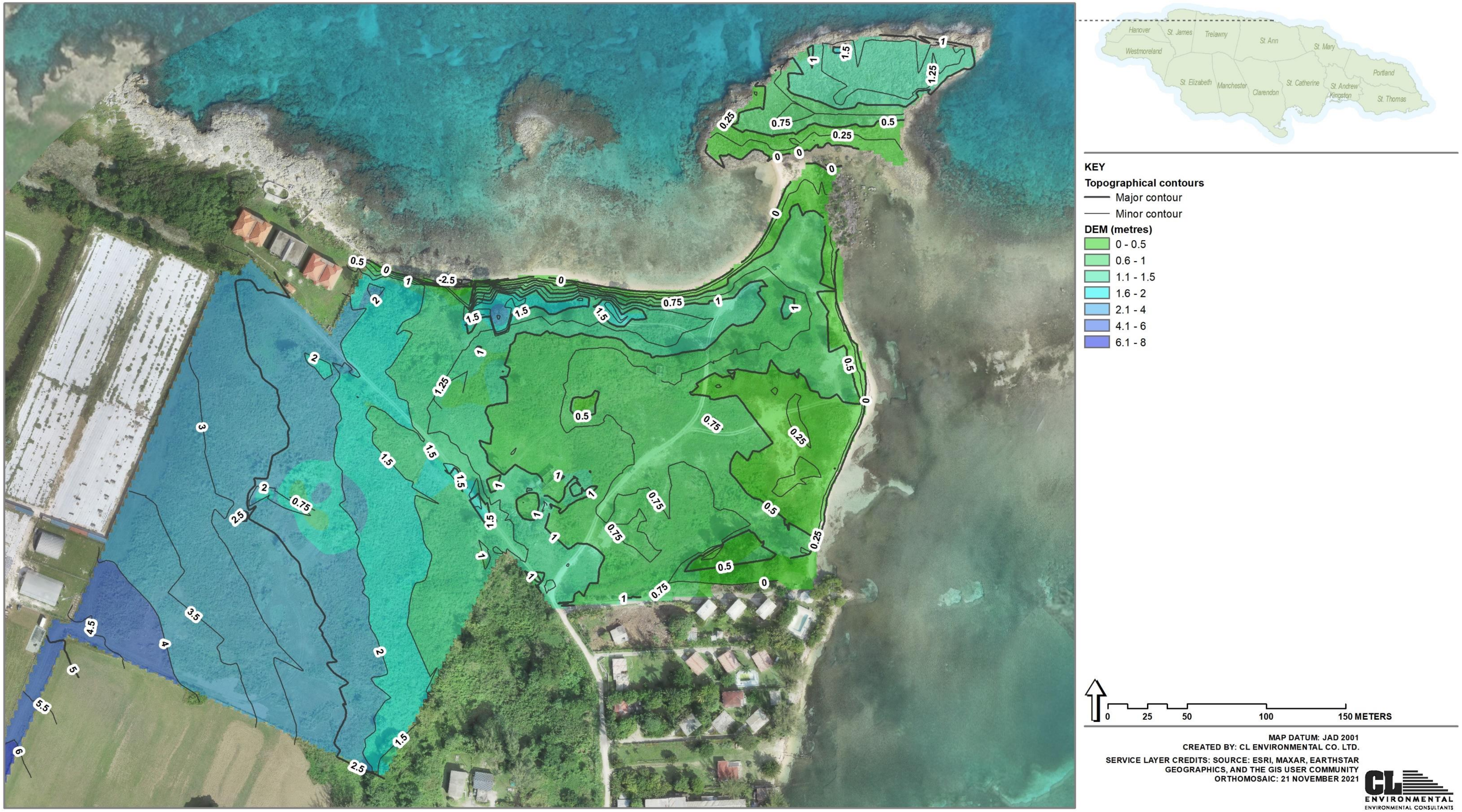


Figure 5-1 Contours and Digital Elevation Model (DEM) derived from topographical survey of the project site

Figure 5-2 Slope derived from Digital Elevation Model (DEM) of the project site

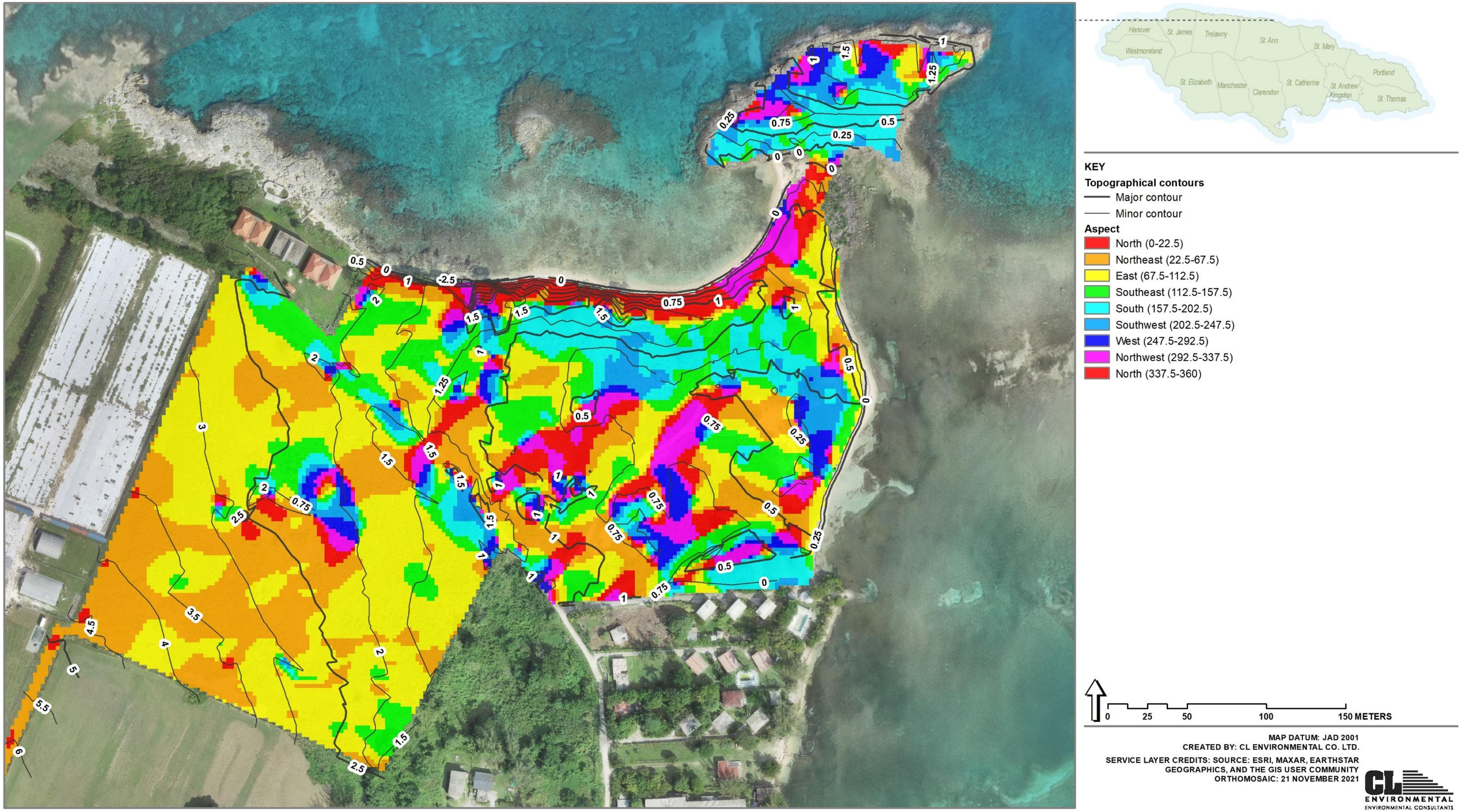


Figure 5-3 Aspect derived from Digital Elevation Model (DEM) of the project site

5.1.1.2 Beach and Nearshore Surface

Bathymetric and topographic data were received from various sources to derive a realistic surface of the beach and the nearshore areas.

Satellite-derived bathymetry (SDB) had been obtained for the project area where depths were less than 25m. This data was available on a 2m grid spacing. This satellite derived bathymetric data was validated against nearshore profile survey data collected along the project shoreline. The satellite data fit well with the measured data with a correlation of approximately ±50cm absolute and 5-10% depth-dependent vertical uncertainty. The SDB data was merged with data from nautical charts in the MapSource (Garmin HomePort) database These charts were digitized and added to the project database.

An aerial drone survey of the project property was conducted, and the contours generated for incorporation into the database. That aerial drone survey was able to collect high-resolution detail of the project area. The Digital Elevation Model (DEM) points and the geo-referenced image were also incorporated into the database.

The measured data were post-processed and converted to the Universal Transverse Mercator (UTM) grid coordinate system and Mean Sea Level (MSL) datum. All the resulting bathymetry and topographic points are shown in Figure 5-4.

Using the various sources of data, a base map (or surface) was created for use in subsequent modelling activities. To provide continuous data between the discrete measurements and points, interpolation methods (built into the numerical model) were used. Various methods such as kriging, variogram etc. were used and the final surface in the modelling exercises is shown in Figure 5-5.

The bathymetric plot shows a sharp incline at the -30m contour from deeper depths. From there it's a gradual incline towards the shore as shown in Figure 5-5. Figure 5-6 shows typical sections through the east and west beaches and along the headland of the property. The general slope of the seafloor from -20m up to -12m for the three profiles are similar, however, the headland profile diverts at this depth and inclines at a much steeper gradient up to the headland at just under 2m above MSL.

For both the east and west beach profile, the gradients are similar up to the -2m depth contour. From the -2m contour, the east beach profile begins to flatten over a distance of 100m (<1m). The west beach continues with a gentle slope up to MSL.

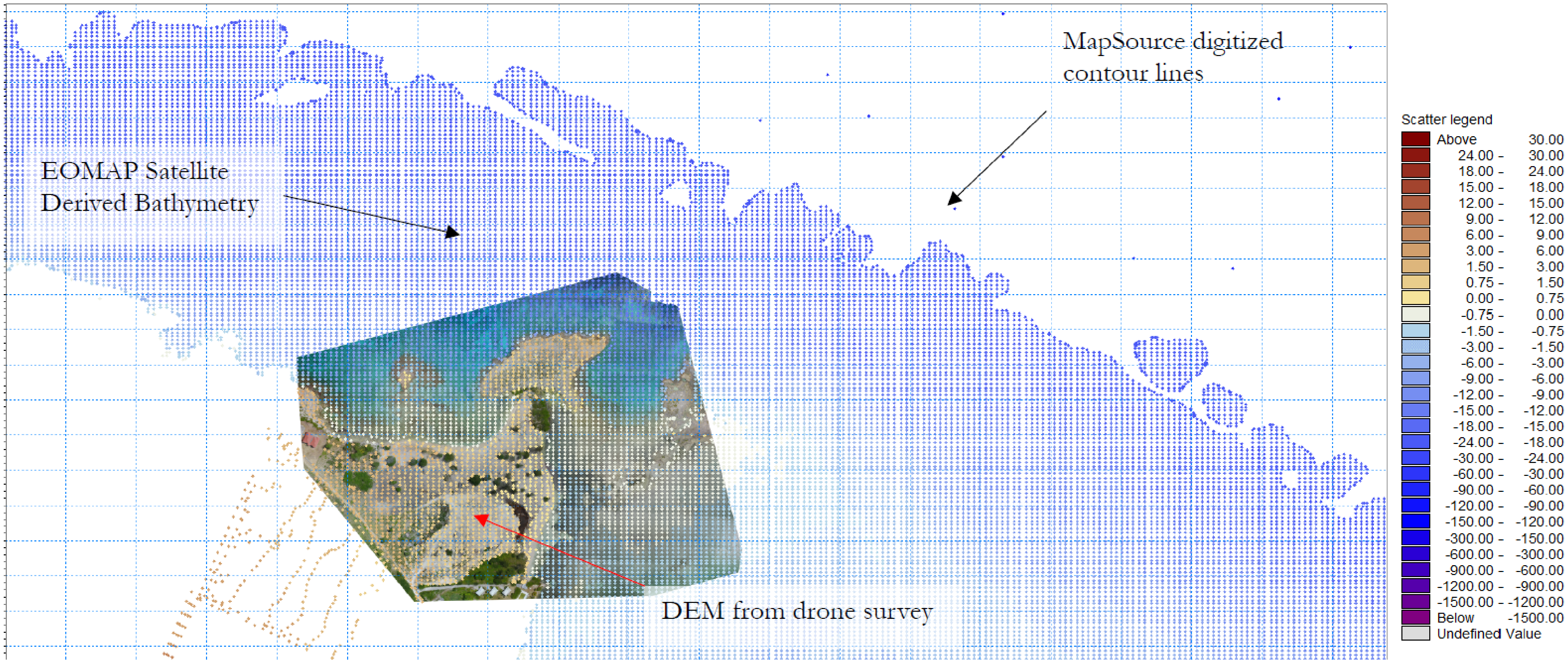


Figure 5-4 Bathymetric and topographic data points (obtained from all sources) that were used in surface creation

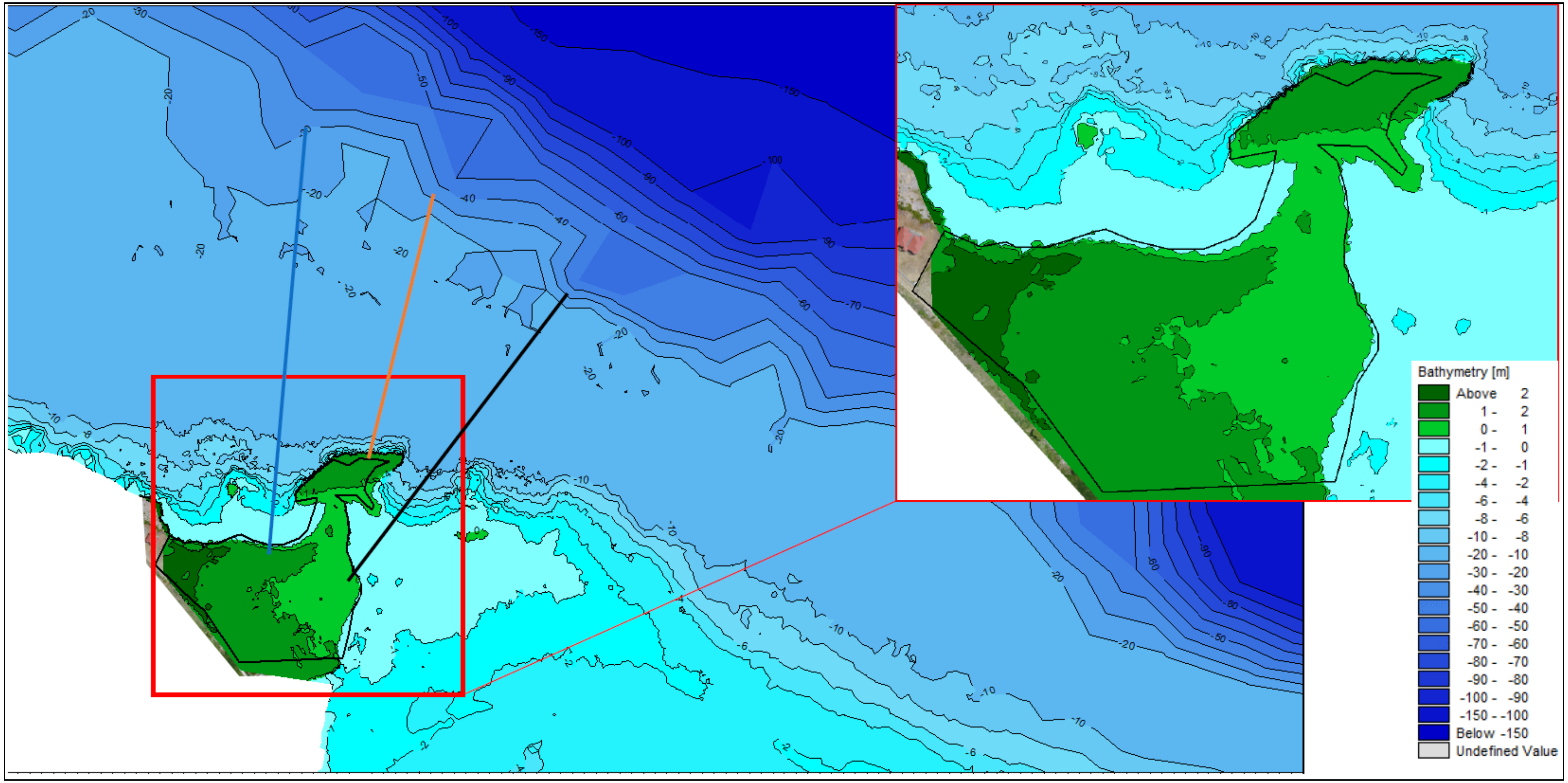


Figure 5-5 Surface created through interpolation in the numerical model (shown at varying levels of detail) with profile lines

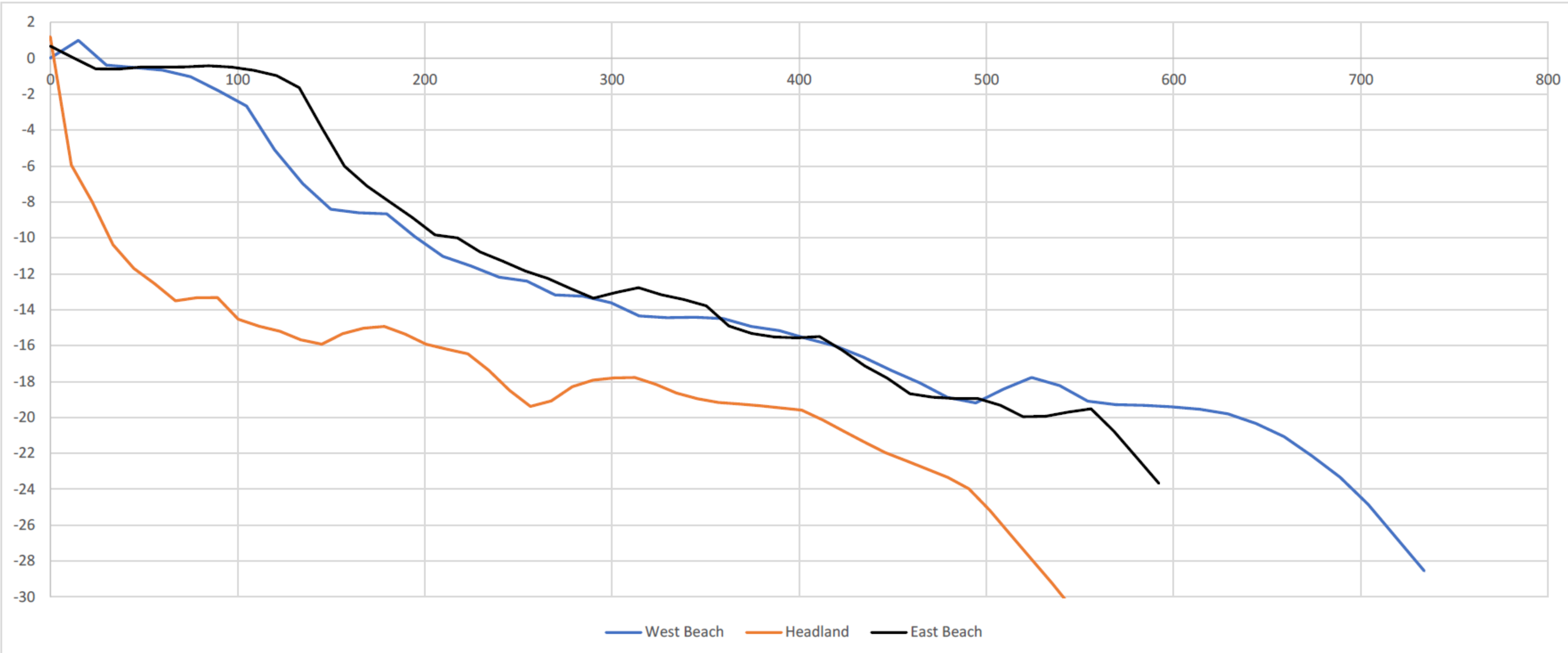


Figure 5-6 Profiles are the West, East and Headland of the property shoreline

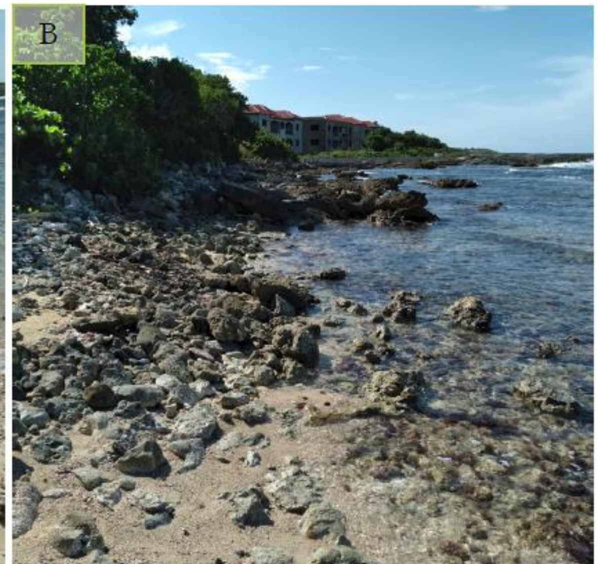
5.1.1.3 Shoreline Features

Northwest Beach

Main observations regarding the shoreline in this area (Figure 5-7) are as follows:

- The shoreline has sand; however, it's mixed with rubble.
- The beach area is very narrow Plate 5-1A.
- Moving further west, the sand that was present is replaced with rubble and a steep cliff as shown in Plate 5-1B.
- Offshore the perched beach location, the water is noticeably shallower, and several black sea urchins were present on the seafloor.
- Based on the lack of sandy beach in this area, it is likely this location is exposed to a high energy wave environment.

Figure 5-7 Location of the proposed perched beach with outline of proposed plan of enhancement



A: Looking to the west from the northeast beach showing a very narrow and rocky sandy shoreline.

B: Looking to the west near the western property boundary showing excessive rubble

C. Looking offshore from the proposed perched beach location showing the shallow depths offshore

Plate 5-1 Along the north-western perched beach location

North-eastern Beach

Main observations regarding the shoreline in this area (Figure 5-8) are as follows:

- This section of the shoreline has more sand than the north-western beach. This could be due to the peninsula providing some sheltering from wave energy.
- Similar to the north-western beach, the water depths offshore were very shallow with an abundance of black sea urchins.
- In this section, the back of beach was not as steep as the north-western section and would be susceptible to inundation by extreme storm events (Plate 5-2A).
- Plate 5-2C shows the ironshore on top of the peninsula looking back at the north-eastern beach.

Figure 5-8 Location of the north-eastern beach with outline of proposed plan of enhancement

A: Looking to the east from the perched beach showing a very narrow and sandy shoreline with rubble present.
B: Looking at the nearshore showing very shallow water depths.
C: On the peninsula looking back at the north-eastern beach.

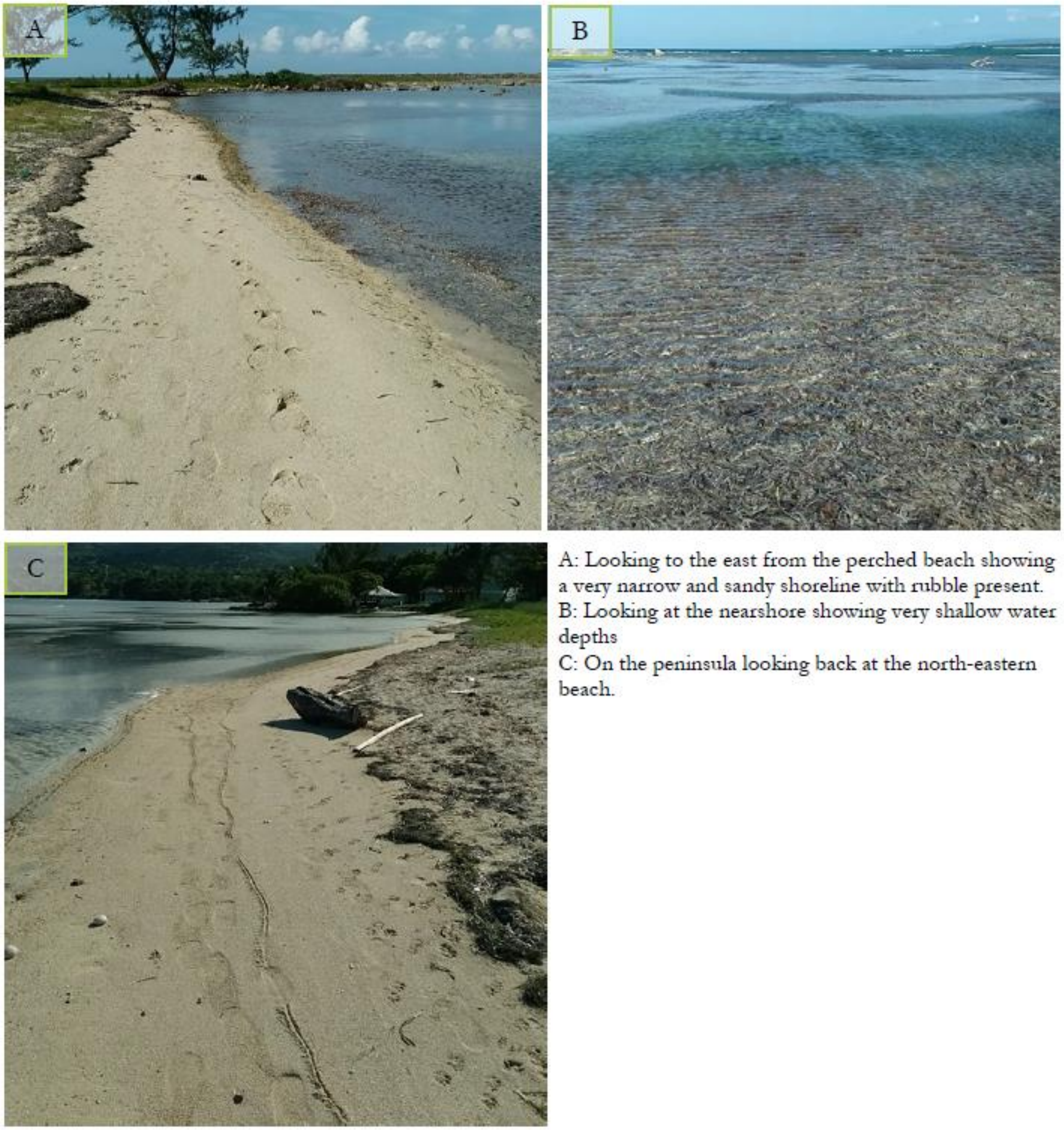
Plate 5-2 Along the north-eastern swimming beach

Eastern Beach

The points below highlight the main observations about shoreline in this area (Figure 5-9).

- The eastern beach has a narrow, low-lying sandy beach with very dense seagrass offshore (Plate 5-3A).
- Very dense seagrass is present along the eastern beach as you step into the water. The water along this beach is very shallow (<1m).

Figure 5-9 Location of eastern beach with outline of proposed plan of enhancement



A: Looking to the east from the perched beach showing a very narrow and sandy shoreline with rubble present.
B: Looking at the nearshore showing very shallow water depths
C: On the peninsula looking back at the north-eastern beach.

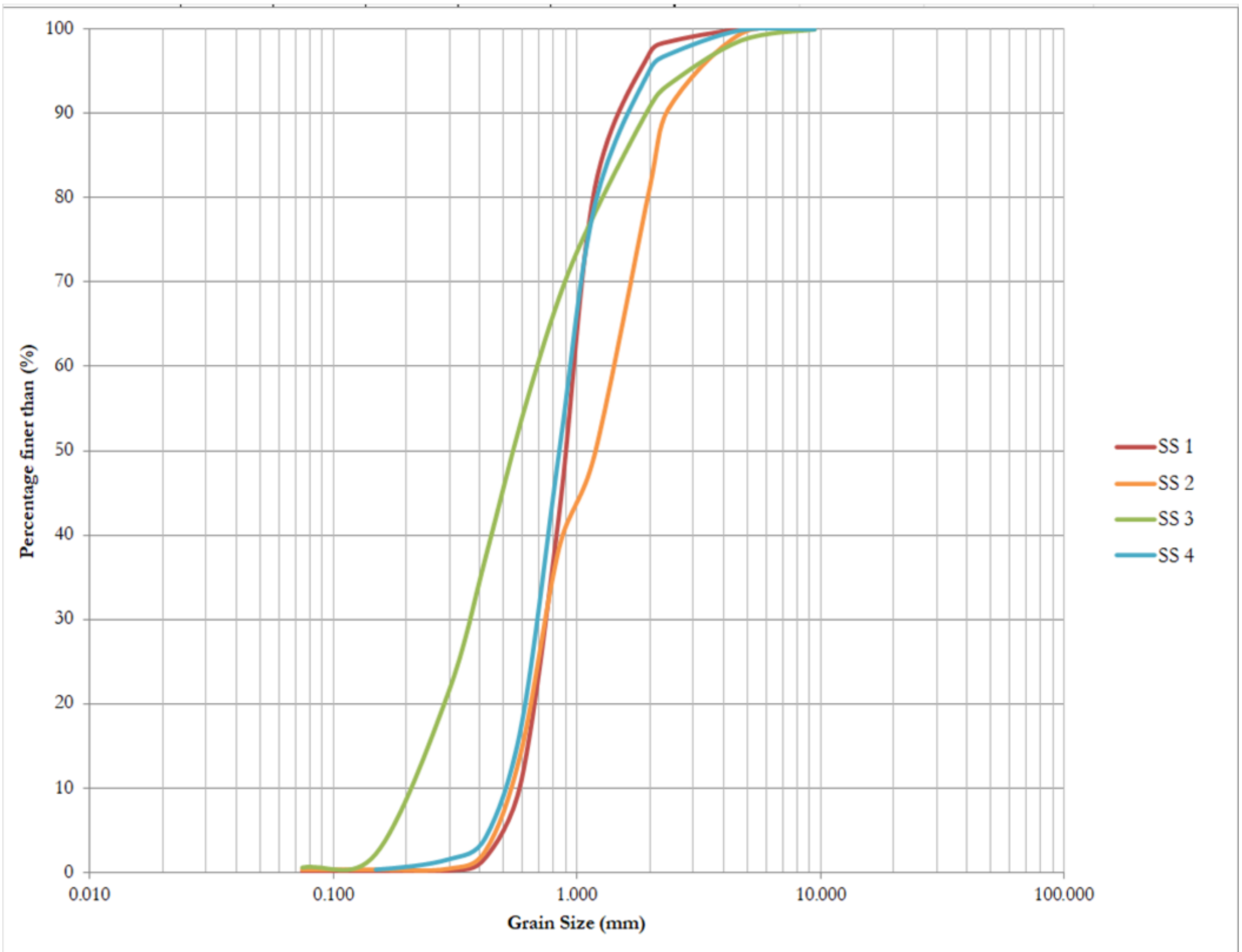
Plate 5-3 Photos taken along the eastern beach

5.1.2 Sedimentology

5.1.2.1 Sieve Analysis

An analysis of sediment grain size on a beach can aid in the understanding of the coastal processes. Four sand samples were collected at the Priory property, two along the western beach and two along the eastern beach as shown in Figure 5-10. The collected samples were sent to a geotechnical lab to be visually inspected, air dried and subjected to a standard dry sieve analysis to determine characteristic parameters. The results are shown in Figure 5-49. The analyses indicate that all the samples are poorly graded sand, composed on average of 99% sand, with small percentages of gravel and/or silt. The results also showed that the sediment on the western beach was coarser than that on the eastern beach, which coincides with observations made during site visits. The western beach average D50 was 1.06mm while the eastern beach average D50 was 0.70mm. The sediment grain sizes are relatively course. This implies high energy wave environment, especially on the western side of the shoreline.

Figure 5-10 Sediment Grain Size Analysis Sampling locations



Sand Sample ID	GRAIN SIZES (mm)				Sediment Percentage Breakdown			Description	
	D60	D50	D30	D10	%Gravel	%Sand	%Silt/Clay	Classification	Grading
SS 1	1.41	1.20	0.749	0.522	0.6	99.1	0.4	Very Coarse Sand	Poorly Graded
SS 2	0.99	0.91	0.739	0.577	0.0	99.9	0.0	Coarse Sand	Poorly Graded
SS 3	0.69	0.55	0.360	0.199	1.3	98.0	0.7	Coarse Sand	Poorly Graded
SS 4	0.95	0.85	0.681	0.490	0.2	99.6	0.3	Coarse Sand	Poorly Graded

Figure 5-11 Graphical and tabular summary of sieve analysis results

5.1.2.2 Benthic Sediment Chemistry

Methodology

Five (5) sediment samples (Table 5-1, Figure 5-12) were taken from within the project area using a sediment grab sampler on October 5th, 2022, and analysed for the heavy metals (Pb - lead, As - Arsenic, Cd - Cadmium, Hg - Mercury) and Total Petroleum Hydrocarbons (C8-C40). The samples were stored on ice in a cooler and transported to Test America Pensacola Laboratory in Florida for analyses.

Table 5-1 Benthic sediment sampling locations (JAD2001)

Station	X	Y
SP1	726581.028820	700054.882366
SP2	726452.269983	700017.217307
SP3	726445.966029	700142.706954
SP4	726303.614713	700219.776137
SP5	726210.224996	700210.709175

Results

Table 5-2 displays the sediment sampling results for the parameters at the various sampling locations. No cadmium was detected in any of the samples taken. Arsenic values ranged from a low of 3.5 mg/kg at Station 1 to 9.5 mg/kg at Station 3, while lead values ranged from a low of 1.8 mg/kg at Station 2 to a high of 3.4 mg/kg at Station 5. Mercury was detected at all stations and ranged from a low of 0.1 mg/kg at Station 3 to a high of 0.084 mg/kg at Station 4. When these metal concentrations were compared to the average levels found in Jamaican soil (Table 5-3), all current values were below the reported average for each metal. No hydrocarbons were detected in any of the samples taken.

Table 5-2 Marine benthic sediment values

STATION	Arsenic (mg/kg)	Cadmium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	TPH (C8 – C40) (mg/kg)	TPH (C8-10) (mg/kg)	TPH (C10-C28) (mg/kg)	TPH (C28-C40) (mg/kg)
1	3.5	ND	2.5	0.045	ND	ND	ND	ND
2	6.8	ND	1.8	0.049	ND	ND	ND	ND
3	9.5	ND	3.2	0.10	ND	ND	ND	ND
4	5.8	ND	3.3	0.084	ND	ND	ND	ND
5	4.5	ND	3.4	0.080	ND	ND	ND	ND

ND – None Detected

Table 5-3 Metal Concentrations in Jamaican Soil

Metal	Avg. Concentration (mg/KG)	Range (mg/Kg)	95th Percentile (mg/KG)
Arsenic	25	1.4-203	<64.9
Cadmium	20	0.2-409	<77.6
Lead	46.5	6-897	<90
Mercury	0.2	0.04-0.83	<0.46

Source: A geochemical atlas of Jamaica, Centre for Nuclear Sciences, UWI, 1995, Canoe Press

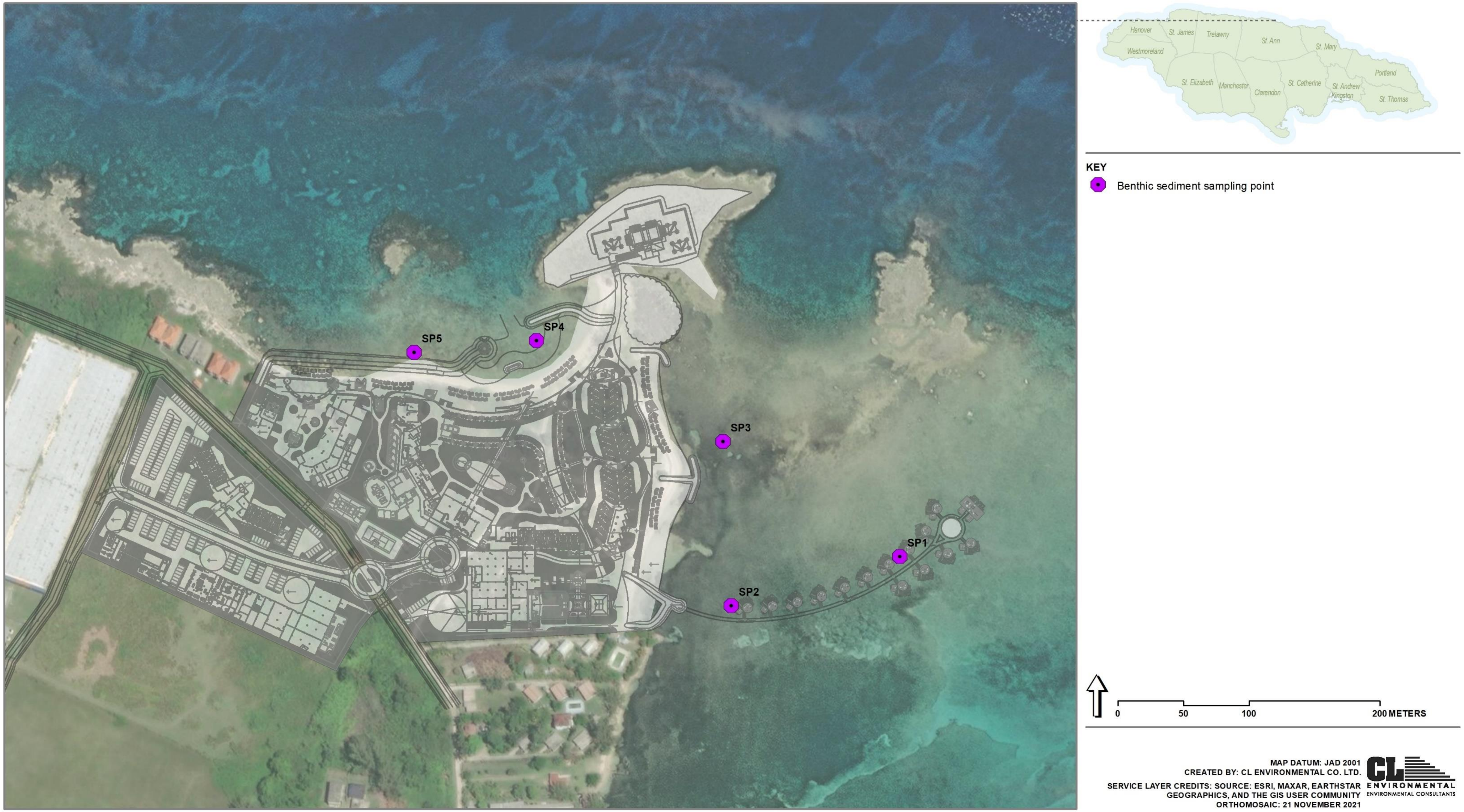


Figure 5-12 Marine benthic sediment sampling locations

5.1.2.3 Sediment Loading

Methodology

Baseline sedimentation data were collected using sediment traps. A total of six (6) sediment traps were deployed in and around the project area. The traps were retrieved after 33 days, and its contents analysed to determine the rate of sedimentation ($mg/cm^2/day$) in the area. The sediment trap dimensions were approximately 21.4” (54.3 cm) long with an internal diameter of 3” (7.6 cm) (Plate 5-4). Sediment traps were taken to the Caribbean Environmental Testing and Monitoring Services Limited for analysis.

Plate 5-4 Example of Sediment Trap deployed

The contents of the sediment traps were filtered through a filter paper, dried and then weighed. The results are represented in the form of “Mass of Sediment Recovered”. Using the results retrieved from the laboratory, the sedimentation rate per day ($mg/cm^2/day$) was calculated by dividing the mass of sediment recovered by the number of days deployed and the area of the sediment trap opening.

$$\textit{Sedimentation Rate per day} = \frac{\textit{Mass of Sediment Recovered}}{(\textit{\# of days deployed}) \times (\textit{area of trap opening})}$$

Sediment traps were deployed on September 9th, 2022 and were retrieved on October 12th, 2022. Table 5-4 gives the coordinates and Figure 5-13 shows a map of the sediment trap locations.

Table 5-4 Sediment Trap location coordinates

STATION #	LOCATION (JAD2001)	
	X	Y
ST1	726676.087	700367.288
ST2	726498.753	700271.460
ST3	726564.819	699989.202
ST4	726566.048	699713.478
ST5	726267.749	700257.275
ST6	725976.247	700439.099

Results

Sedimentation rates ranged from a low of 0.002 mg/cm^2/day at Station ST1, to a high of 0.065 mg/cm^2/day at Station ST5 (Table 5-5). The highest sedimentation rates were observed at Stations ST3 and ST5. Station ST3 and ST5 were located nearshore and in shallow water and thus will tend to have, on average, higher sedimentation rates than those in the deeper waters due to the wave climate and subsurface currents having a greater effect on the stirring up of sediments in shallow depths, and thus the sedimentation rates. Stations ST1 and ST6, located in deep water relative to the other stations, had the lowest sedimentation rates.

Table 5-5 Sedimentation Rates at each Location

Sediment Trap Locations	Mass of Sediment Recovered (mg)	Area of trap opening (cm^2)	Deployment date	Retrieval date	# of days deployed	Sedimentation Rate (mg/cm^2/day)
ST1	3	45.61	09.09.22	12.10.22	33	**0.002**
ST2	74	45.61	09.09.22	12.10.22	33	**0.049**
ST3	92	45.61	09.09.22	12.10.22	33	**0.061**
ST4	60	45.61	09.09.22	12.10.22	33	**0.039**
ST5	98	45.61	09.09.22	12.10.22	33	**0.065**
ST6	18	45.61	09.09.22	12.10.22	33	**0.012**

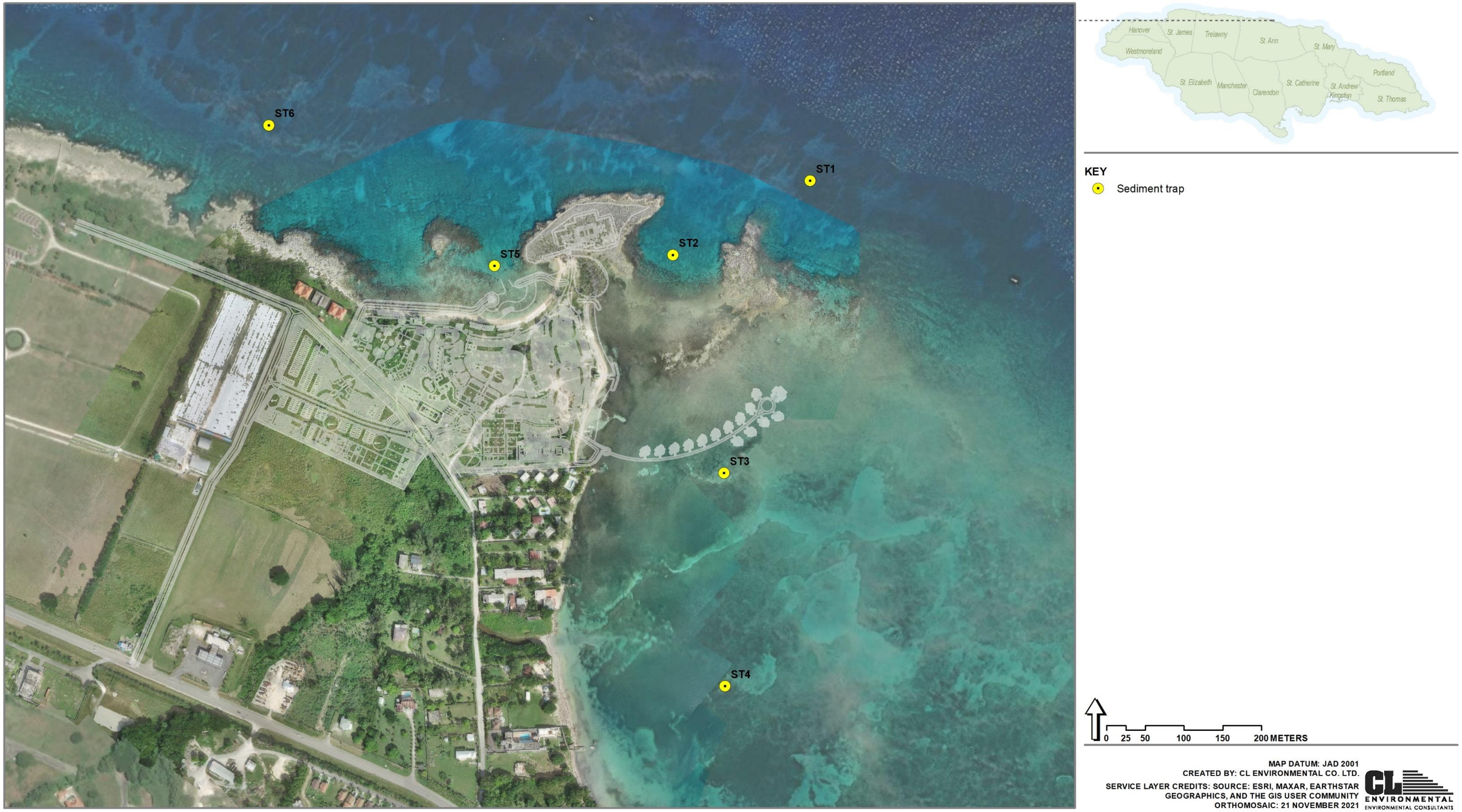


Figure 5-13 Sediment trap locations

5.1.3 Soils and Geology

5.1.3.1 Geological Setting

Jamaica is the third largest island in the Caribbean with approximately 11,000 km^2. The island is located in the north-eastern part of the Caribbean, with Cuba to the north and Hispaniola to the northeast, bordering the North American Plate.

The island can be divided into three different parts based on the morphology of the soil: the central mountain range that occupies most of the central area of the island, formed by igneous and metamorphic rocks; the hills of karstic limestone and finally the coastal planes.

Based on the St. Ann Ocho Rios Geological Sheet 04 of the 1:50,000 Geological Series, the site is located on Elevated Reef (Ql). The Elevated Reef forms a fringing terrace along the coast, consisting of in situ corals and associated reef. Two facies can be recognized, the reef proper with abundant corals and the back reef facies characterized by the absence of corals and presence of numerous molluscs.

5.1.3.2 Geotechnical Investigations

This section contains excerpts of the Geotechnical Report conducted for the project (Horizon Construction Jamaica Ltd., 2022). Borehole testing was conducted in November 2022. Figure 5-14 illustrates the approximate location of the borings that were completed and Table 5-6 shows a summary of the general properties of the borings. Coordinates are in Universal Transverse Mercator (UTM Projection WGS84 Datum).

Forty-seven (47) soil borings were drilled for this project up to a depth of 37 meters below the ground surface. A CME-55 drill rig and 8-inch diameter hollow-stem augers (HSA) were used to advance the boreholes (Plate 5-5). The soils were sampled by following the Standard Penetration Test (SPT) ASTM D-1586 with an automatic 140-pound hammer falling from a height of 30 inches per blow was made. A 24-inch long, 2-inch diameter split spoon sampler was utilized.

SPT tests were performed at intervals of 5 feet. The number of blows required to advance the sampler every 15 cm are recorded in field logs. The sum of the second and third blow counts for each 24-inch sampling interval constitutes the SPT-N value in blows/foot The CME-55 drill rigs use an automatic hammer release mechanism with Efficiency (Em) of 0.8 (80%).

The recovered samples descriptions are based on visual field and laboratory observations using classification methods of ASTM D2488. When laboratory data are available, classifications are in accordance with ASTM D2487. The depth of the water table was measured at the end-of-drilling and is indicated in Table 5-6.

Plate 5-5 CME-55 drill rig

Table 5-6 General properties of boreholes conducted

Boring No.	Depth [ft]	Elevation [m]	Water Table [ft]	Structure Name	Easting [m]	Northing [m]
BH01	102	3.2	10.3	Technical Area	264769	2041649
BH02	102	3	10.2	Technical Area	264789	2041640
BH03	52	2.4	8.9	Technical Area	264837	2041620
BH04	102	2.1	8.5	Technical Area	264865	2041608
BH05	52	1.7	6.2	Technical Area	264894	2041595
BH06	52	1.25	6.6	Technical Area	264923	2041583
BH07	102	1.3	5.9	Technical Area	264932	2041612
BH08	102	1.6	5.2	Hotel 2	264889	2041670
BH09	27	1.8	7.1	Hotel 2	264866	2041681
BH10	27	2.1	7.3	Hotel 2	264851	2041689
BH11	102	2.25	7.0	Hotel 2	264841	2041705
BH12	27	2.3	6.9	Hotel 2	264832	2041723
BH13	52	2.4	7.9	Technical Area	264806	2041749
BH14	27	2.85	7.4	Technical Area	264785	2041705
BH15	52	2.98	5.6	Hotel 2	264870	2041758
BH16	52	1.65	4.6	Hotel 2	264891	2041749
BH17	52	1.25	5.3	Hotel 2	264927	2041727
BH18	52	1.1	3.4	Hotel 2	264943	2041709
BH19	52	1.08	3.0	Switchyard	264948	2041680
BH20	52	0.9	2.4	Games Zone	264974	2041691
BH21	52	0.95	2.2	Games Zone	264980	2041672
BH22	52	1.1	3.1	Hotel 2	264954	2041737
BH23	52	1	2.9	Hotel 2	264971	2041749
BH24	27	0.85	3.1	Hotel 1	264988	2041721
BH25	107	0.7	2.6	Hotel 1	265009	2041740
BH26	52	0.6	0.2	Hotel 1	265017	2041715
BH27	52	0.8	1.9	Hotel 1	265021	2041692
BH28	52	0.82	1.3	Hotel 1	265040	2041677
BH29	117	0.78	0.3	Hotel 1	265057	2041656
BH30	62	0.8	0.3	U.V.C	265064	2041672
BH31	72	0.83	0.3	Hotel 1	265087	2041674
BH32	62	0.4	0.2	Hotel 1	265130	2041666
BH33	57	0.55	0.1	Hotel 1	265112	2041698
BH34	57	0.37	0.3	Hotel 1	265136	2041696
BH35	52	0.65	2.2	Hotel 1	265123	2041739
BH36	52	0.55	0.7	Hotel 1	265144	2041732
BH37	52	0.93	3.1	Hotel 1	265132	2041777
BH38	52	0.8	1.1	Motor Lobby	265037	2041639
BH39	57	0.75	1.0	Sport Bar	265067	2041632
BH40	52	0.75	1.6	Sport Bar	265087	2041625
BH41	122	0.62	1.3	Hotel 1	265118	2041631
BH42	52	0.47	2.4	Hotel 1	265129	2041613
BH43	52	0.7	3.2	Theater	265089	2041600
BH44	27	0.75	2.0	Theater	265061	2041609
BH45	102	0.85	2.5	Convention	265037	2041611
BH46	27	0.25	2.7	Overwater Villas	265163	2041638
BH47	52	0.25	3.0	Overwater Villas	265162	2041624

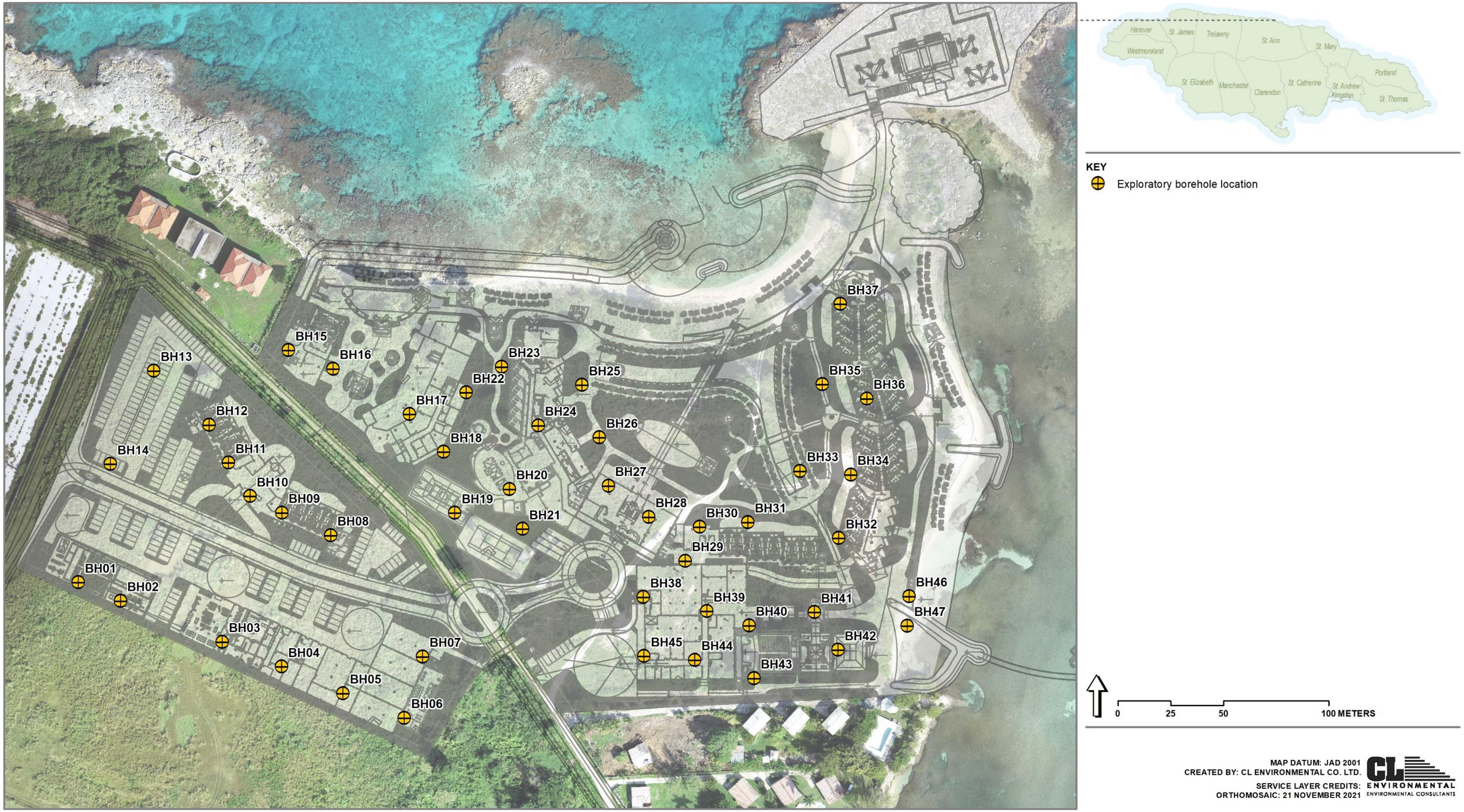


Figure 5-14 Borehole locations

5.1.3.3 Soils

With the data obtained from the exploration (Horizon Construction Jamaica Ltd., 2022), four noticeable soil layers were identified:

1. Topsoil
2. Layer of loose clay and peat
3. Coralline limestone layer
4. Layer of silty sand and gravel

Geological Stratigraphy

The project site is characterized by a coral reef formation that stretch parallel to the coast. These geological formations have cavities that are filled by degraded coral detritus. In addition, features of marine sediments, which consist of loose to medium dense sands, silts and clays with layers of coral also exists. Finally, alluvial soils consisting of sand, silts and clays, cover the area superficially.

A surficial layer was encountered in almost all the borings, composed of 1) Peat (PT) / Clay (CH) (CL) / Silt (ML), with the presence of roots, at depth from the top of the surface to 1 meter approximately.

Below this layer, there is a soft layer of 2) Clay (CL, CH) / Silt (ML). This layer has a thickness that ranges 2-5 meters. The material in this zone has an average SPT-N values of around 6 blows per foot and values of around 0.5 – 3.5 kg/cm^2 to the pocket penetrometer.

At about the 3-6 metre depth, borings encountered alternating layers of 3) Coralline Limestone (LM). This material has an average SPT-N values of 58 blows per feet.

The other layer is coralline limestone in different weathering grades. These samples were classified as 4) Silty Sand (SM) / Clayey Sand (SC) / Silty Gravel (GM). This layer was encountered after the coralline limestone layer up to the end of the borings, after the clay and silt layer, and in some borings was found from the surface.

Some of the deeper borings detected a coralline limestone layer at depth greater than 13 metres. Other ones found a layer of clay with remains of a weathered rock. The last one was found at depths greater than 17 metres and was found in a dense condition.

Soils Inventory Map of Jamaica

The Ministry of Agriculture's Soils Inventory Map of Jamaica was acquired for the soil types occurring in the catchment (Figure 5-15). It was found that the dominant soil textures present in the catchment is stony loam and clay. Stony loam is described by the Imperial College of Tropical Agriculture's 1995 Soils and Land use Survey Report as having high erosion capacity, very rapid internal drainage, and low moisture storage capacity.

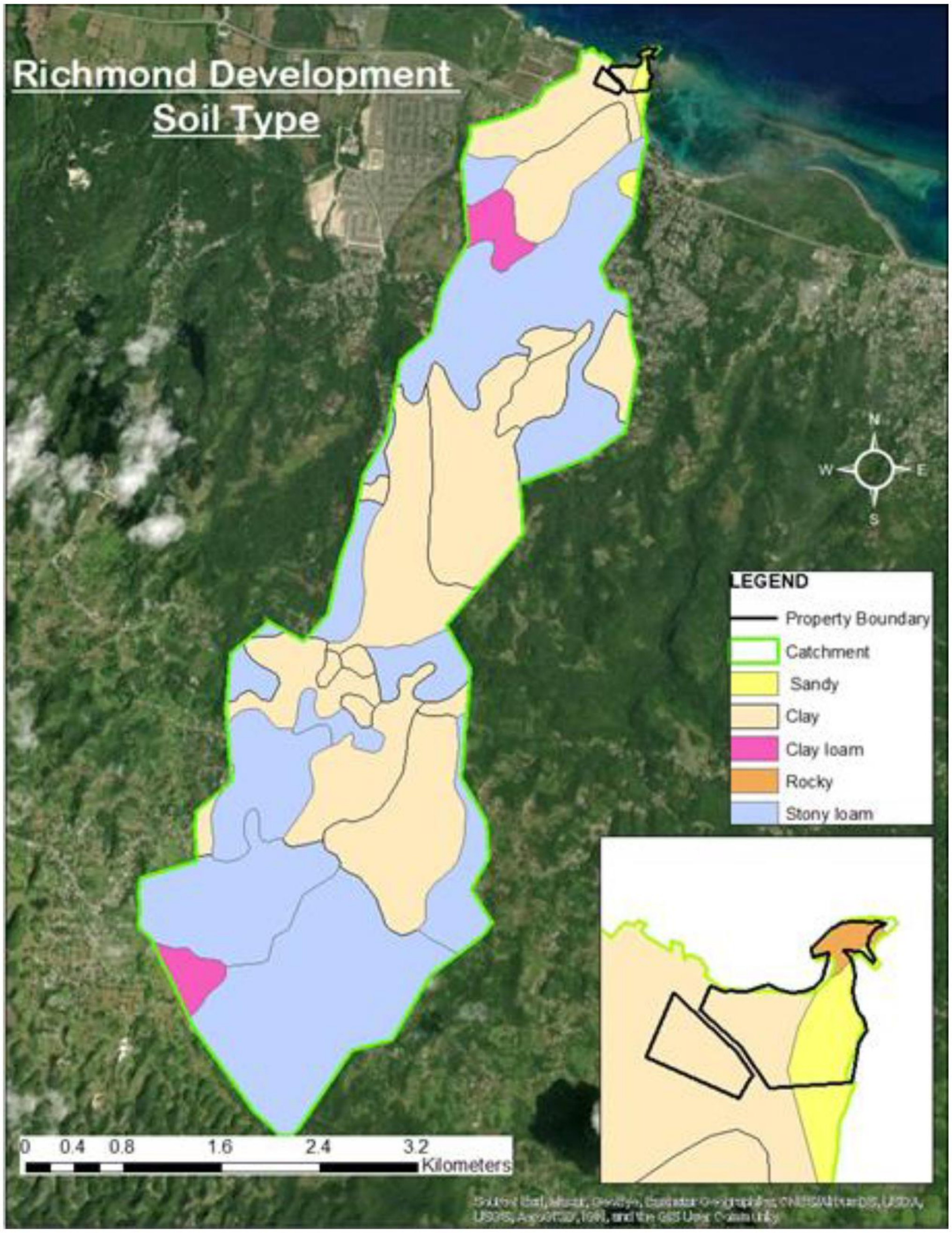


Figure 5-15 The Ministry of Agriculture's Soils Inventory Map of Jamaica showing soil types occurring in the wider catchment area

Groundwater

Groundwater was encountered in all borings at depths of 0 – 3.05 m (0 to 10 feet). Fluctuations in the groundwater table can be expected (Table 5-6).

5.1.4 Climate

5.1.4.1 Weather Station Data

Temperature, relative humidity, rainfall, wind speed and direction and barometric pressure were recorded over the period December 1-20, 2021, on the proposed project site, by using a Davis Instruments wireless Vantage Pro2 weather system with a data logger and a complete system shelter erected on a tripod. Data were collected every fifteen minutes and stored on the data logger. This information was downloaded using the WeatherLink 6.0 software.

The following were the summarized results of the assessment:

- Average temperature recorded was 26.5°C and ranged from a low of 19.4°C to a high of 31.0°C.
- Average relative humidity was 85.5% and ranged from a low of 67% to a high of 97%.
- Average rainfall was 0.02 mm and ranged from a low of 0 mm – 7.9 mm.
- Average wind speed was 0.63 m/s and ranged from a low of 0 m/s to a high of 2.4 m/s.
- Dominant wind direction was from the southeast.

5.1.4.2 Relative Humidity

Relative Humidity data was requested from the Meteorological Service Jamaica for weather stations in proximity to the proposed project site. The Meteorological Service supplied daily relative humidity data for the Llandovery, St. Ann weather station from December 2012 – July 2020. Average relative humidities ranged from a low of 79% in September month to a high of 85.2% in December month (Table 5-7, Figure 5-16).

Table 5-7 Average relative humidities for the period December 2012 – July 2020.

MONTH	Relative Humidity (%)
JAN	83.9
FEB	83.5
MAR	82.3
APR	82.3
MAY	82.6
JUN	80.7
JUL	79.7
AUG	81.4
SEPT	79.0
OCT	83.6
NOV	84.6
DEC	85.2

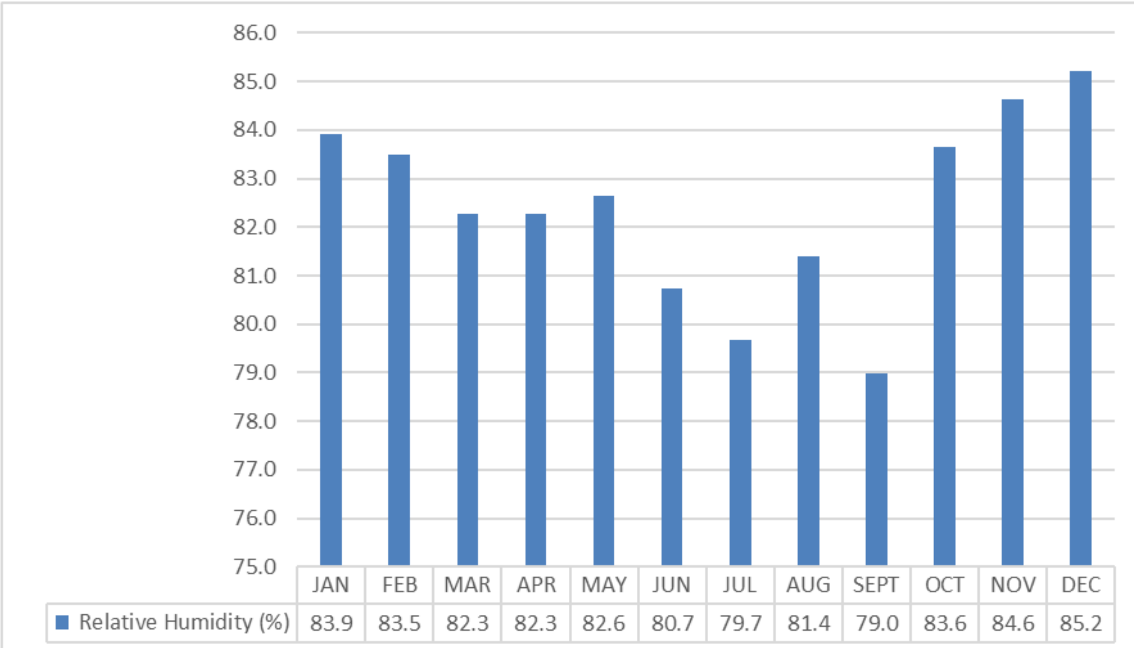


Figure 5-16 Average relative humidities for the period December 2012 – July 2020.

5.1.4.3 Present and Future Rainfall

Rainfall

Rainfall data was requested from the Meteorological Service Jamaica for weather stations in proximity to the proposed project site. The Meteorological Service supplied daily rainfall data for the Llandovery, St. Ann weather station from December 2012 – July 2020. Average rainfall ranged from a low of 1.0 mm in June and July month to a high of 7.5mm in September month (Table 5-8, Figure 5-17.

Table 5-8 Average rainfall for the period December 2012 – July 2020.

MONTH	Rainfall (mm)
JAN	5.6
FEB	2.5
MAR	2.0
APR	1.6
MAY	3.9
JUN	1.0
JUL	1.0
AUG	1.9
SEPT	7.5
OCT	2.6
NOV	4.5
DEC	5.4

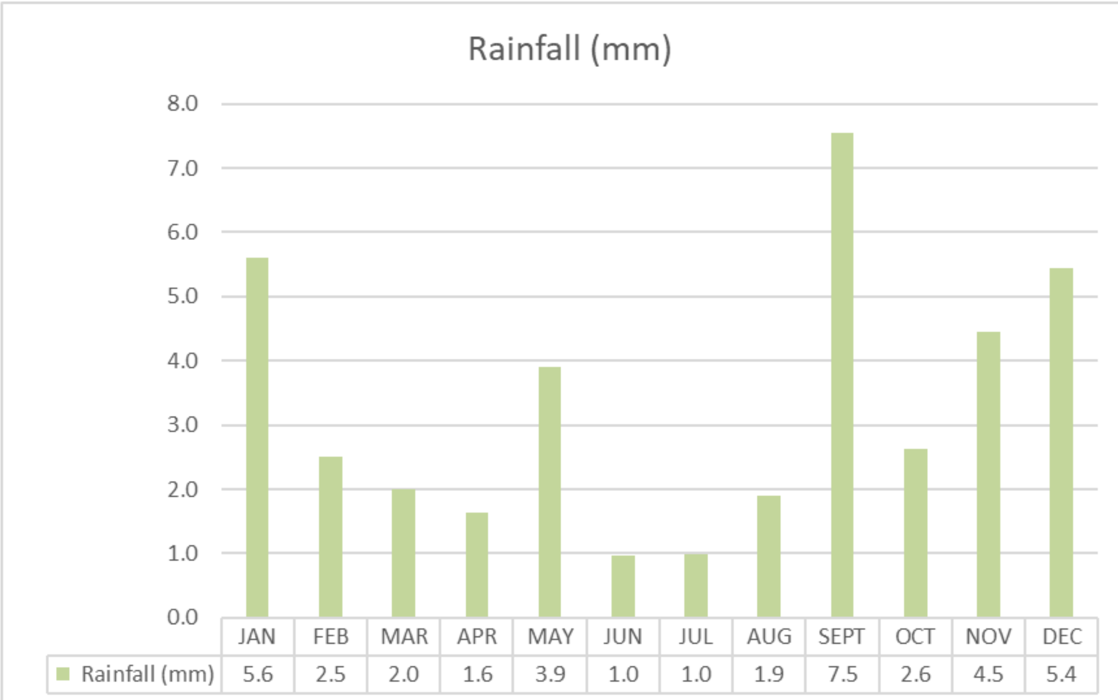


Figure 5-17 Average rainfall for the period December 2012 – July 2020

Analysis of Extreme Rainfall

The 24-hour rainfall data for approximately 250 gauges across Jamaica were obtained from the Meteorological Office of Jamaica. Information for the gauges spanned 1930 to 1980 and 1992 to 2012. Both sets of data were subjected to Weibull analysis for the extreme rainfall data for the 2-to-100-year return period. Historical rainfall extremes for stations across the island for the period 1930 to 1988 were compared with the extremes determined for the period 1992 to 2012. Rainfall depths for corresponding return periods were subjected to comparative analysis to determine if there was an overall increase or decrease in extreme rainfall.

Rainfall data for the catchments was obtained from two sources:

1. The Meteorological Office of Jamaica houses the dataset for 24-hour intensity rainfall for Jamaica. Rainfall data for the closest station (Richmond, located approximately 5km south of the proposed site) was used for the analysis. These values are shown in Table 5-9.
2. The Intensity Duration Frequency (IDF) Curves data set analysed in 1995 by the Water Resources Authority was also used. The IDF curve used is shown below in Figure 5-18.

Table 5-9 Published rainfall data from 24 hour met office records for Richmond rain station

Return Periods, T_r (years)	24-hour rainfall, P (mm)
2	120
5	148
10	163
25	179
50	189
100	199

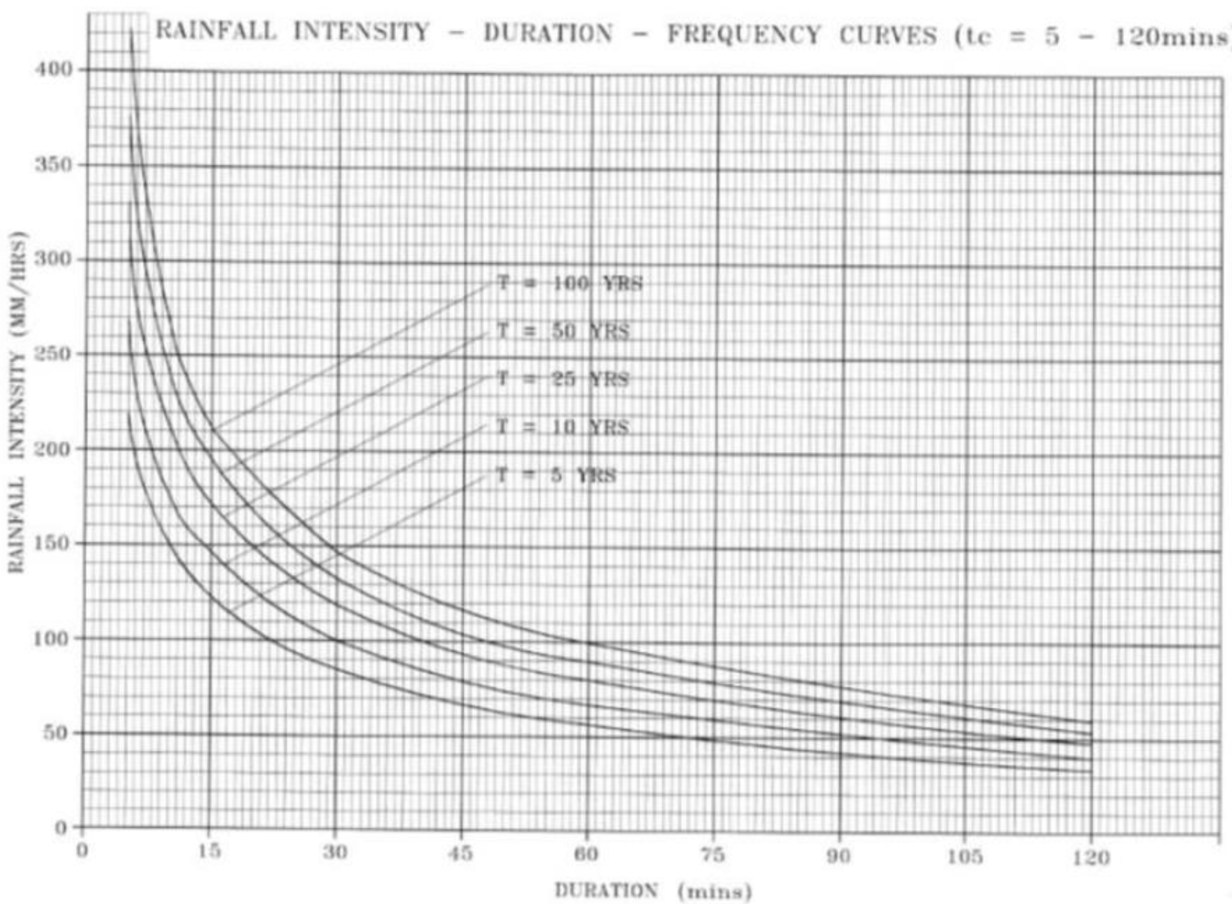


Figure 5-18 IDF Curve for 5-to-100-year rainfall events

CLIMATE CHANGE CONSIDERATIONS

It should be noted that according to the meteorological office this data has been developed from an analysis of a collection period from 1930 to 1980 and 1992 to 2012. Not only is this data period limited in duration, but it is also aged and therefore has not captured recent rainfall events or any changes in precipitation patterns since 2012 (which may be due to climate change effects). However, it should be noted that the impacts of climate change were accounted for by using the projected changes in rainfall throughout Jamaica guided by the Climate Studies Group of Mona University of the West Indies in their 2017 publication of "The State of the Jamaican Climate 2015" (UWI, 2017). The information indicates that for the parish of St. Ann, Jamaica where the site is located. Rainfall is expected to increase during the years of the 2020's and it is being further anticipated that the intensity of rainfall will decrease thereafter into the year 2080 (Table 5-10).

Table 5-10 24hr Extreme Rainfall for St. Ann, Jamaica

Storm Frequency	*Peak 24hr Rainfall (mm)*				
	Peak 24hr Rainfall(mm)	*1.27% increase due to climate change 2020's*	*3.89% decrease due to climate change 2030's*	*2.16% decrease due to climate change 2050's*	*9.70% decrease due to climate change 2080's*
2	133	135	128	130	120
5	189	191	182	185	171
10	226	229	217	221	204
25	273	276	262	267	247
50	307	311	295	300	277
100	342	346	329	335	309

5.1.4.4 Historical Long-Term Wind Data

Weather data was requested from the Meteorological Service Jamaica for the closest weather station to the proposed project site. The Meteorological Service provided 8 years of hourly data from Bengal Farm from 2013 - 2020. The data was analysed using Wind Rose Plots for Meteorological Data (WRPLOT View version 8.0.2).

Monthly Wind Data

Monthly wind data between 2013 and 2020 has indicated that between January and December average wind direction varied between 143 degrees (Southeast) and 176 degrees (South). Average wind speed ranged from 2.71 – 3.98 knots (1.39 – 2.05 ms-1) (Table 5-11). The percentage of calm winds ranged from 8.18 – 12.42%. Calm winds are defined by a wind speed less than the threshold of the wind instrument and coded as a zero-wind speed and direction.

For all the months analysed, wind from the southwest were the most frequently occurring although they were less than 25% of the time. Highest frequency wind direction ranged from 18.0 – 22.6% of the time (Table 5-11).

Table 5-11 Monthly average wind direction and speeds, percentage of calm winds and the highest frequency of wind direction and the percentage of the time period

MONTH	AVERAGE WIND DIRECTION -BLOWING FROM (DEG.)	HIGHEST FREQUENCY WIND DIRECTION (BLOWING FROM)	HIGHEST FREQUENCY WIND DIRECTION (%)	AVERAGE WIND SPEED (KNOTS)	%CALM WINDS
January	164	SW	21.0	2.99	9.71
February	157	SW	18.0	3.15	10.41
March	144	SW	17.4	3.42	11.53
April	149	SW	19.5	3.84	8.18
May	158	SW	21.6	3.71	9.11
June	144	SW	22.6	3.91	8.87
July	143	SW	21.7	3.98	9.63
August	157	SW	20.9	3.81	6.85
September	173	SW	19.4	3.25	10.39
October	176	SW	21.4	2.94	10.49
November	164	SW	18.3	2.73	11.13
December	163	SW	20.0	2.71	12.42

Yearly Wind Data

Yearly wind data between 2013 and 2020 has indicated that between 2013 and 2020 average wind direction varied between 143 degrees (Southeast) and 170 degrees (South). Average wind speed ranged from 2.46 – 4.02 knots (1.26 – 2.07 ms-1) (Table 5-12). The percentage of calm winds ranged from 0.11 – 28.76%.

For all the years analysed except in 2020, wind from the southwest were the most frequently occurring. In 2020 the most frequent wind was from the south. Highest frequency wind direction ranged from 11.3 – 31.3% of the time (Table 5-12).

Table 5-12 Yearly average wind direction and speeds, percentage of calm winds and the highest frequency of wind direction and the percentage of the time period

YEAR	AVERAGE WIND DIRECTION - BLOWING FROM (DEG.)	HIGHEST FREQUENCY WIND DIRECTION (BLOWING FROM)	HIGHEST FREQUENCY WIND DIRECTION (%)	AVERAGE WIND SPEED (KNOTS)	%CALM WINDS
2013	170	SW	31.3	4.02	0.11
2014	164	SW	27.4	3.97	0.24
2015	163	SW	28.0	3.82	0.62
2016	157	SW	24.1	3.10	11.97
2017	155	SW	15.3	2.46	28.76
2018	143	SSW	11.3	2.66	23.27
2019	155	SSW	16.7	3.46	11.10
2020	156	S	18.9	3.27	5.08

Average Wind Data (2013-2020)

Average wind direction over the time period was from the south-southeast direction with an average wind speed of 3.37 knots (1.73 ms-1). Calm winds occurred 9.93% of the time (Figure 5-19). Wind from the southwest were the most frequent, occurring 19.6% of the time. The most frequent wind class category was the 0.97 – 4.08 knots (0.5 – 2.10 ms-1) which occurred between 56.9% of the time (Figure 5-20).

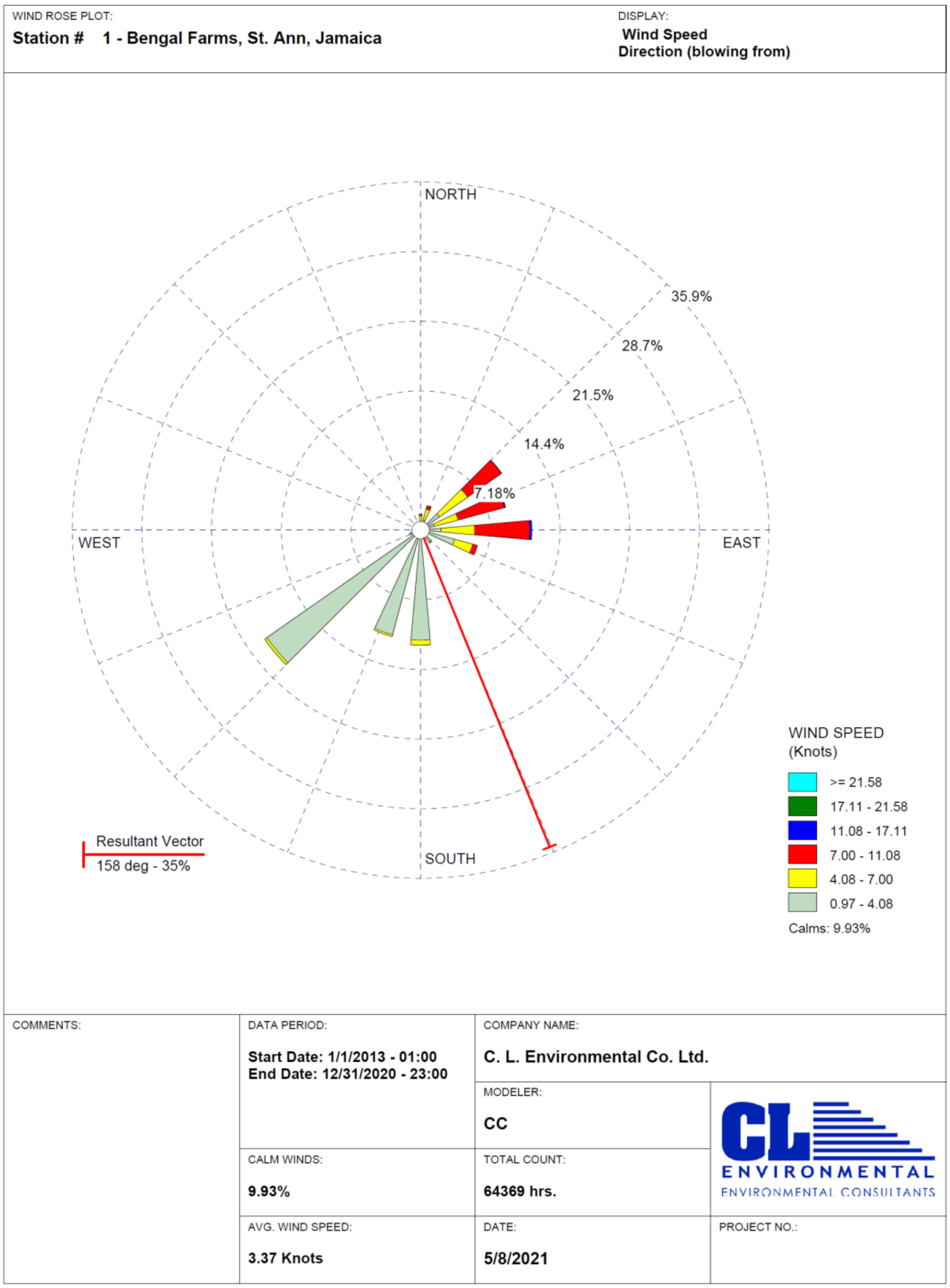


Figure 5-19 Windrose for January 1, 2013, to December 31, 2020

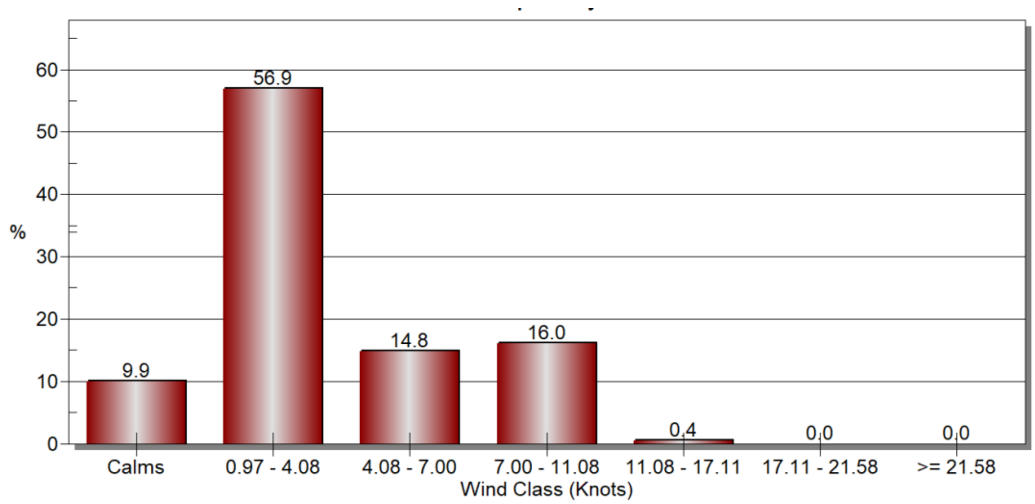


Figure 5-20 Wind class distribution for January 1, 2013, to December 31, 2020

5.1.5 Hydrology and Drainage

5.1.5.1 Existing Drainage Features

The existing drainage system within the area is a mixture of open U channels, kerb and gutter, and earth drains/swales, box and pipe culverts that takes runoff from both the road and the catchment extending southwards of the A1 highway. Runoff from the catchment south of the A1 highway enters a double box culvert (3.5m wide by 2.0m deep) located west of the site, a 900mm HDPE pipe and a 5m wide by 2m deep open U channel located to the east of the site. These major drainage features intercepts runoff generated from the upper catchment and discharges into the Caribbean Sea 200 meters south of the site (Figure 5-21). There is evidence of areas across the site were water settles after periods of heavy rainfall due to the undulating terrain. There is an existing earth drain that is not properly defined, that runs along the southern property boundary and connects to the shoreline Figure 5-22. Overall, there is no major drainage system/features that passes through the site and stormwater from the surrounding catchment areas are intercepted and directed away from the site. It should be noted that residents within the area indicate that the area is not prone to flooding during heavy rainfall, and areas where water would settle after rain events would infiltrate within one or two days.

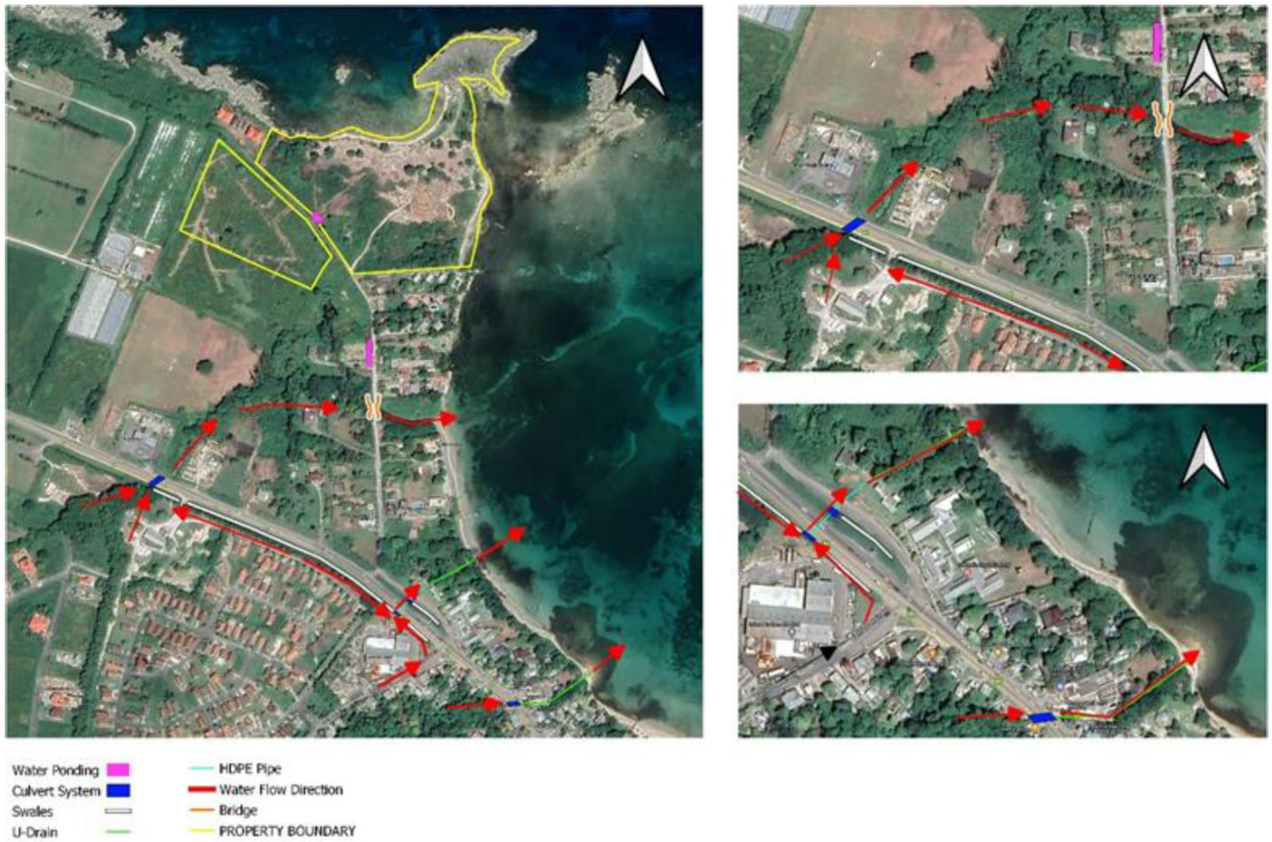


Figure 5-21 Existing drainage features within the catchment area

Figure 5-22 Existing drainage features within the catchment area showing (A) Double Box Culvert, (B) Earth Drain that discharge into the sea, (C) earth swale, (D) Pipe Culvert and (E) Open U Channel

5.1.5.2 Catchments and Delineation

It was important to delineate the catchment associated with the site to calculate the expected runoff within the project area (Figure 5-23). The catchment was delineated using the topographic data provided by the client and supplemented by the 12,500 maps and topographical data available through a Digital Elevation Model (DEM) obtained from the National Spatial Data Management Division (NSDMD) of Jamaica. A field investigation was also carried out to physically map drainage features within the immediate catchment area that would either direct flows into or away from the catchment area. The data for the catchment area had several gaps and was not at a fine enough resolution to allow for processing in the model or further division into detailed sub-catchments. This is a significant limitation in the hydraulic analysis, as flows can be dramatically altered based on the slope over which they move. Not having a detailed DEM creates gaps and inaccuracies over the catchment area and means the resulting flows can be taken as an estimate only.

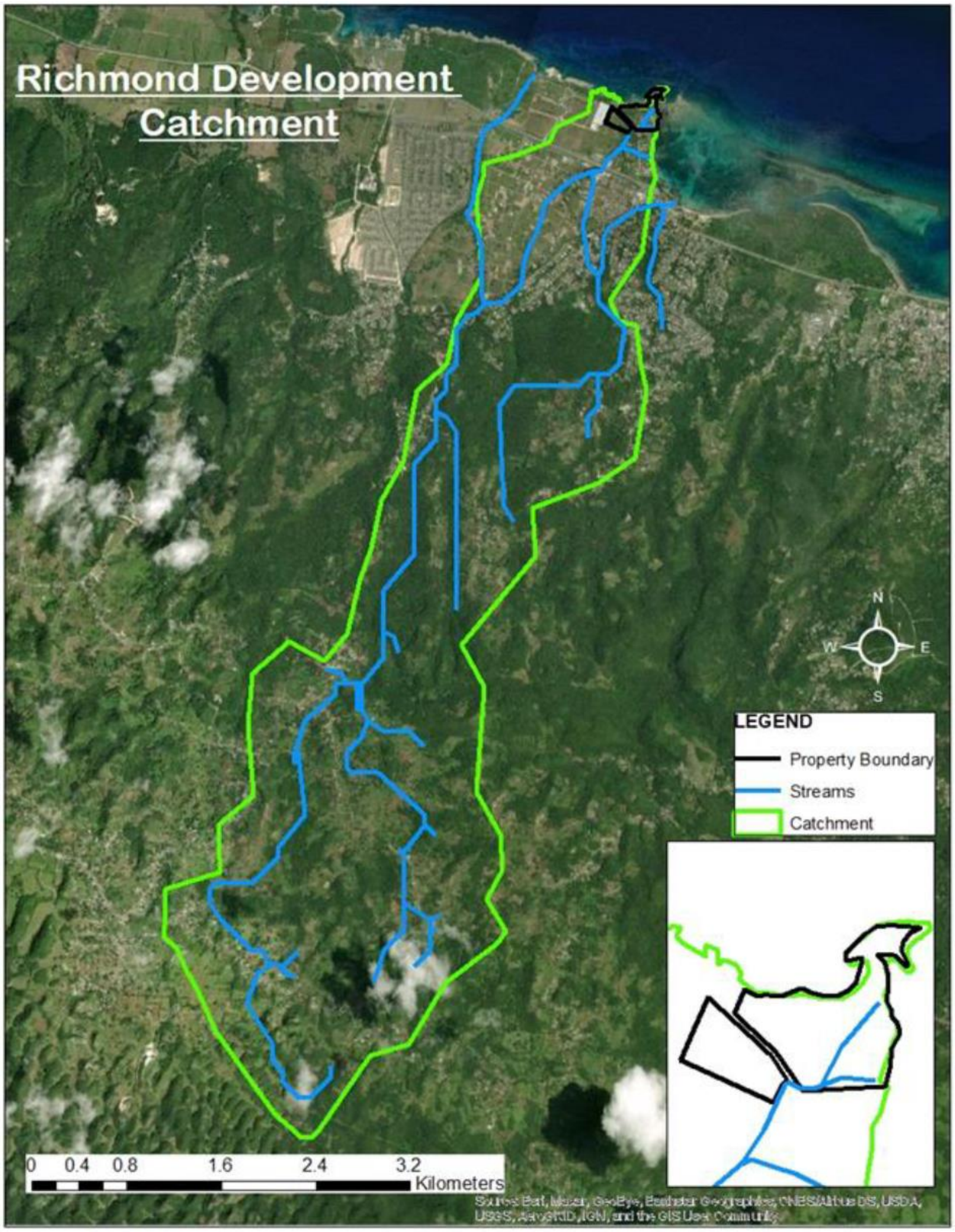


Figure 5-23 Catchment associated with the study area

The delineated catchment was determined to encompass approximately 14,420,467.67 square meters in area. The catchment is gently sloping from south to north. However, it should be noted that stormwater runoff from the wider catchment area south and immediately north of the A1 Highway is intercepted by the existing drainage features discussed above and discharges into the Caribbean Sea at locations west, south, and east of the site. The catchment area southwest of the parochial road used to assess the proposed site, drains towards and existing undefined earth drain along the south-eastern property boundary and empties into the Caribbean Sea. Therefore, the site catchment area is within the site boundaries and the area south of the parochial road which is approximately 160,083.23 square meters (Figure 5-24).

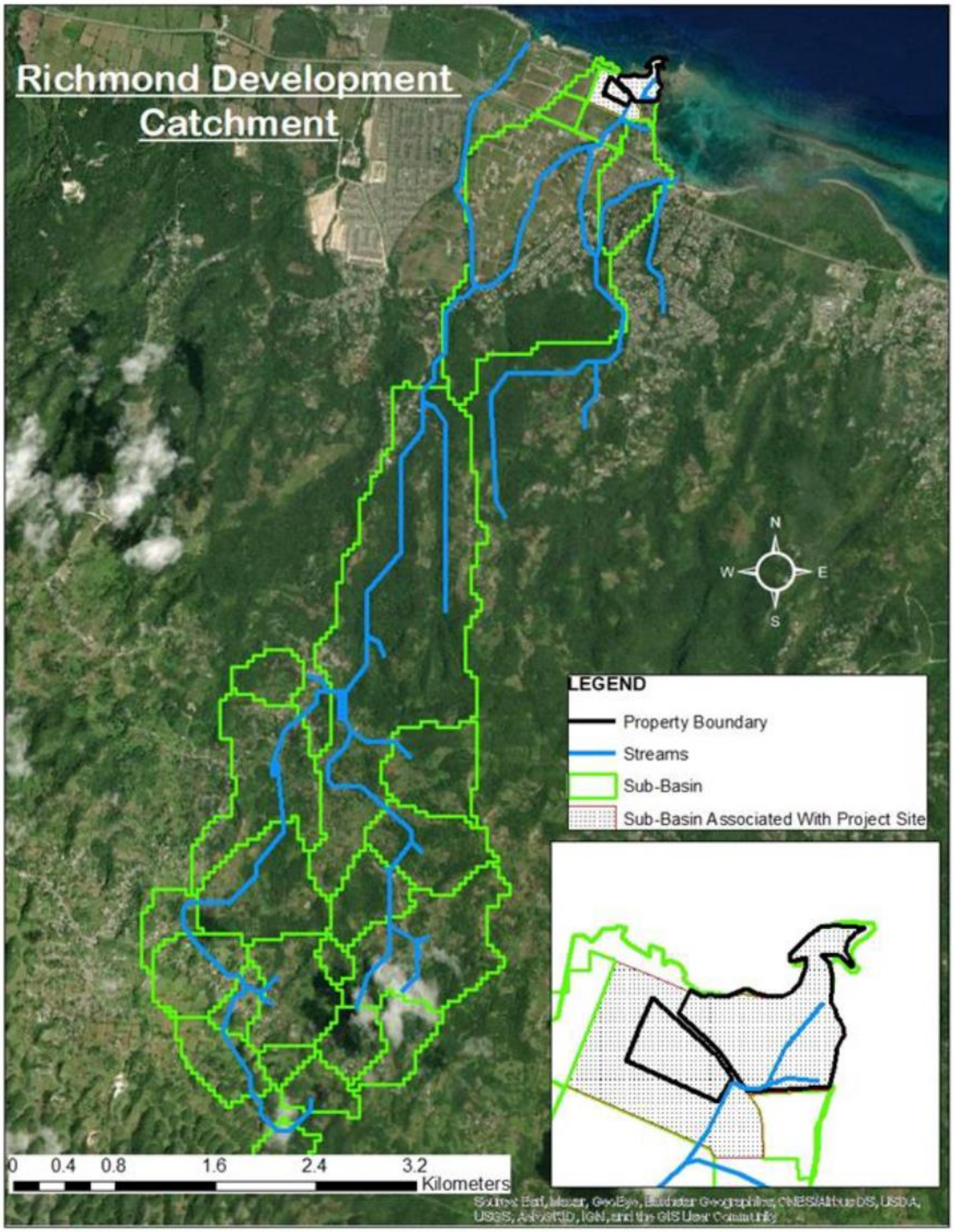


Figure 5-24 Sub catchments associated with the Richmond Development

5.1.5.3 Stormwater Runoff

Method

Three (3) calculation methods were considered for estimating the stormwater runoff for the catchment area. These methods were: the SCS method, The Rational Formula, and the Jamaica II method. The Jamaica II method was developed for local conditions and is applicable to the rural areas of Jamaica where significant and suitable soil cover exists. It can also be used for rural catchments contributing to an urban system. The intensity formulas are based on 24-hour rainfall and rainfall duration data collected at the Richmond rain gauge and the intensity formulas are therefore very relevant to the site. This method was thus selected for the project area.

Limitations

As previously discussed, there was a lack of accurate data for this analysis. Most notably the Jamaica DSM was not available at a high enough resolution leading to major gaps and possible inaccuracies in the fulsome catchment delineation. Additionally, the soils and land-use data (which are used to determine the Curve Number) had to be averaged across the main catchment, which could in turn lead to over-estimating or under-estimating the flows.

Results

The calculation of surface runoff, based on a statistical depth of rainfall for a particular return period estimate and selected temporal distribution, was carried out for this project. The resulting peak discharge calculated using the Jamaica II method are as shown in Table 5-13 for the pre and post development conditions. The corresponding stormwater hydrographs are shown in Figure 5-25 and Figure 5-26.

Table 5-13 Calculated peak discharges flowing from the catchment though the drains

Return Periods (1/n years)	Pre-Development - Peak Flows, Q (m^3/s)	Post-Development - Peak Flows, Q (m^3/s)
2	0.70	1.71
5	1.41	2.83
10	1.73	3.40
25	2.30	4.26
50	2.77	4.95
100	3.28	5.65

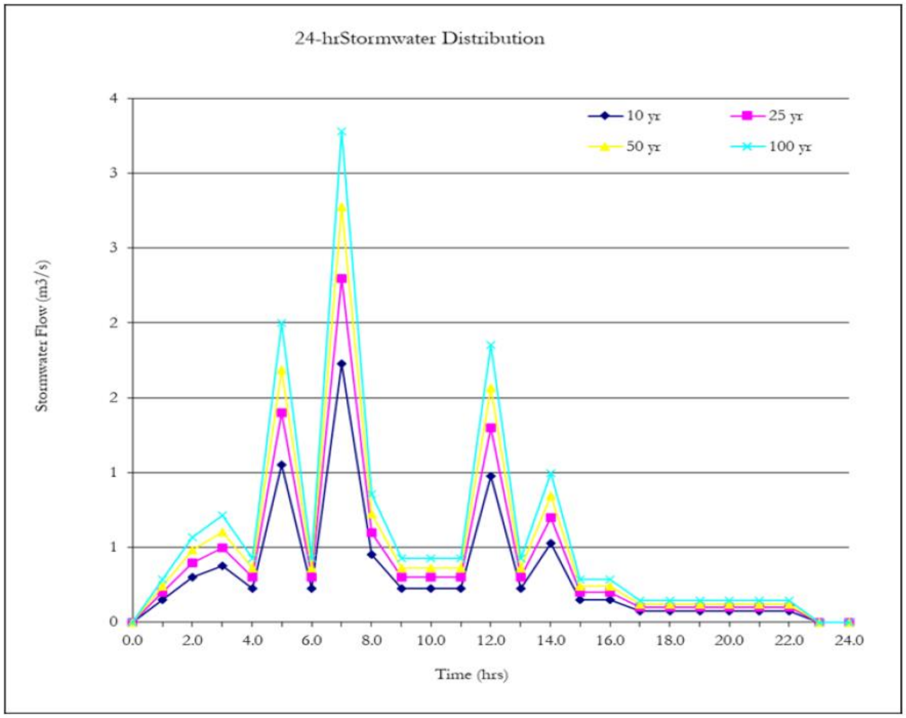


Figure 5-25 24-hour stormwater flow distribution for pre-development conditions

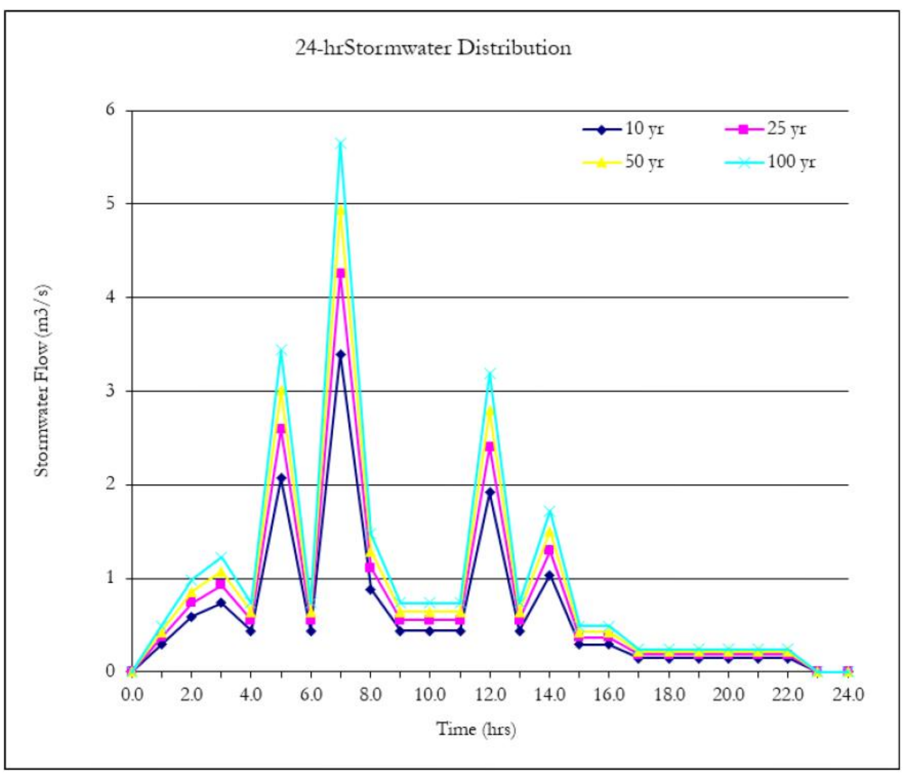


Figure 5-26 24-hour stormwater flow distribution for post-development conditions

As shown, the calculated return periods vary from 5 years to 100 years, which is typical for a hydrological analysis. The choice of the actual drainage design return period however depends on various factors, including the size of the drainage area, the risk of failure, the importance of the structure, and the desired degree of conservatism. For the drainage area related to the proposed Richmond development, the 25-year design rainfall event was used. This is in line with the National Works Agency (NWA) recommendations for major drains.

The NWA requires flood protection works for minor drainage systems be designed for the 10-year return period. This includes inlets, street and roadway gutters, roadside ditches, small channels and swales, and small underground pipe systems. These all collect storm water runoff and transport it to control facilities, pervious areas and/or the major drainage system (i.e., natural waterways, large impoundments, gullies, rivers, etc.).

Major drainage systems (including natural waterways, rivers, large man-made conduits, depression storage areas and large water impoundments) must be designed for up to the 100-year event. The peak runoff generated for the catchment ranges from 1.41 to 3.28 m^3/s for the predevelopment conditions and 2.83 to 5.65m^3/s for 5-to-100-year return period for post development conditions. It should be noted that the 25-year event post development peak runoff (4.26 m^3/s) will be considered when sizing the main drainage system for the proposed site.

5.1.6 Oceanography and Hydrodynamics

Baseline coastal zone modelling is required to gain an understanding of the coastal processes acting along the shoreline of the project site. Waves, currents and sediments all interact to affect shoreline morphology, such as erosion or accretion. Coastal hazards that affect the coast include flooding from storm surge due to hurricanes, and chronic shoreline erosion from daily and swell waves. Shorelines may show signs of dynamism, as they build up during the summer months when the conditions are calmer and erode during the winter months when the wave conditions are stronger due to ocean swells. To understand the daily wave climate and storm surge potential of the area, detailed numerical modelling was carried out and the results are presented in this section. Potential erosion at the site due to swells and hurricanes is also presented.

5.1.6.1 Model Validation

Smith Warner International Ltd. collected measured data along the north coast shoreline near the Richmond Estate property as shown in Figure 5-27 (approximately 5km away). Due to the proximity of that site and the similar orientation of the shoreline and offshore depths, SWI believes the conditions along the two shorelines are comparable. There are no major differences in current speed and directions. It is not expected to be an exact match to the measured, however, the current speed and direction at Richmond should be very close to the measured data from the site 5km away.

The calibration parameters used for the numerical model for Richmond were the same as those used for Karisma where the measured data was for. The parameters that were used are:

- Measured wind data during the same period as the measured currents;

- Adjusted bed friction;
- Global Ocean Tide model DTU 10 as input to the model boundaries to drive the currents.

The numerical model was run for 17 days to capture both spring and neap tidal cycles. Figure 5-28 shows the comparison of the measured data (blue) at Karisma, compared to the simulated data (red) at the Richmond Estate. The numerical model shows that the dominant currents (eastings, i.e., those from the east) fall within the general range of current speeds captured by the measured data. The northings, which are less dominant due to the orientation of the shoreline, does not capture the variability of the measured data. In general, numerical models do not capture current variability in the non-dominant direction as well as measured data, plus the comparison is not exactly at the same location. Overall, the current speeds from eastings) are captured well, which is expected based on the proximity of the measured location and the project location.

This validation provides confidence in the ability of the numerical model to investigate the main drivers of the coastal processes.

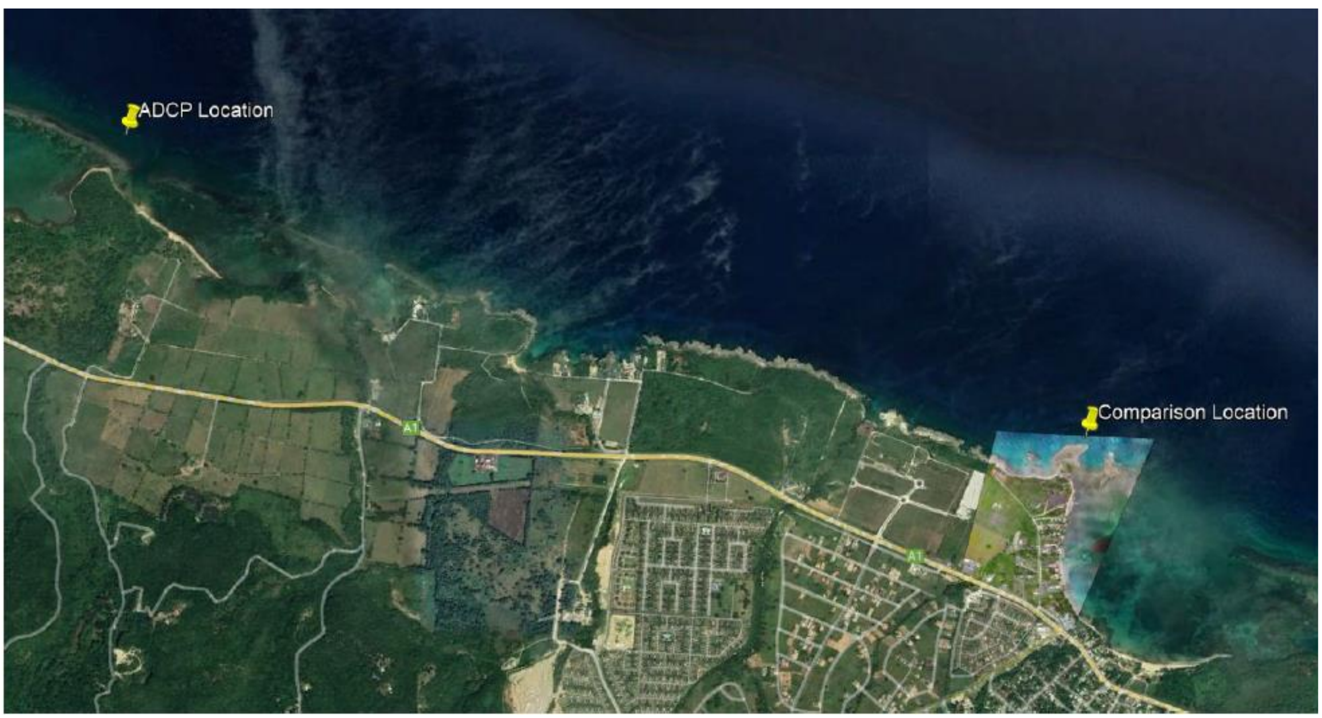


Figure 5-27 Location of ADCP with measured data and the comparison point at Richmond

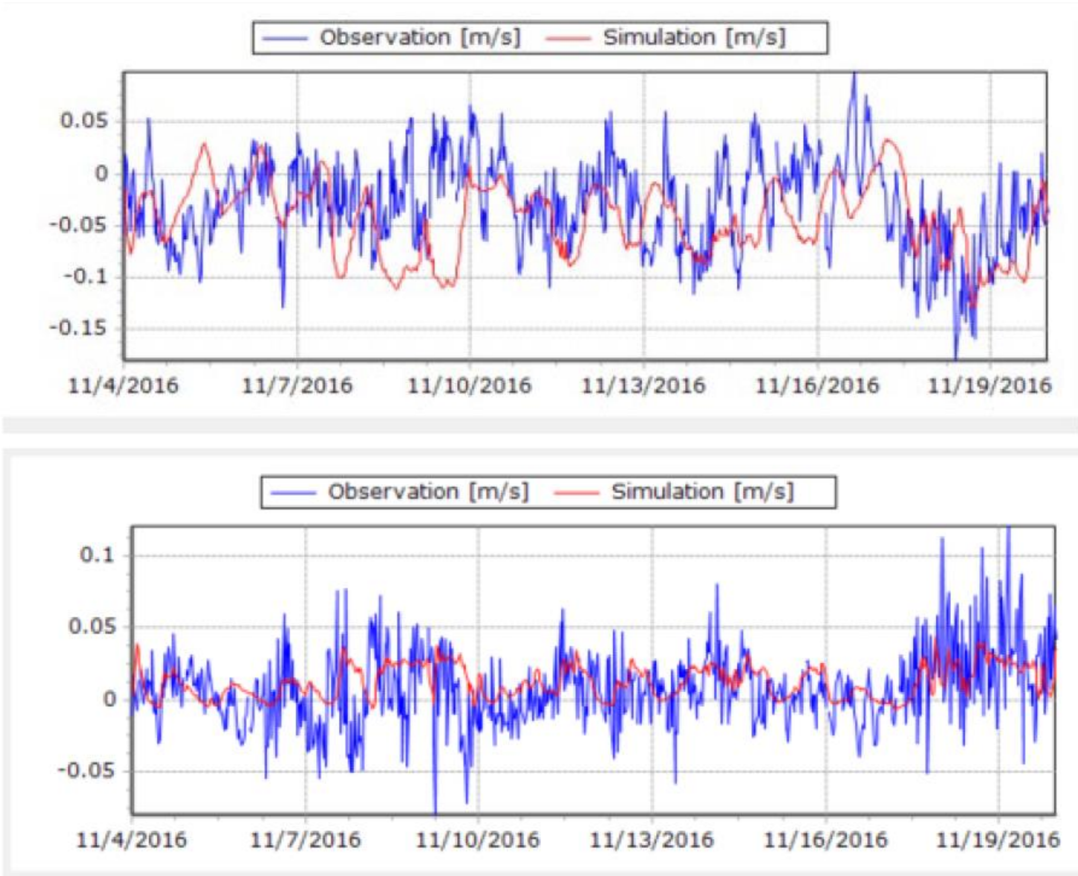


Figure 5-28 Measured (blue) vs modelled (red) Eastings (top) and Northings (bottom) current speeds

5.1.6.2 Operational Waves

The operational wave climate at the project site is characterized by day-to-day, relatively calm conditions and by seasonal winter swells (December to May). The day-to-day conditions are created by the north-east Trade Winds. The swells, however, are generated by North Atlantic cold fronts and these waves approach from the north to north-west sector. As such, the north coast of Jamaica can be exposed to these longer period and more aggressive wave conditions on an annual basis. It is these conditions that have the more profound impact on the shoreline of the project site, even though, as a percentage of the year, their occurrence is relatively small.

The deep-water operational wave climate was established using the ECMWF Reanalysis v5 (ERA5) produced by the European Centre for Medium-range Weather Forecast (ECMWF). The ERA5 model reanalyses wave parameters including wave height, period and direction as well as the wind speed and direction every hour from 1979 to 2021. These over 373,000 timesteps of data can be extracted at an enhanced resolution of ~31x31km (or ~0.25 deg).

The wave data obtained from ERA5's Node 8 were categorized using a tri-variate frequency analysis of wave height, period and direction, a process also known as "binning". This frequency analysis resulted in 2,452 different conditions or "events" representing a combination of wave height, peak period and direction, each with a specific duration related to the number of occurrences over the 42-year period. Analysis of the binned data showed that waves approached from the northeast to southeast sectors most of the time. Figure 5-29 shows the wave height distribution and the location of the node (Node 8) that was selected for the project. In terms of magnitude, typical significant wave heights (Hs) offshore the coast are 0.5 - 2m, with associated with average peak periods (Tp) of 6-8 seconds.

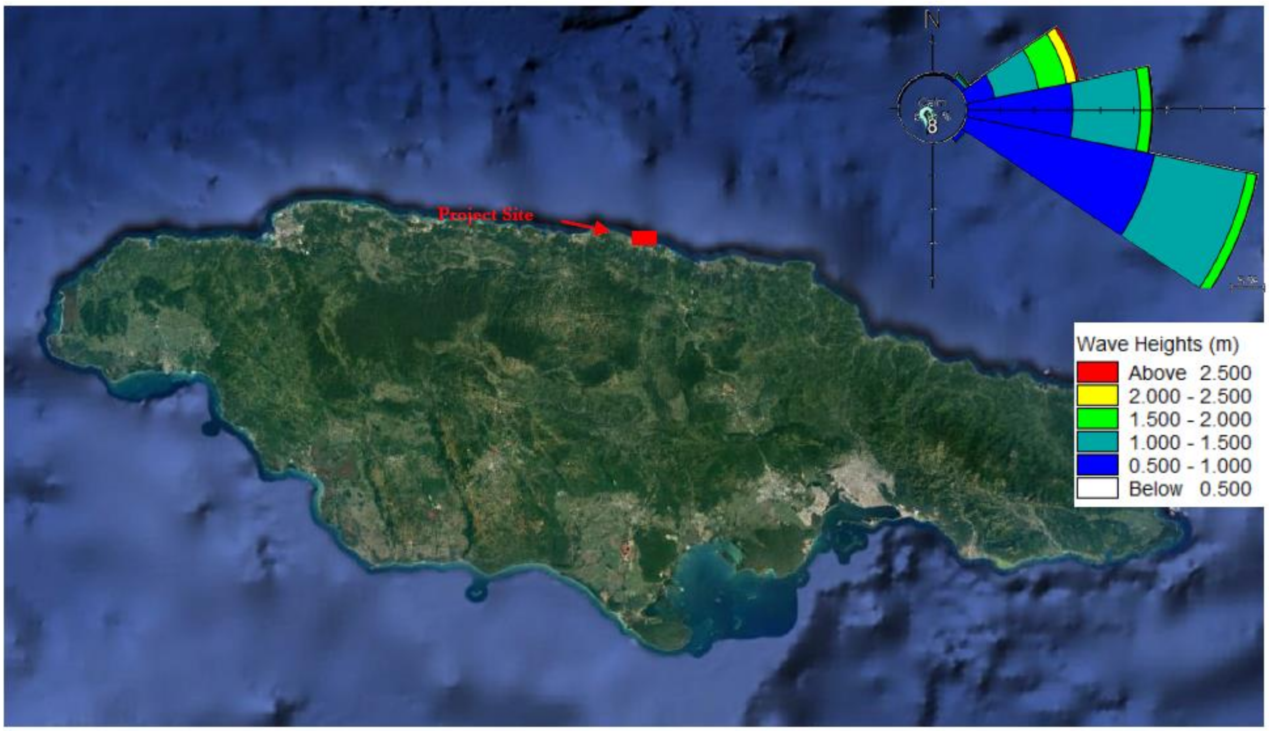


Figure 5-29 Wave Rose at the offshore ERA 5 Node 8 summarizing 42 years of data

As previously mentioned, the ERA5 model is usually applied on spatial scales (grid increments) larger than 30km and outside the surf zone. As a result, the model is not at a sufficiently detailed scale to provide accurate nearshore wave data along the Richmond Bay coastline. The project area's nearshore wave climate was therefore developed using a spectral wave model MIKE 21 SW to simulate waves as they approach from the east, north and west and move over the offshore bathymetry of the island to reach the project site. The model was run in a semi-stationary mode with inputs of the wave heights, periods and directions along the boundaries of the model domain.

The resulting nearshore wave 2D-plot is shown in Figure 5-30. It depicts the mean annual wave climate (50^{th} percentile - top) as well as the 99.86th percentile wave climate (bottom). The 99.86th percentile wave denotes conditions that were exceeded 0.14 percent of the time. This equates to 12 hours per year. The annual mean wave climate, on the other hand, describes the average wave heights and directions in a given year.

For the mean annual wave climate, the following observations were made:

- 0.1m waves reaching the eastern and north-eastern shoreline
- to 0.2m waves reaching the north-western shoreline
- to 0.7m waves reaching the peninsula/headland

For the extreme operational wave conditions, the following observations were made:

- 0.1 to 0.2m waves reaching the eastern and north-eastern shoreline
- 0.4m waves reaching the north-western shoreline
- 0.5 to 2m waves reaching the peninsula/headland

Swell waves are also present in the annual wave climate described above. These are less common but can cause significant changes in the direction and magnitude of waves, causing damage to coastal areas. Swell waves are caused by a strong wind field acting over the ocean from afar. As the waves grow in size, they outrun the winds that create them and travel to distant shorelines, such as Jamaica's north coast, bringing a significant amount of energy with them.

A swell event occurs when the amount of wave energy reaching the shoreline significantly increases during the operational wave climate. This increase in wave energy has the potential to cause significant overtopping, flooding, and large-scale erosion. These strong wave events are typically caused by storms in the North Atlantic Ocean (NAO) and/or the Central American Cold Surge (CACS) that acts over the Gulf of Mexico and the Caribbean Sea.

Seasonal cold fronts also affect Jamaica's north coast. These fronts cause a drop in air temperature, which increases the wind speed. They typically affect the coast from December to February each year, resulting in significant annual events. Fronts typically span several hundred kilometres and move into the Caribbean as sheet flow from north to south. This results in larger waves approaching the shoreline from the north-west to the northeast.

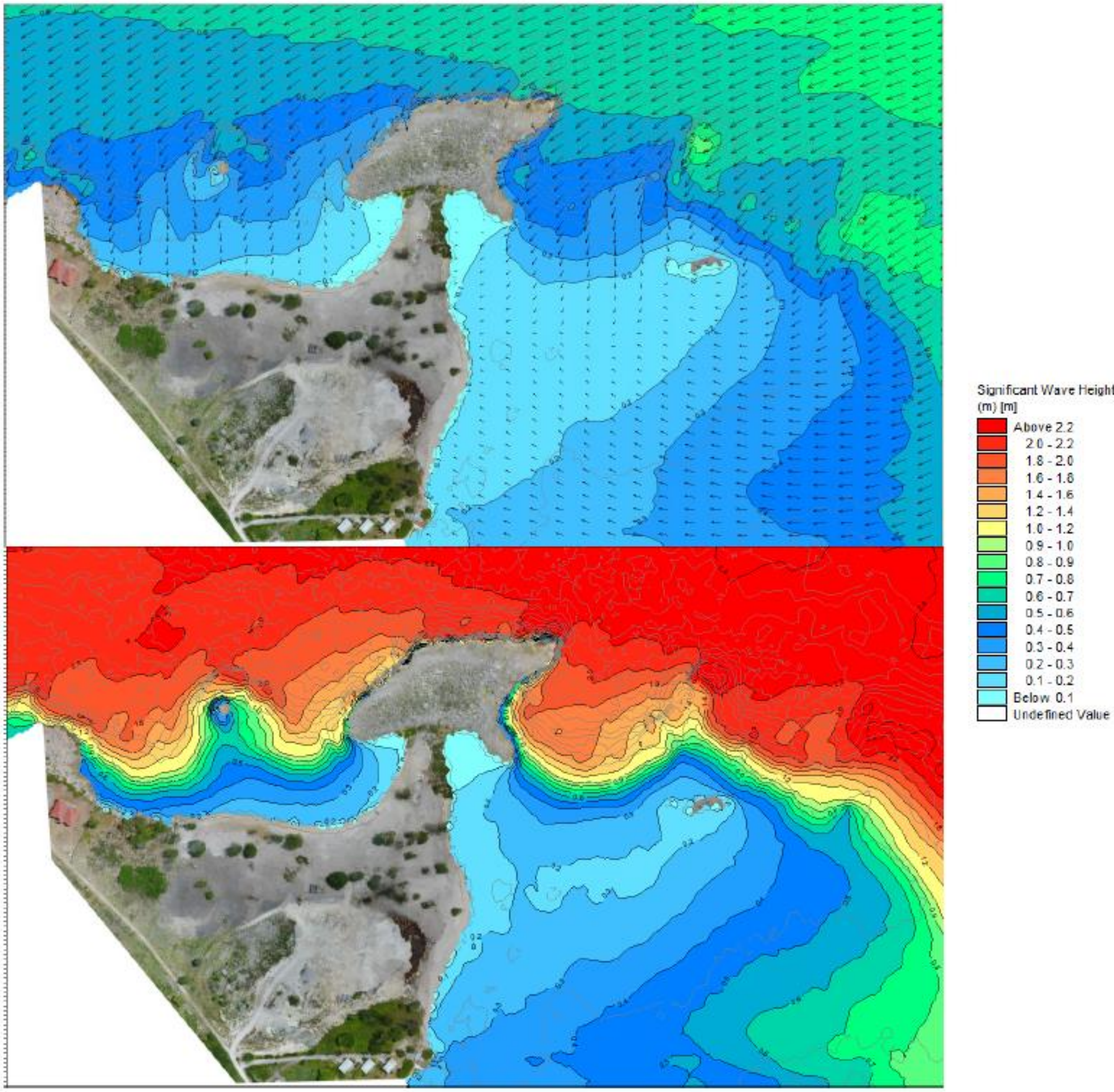


Figure 5-30 Plots describing the operational wave climate at Richmond development. The mean annual wave climate (top) and the 99.86th percentile waves (bottom) are displayed.

The following points summarize the results of the wave modelling:

- Western side of northern shoreline – significantly higher waves, which explains the absence of beach and the presence of course sediments. Any beach creation will require structural intervention to create sustainable beaches.
- Eastern side of the northern shoreline – The peninsula protects the north-eastern corner, but high waves do wrap around and penetrate the northern shoreline. Sediments move from high energy zones to lower energy zones so in this case the sediments move from west to east. This

is corroborated by the site observations where there is a beach in the eastern corner but none on the western side. This area is therefore suitable for a beach, but to avoid erosion during rough sea conditions, structural intervention will be necessary.

- The peninsula – even under normal rough weather throughout the year, this area is vulnerable to waves and splashing. Therefore, there is no significant vegetation here. Any structure on this will need to be horizontally set back at a safe distance from the waterline as well as elevated to minimize splash.
- Eastern shoreline – The shallow flat shelf is a natural breaker of high energy waves and therefore provides a calm environment. In addition, there is a natural island outcrop that further helps to create a wave pattern that encourages sand accumulation within the centre of the project shoreline here. It is this calm environment that encourages such dense seagrass growth in the area. Further, this area is ideal for safe wading and as a location for overwater villas.

5.1.6.3 Operational Hydrodynamics

Tide Data

Global tide models are generally accepted as sufficiently accurate to describe operational hydrodynamics including coastal circulation. Typically, these global tide models are based on harmonic analyses of measured tide gauge data, or from processed satellite observations. Figure 5-31 shows the Denmark Technical University (DTU) model-predicted tides just offshore the project site from January to December 2021. It should be noted that these model-generated tides tend to ignore thermal effects, which can vary the water level through the year by ±0.07m, and a multitude of other smaller factors that can cause “natural variability” in tide; they are however sufficient to form a basis for circulation and flushing analysis. The following observations can be made about the tides:

- Tidal range is quite small. (approx. 0.43m);
- Typical high tide of 0.22m and a low tide of 0.21m;
- The tide plot also reveals a semi-diurnal signal, meaning there are two highs and lows per day, often of unequal magnitude;
- This tidal range is quite typical for the north coast of Jamaica and because of its relatively small range it means tidally-induced currents are small.

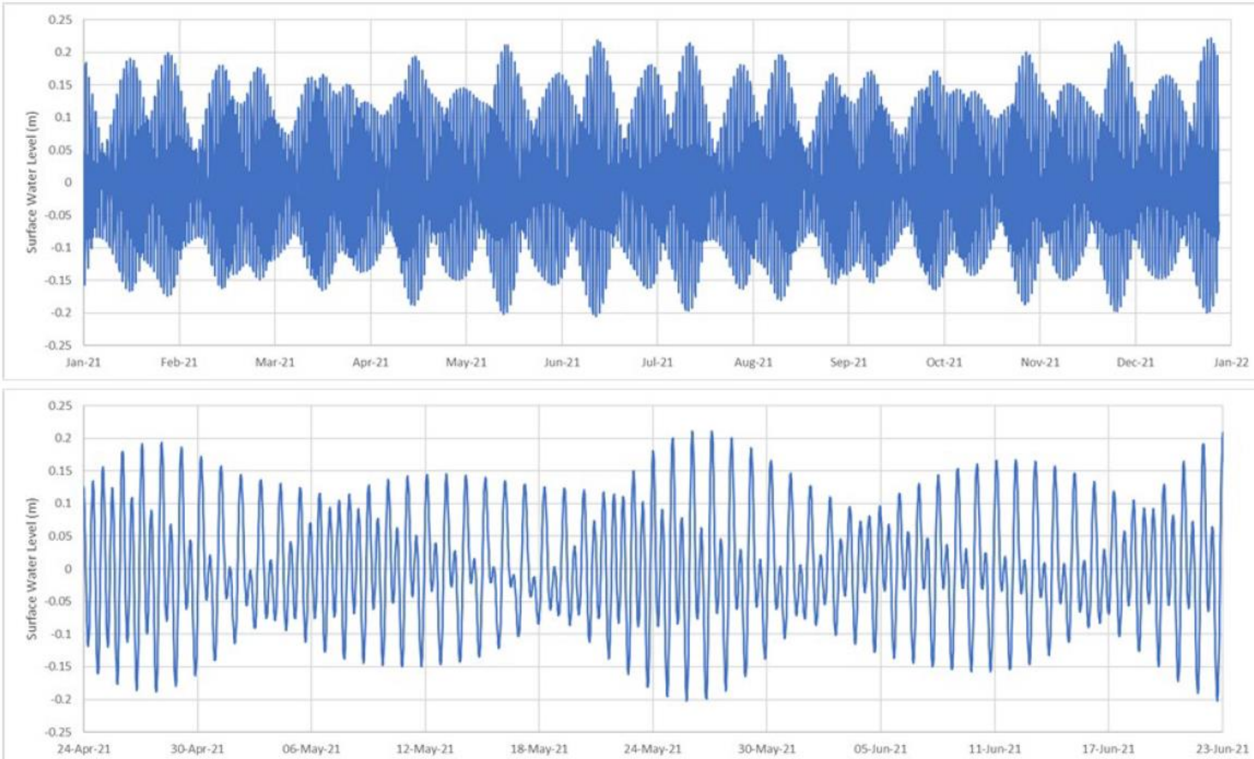


Figure 5-31 Tidal signal offshore the project site (2021)

Tidal Current Speed and Direction

This section looks at the tidal current patterns offshore and along the project site. Based on visual observations, which show little to no movement of currents in the nearshore, the currents in this area appear to be low and tidally driven. Any sediment movement would therefore be due to wave forces and wave-induced currents.

The MIKE 21 HD model was run over a spring and neap tidal cycle to determine the range of current speeds along the project shoreline as shown in Figure 5-32. The hydrodynamic model shows that the currents along the shoreline are slow and will not initiate bed load or suspended sediment transport. The current speeds range between 0 to 0.01 m/s.

In summary, the tide-induced currents in this area are negligible and will not have a significant impact on sediment transport or other coastal processes.

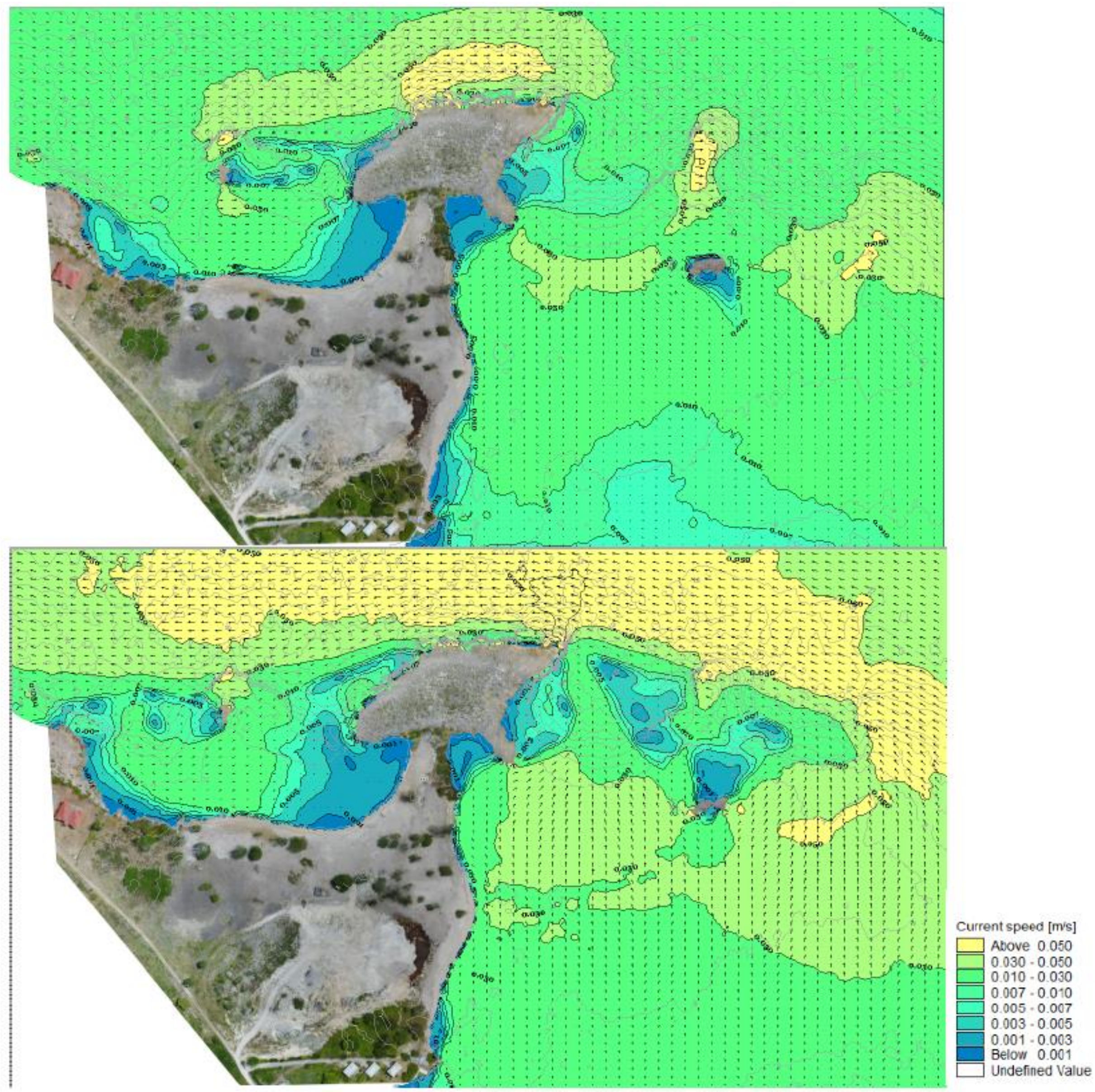


Figure 5-32 Spring rising (top) and falling (bottom) tidal cycles at the project site

Tidal Current Speed and Direction with Waves Included

This section looks at the influence waves have on the current speeds and direction along the shoreline. For this simulation, the mean annual wave height was used, which is approximately 0.6m in deeper water. The approach of the waves was from the northeast, which is typical for the mean annual wave climate. What stands out is the influence of wave conditions on current directions; even when the tide is falling, the currents are still influenced by incoming waves, drive the currents towards the shore. In other words, current speeds as a result of waves are faster than just the tidally influenced current speeds (Figure 5-33).

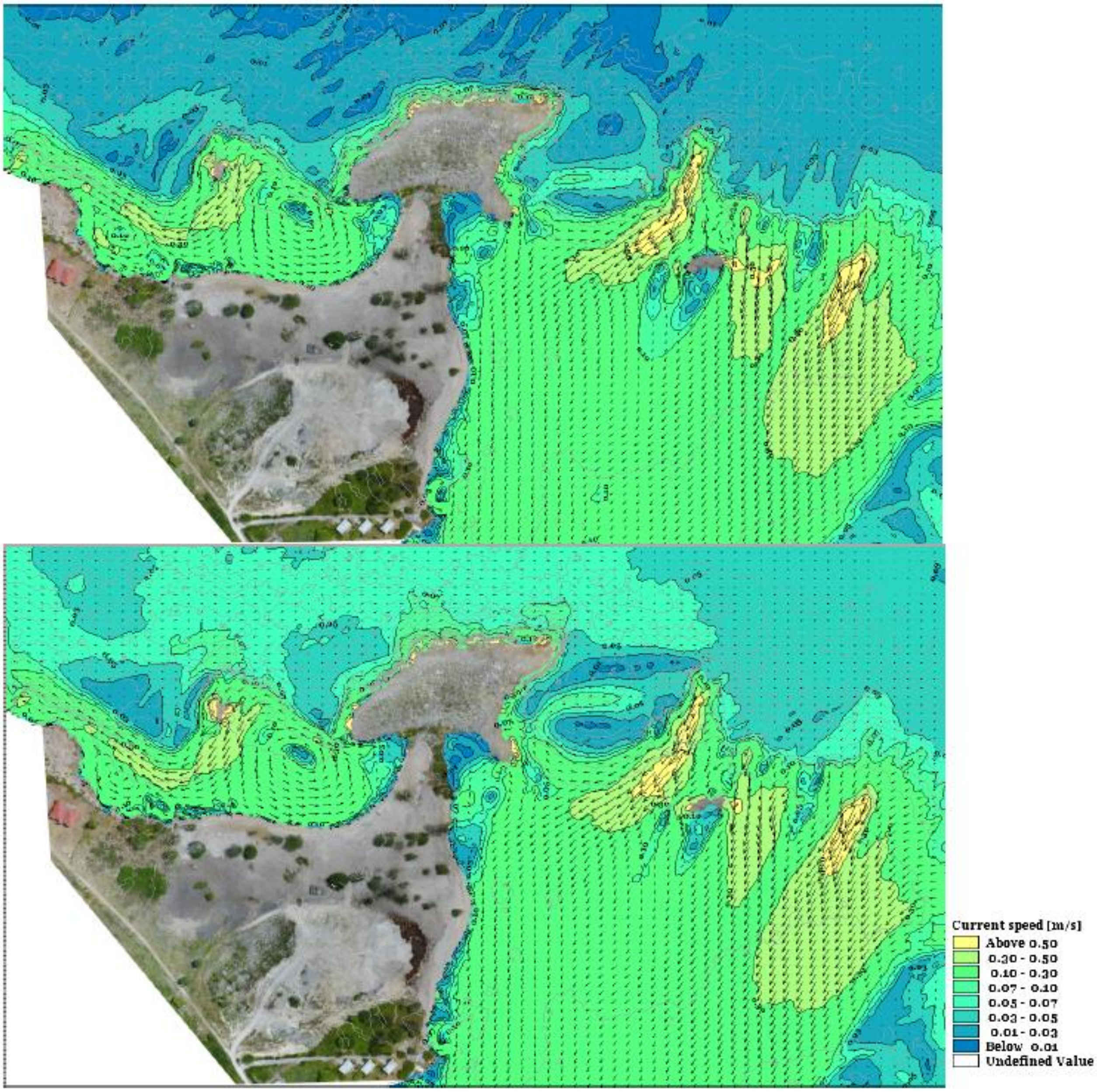


Figure 5-33 Spring rising (top) and falling (bottom) tidal cycles at the project site with typical waves included

Summary

Although the tidal currents are small due to the small tidal range in and around Jamaica, there is also the influence of wind and wave-induced currents, which can improve the water circulation and add to both water exchange and mixing. Rip currents are usually in the order of 0.6m/s and are usually unsafe for the average swimmer. For both the north beach and the east beach, the wave-induced current speeds range between 0.03 to 0.1m/s. The nearshore areas are therefore safe for swimming.

5.1.7 Water Quality

Water quality sampling exercises were conducted at eight (8) stations on July 8th, September 2nd, October 5th, December 6th, 2022, and January 12th, 2023. Temperature, conductivity, salinity, dissolved oxygen, turbidity, Photosynthetically Active Radiation (PAR) – light irradiance, total dissolved solids and pH were collected using a Hydrolab DataSonde-5 water quality multi probe meter. Light extinction through the water column was calculated from PAR values recorded.

Whole water samples were collected in pre-sterilized bottles, stored on ice and taken to Caribbean Environmental Testing and Monitoring Services Limited (CETMS Ltd.) for analysis of Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), nitrate, phosphate and faecal coliform. Samples were also shipped to Test America Laboratories in Florida for analyses for Total Petroleum Hydrocarbons (TPH) for the first three samples taken in July, September and October 2022.

Weather Conditions were fair and sunny on July 8th with rainfall events occurring on the days leading up to September 2nd, October 5th and December 6th, 2022, and rainfall occurring during sampling on January 12th, 2023. The sampling locations are listed in Table 5-14 and illustrated in Figure 5-34

Table 5-14 Water quality sampling locations (JAD2001)

Station	X	Y
WQ1	726750.425995	700554.072031
WQ2	726719.304891	699997.169290
WQ3	726403.366916	699804.264826
WQ4	726441.070389	700172.231628
WQ5	726508.738200	700295.704440
WQ6	726306.307239	700391.592790
WQ7	726223.802976	700239.690060
WQ8	725766.749713	700456.327471

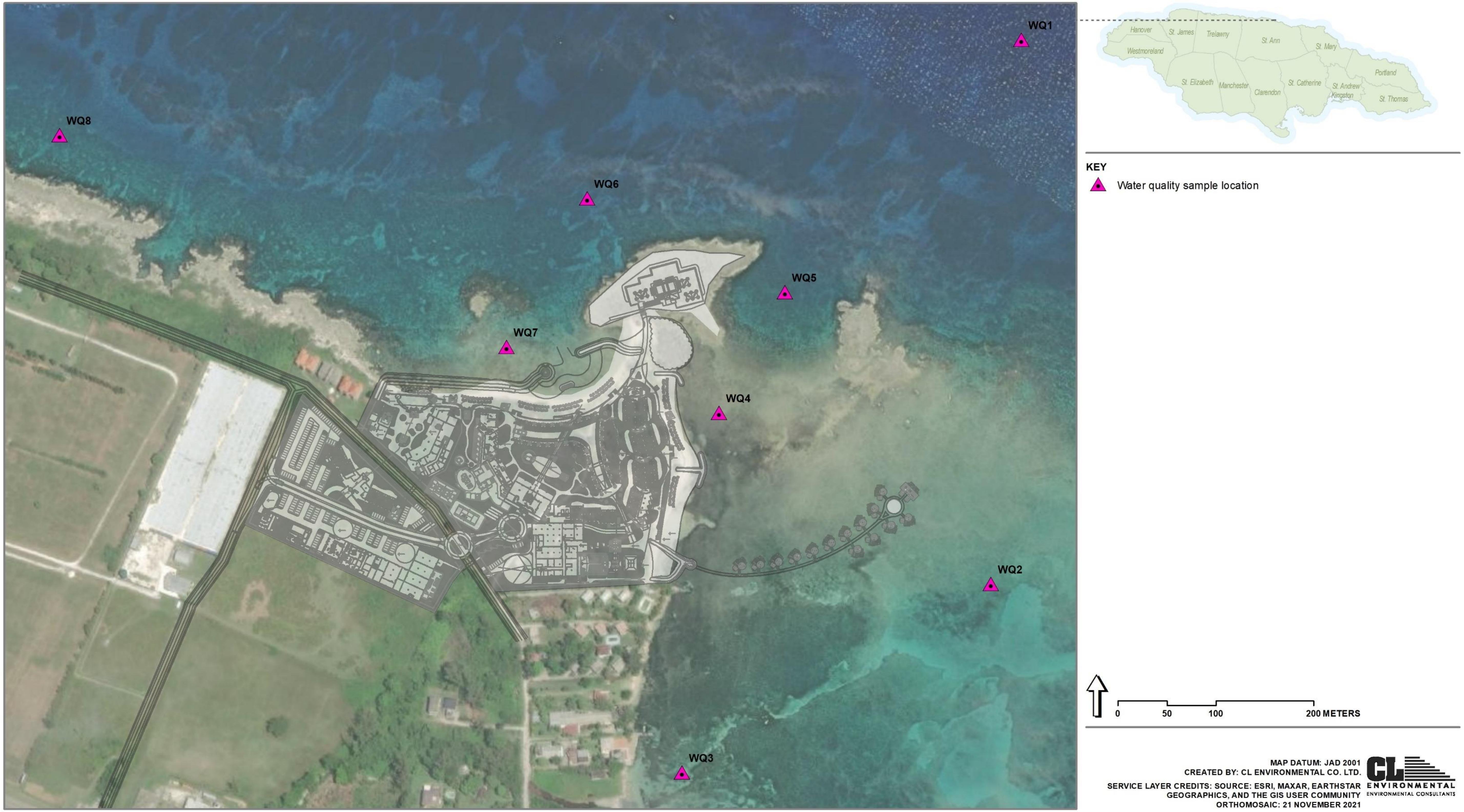


Figure 5-34 Water quality sampling stations

5.1.7.1 Results

Table 5-15 outlines the average in-situ data results and Table 5-16, the average laboratory data results, all stations were compared with NRCA Marine Water Quality Standards, Appendix 9 and Appendix 10 contain the full list of results obtained in-situ and from the various laboratories.

Average temperature values were all considered normal for tropical marine water. Marine water temperatures recorded were expected in a tropical marine area influenced by the Trade Winds (27 – 30 ^{o}C). The average conductivity, salinity and total dissolved solids (TDS) values were all considered normal for tropical marine water. Average dissolved oxygen (D.O.) values all locations were all within acceptable levels (>4 mg/l) and above the level that may be considered detrimental to aquatic life (< 3 mg/l). The lowest D.O. value was recorded at Station 6.

Average pH values were considered normal for seawater and compliant with the NRCA marine water quality standard. Water turbidity remained low for all marine stations but were slightly elevated at Station 3 due to the discharge from the nearby Parsons Gully.

Light extinction calculated for specific stations with depths greater than 0.5 metres, ranged from 0.0753 – 0.7561. The highest average value was obtained at station 7 and the lowest average value was obtained at station 1. The extinction coefficient indicates the rate of loss of light with depth. Station 7 showed the greatest loss of light (0.7561), which would indicate a moderate presence of particles (biological or non-biological) in the water column affecting light penetration. The presence of organic and inorganic material also affects extinction coefficient.

Table 5-15 Average *in-situ* water quality data

Stn.	Temp. (°C)	Cond. (mS/cm)	Salinity (ppt)	pH	D.O. (mg/l)	Turbidity (NTU)	TDS (g/l)	Light Extinction
1	28.86	54.68	36.28	8.19	7.29	0.01	34.99	0.0753
2	28.74	54.31	36.07	8.18	6.54	0.37	34.85	0.2235
3	28.67	54.07	35.87	8.13	6.18	2.04	34.63	0.5076
4	28.69	54.39	35.66	8.14	7.50	0.00	34.89	0.6239
5	28.77	54.59	36.23	8.19	6.43	0.00	34.94	0.1673
6	28.83	54.68	36.28	8.18	6.16	0.00	34.99	0.1859
7	28.86	54.66	36.25	8.19	6.80	0.02	34.99	0.7561
8	28.78	54.61	36.23	8.19	6.47	0.13	34.95	0.1610
NRCA Marine Water Standard	-	-	-	8 - 8.4	-	-	-	-

NB. Numbers in red are non-compliant with the standard/guideline.

Average faecal coliform values were compliant with the NRCA standards for all stations sampled. Average BOD values were mostly compliant, except for stations 2, 3 and 4 which were slightly above the NRCA Marine Water Quality Standard of 1.16 mg/l. Stations 1, 2, 3 and 4 had the lowest average faecal coliform values, <1.1 MPN/100ml, while Stations 5, 6, 7 and 8 were slightly elevated ranging from 3.00 – 5.00 MPN/100ml but were compliant with the NRCA marine coliform standard.

Increases in BOD and faecal coliform values may be as a result of anthropogenic influences in the form of pollution via solid waste dumping and untreated sewage effluent discharge/disposal, particularly from the nearby Parsons Gully outflow (nearby septic tanks and absorption pits).

Total suspended solids (TSS) levels at marine stations mirrored the turbidity values and remained low, indicating clear water. Nitrate and phosphate values at all stations sampled were non-compliant with the NRCA marine standard; however, these nutrient values are considered normal for Jamaican coastal waters and seldom vary outside of this range.

The stations sampled showed no traces of total petroleum hydrocarbons (TPH).

Table 5-16 Average laboratory water quality data

Stn.	BOD (mg/l)	TSS (mg/l)	NIT (mg/l)	PHOS (mg/l)	F.COLI (MPN/100ml)	TPH (mg/l)
1	0.87	<5.00	1.98	0.60	<1.00	ND
2	1.19	<5.00	1.86	0.24	<1.00	ND
3	1.28	<5.00	1.72	0.24	1.02	ND
4	1.21	<5.00	1.90	0.21	<1.00	ND
5	1.06	<5.00	2.28	0.11	3.00	ND
6	1.00	<5.00	1.76	0.36	3.00	ND
7	0.83	<5.00	2.16	0.57	3.00	ND
8	1.10	<5.00	1.74	0.10	5.00	ND
NRCA Marine Water Standard	1.16	-	0.007-0.014	0.001-0.003	<2-13	-

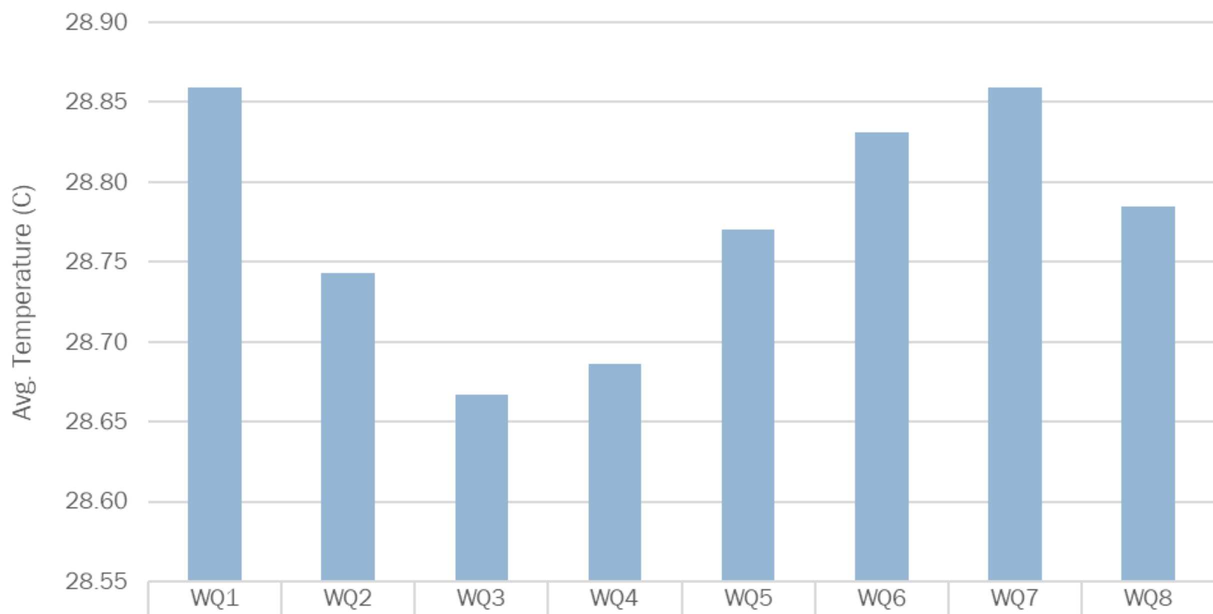
NB. Numbers in red are non-compliant with the standard/guideline.
ND – None Detected

Temperature

Average temperature values were all considered normal for tropical marine water. Marine water temperatures recorded were expected in a tropical marine area influenced by the Trade Winds (27 – 30 ^{o}C). The lowest temperature was recorded at station 3 (Figure 5-35), which was located in close proximity to a nearby Parsons Gully outflow. This freshwater influx most likely lowered the temperature within the area, and most likely contributed to the lower temperatures at Stations 2 and 4, which were also located within the bay.

The mean temperature for the five runs was 28.78^{o}C, with low fluctuations about the mean, demonstrated by a low coefficient of variation (2.68%CV). The spatial coefficient of variations across the eight stations sampled demonstrated low fluctuations with %CV values ranging from 2.54% to 4.00% with similar results for the temporal values, which ranged from 0.27% to 1.76% across the five runs.

These results indicate that there was little variation across the eight stations for the five months sampled. There were no significant spatial or temporal differences in temperature (ANOVA p>0.05). Temperature values peaked during October, while the lowest temperatures were observed during January.



	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8
TEMP. °C	28.86	28.74	28.67	28.69	28.77	28.83	28.86	28.78

Figure 5-35 Average Temperature Values (^{o}C) at the Eight Stations

Conductivity

Conductivity is a measure of the number of free ions within a given water sample and, in conjunction with salinity, is used to gauge whether the water sample is saline/marine or non-saline/fresh water. Typically, higher conductivity readings are indicative of more free ions within the sample of water, and are usually obtained, for example, in the case of saline water (as opposed to fresh water).

Figure 5-36 shows the conductivity readings measured for all eight stations, with station 3 having the lowest conductivity, this is most likely due to freshwater inflow from the Parsons Gully and drainage points along the Eastern property line, which was most likely also affecting the lower values at Stations 2 and 4, which were located within the bay.

The mean conductivity for the five runs was 54.50 (ms/cm), with low fluctuations about the mean, demonstrated by a low coefficient of variation (1.29%CV). The spatial coefficient of variations across the eight stations sampled demonstrated low fluctuations with %CV values ranging from 0.83% to 2.24% with similar results for the temporal values, which ranged from 0.05% to 1.27% across the five runs. These results indicate that there was little variation across the eight stations for the five months sampled. There were no significant spatial or temporal differences in conductivity (ANOVA $p>0.05$). Conductivity values peaked during September, while the lowest conductivities were observed during January.

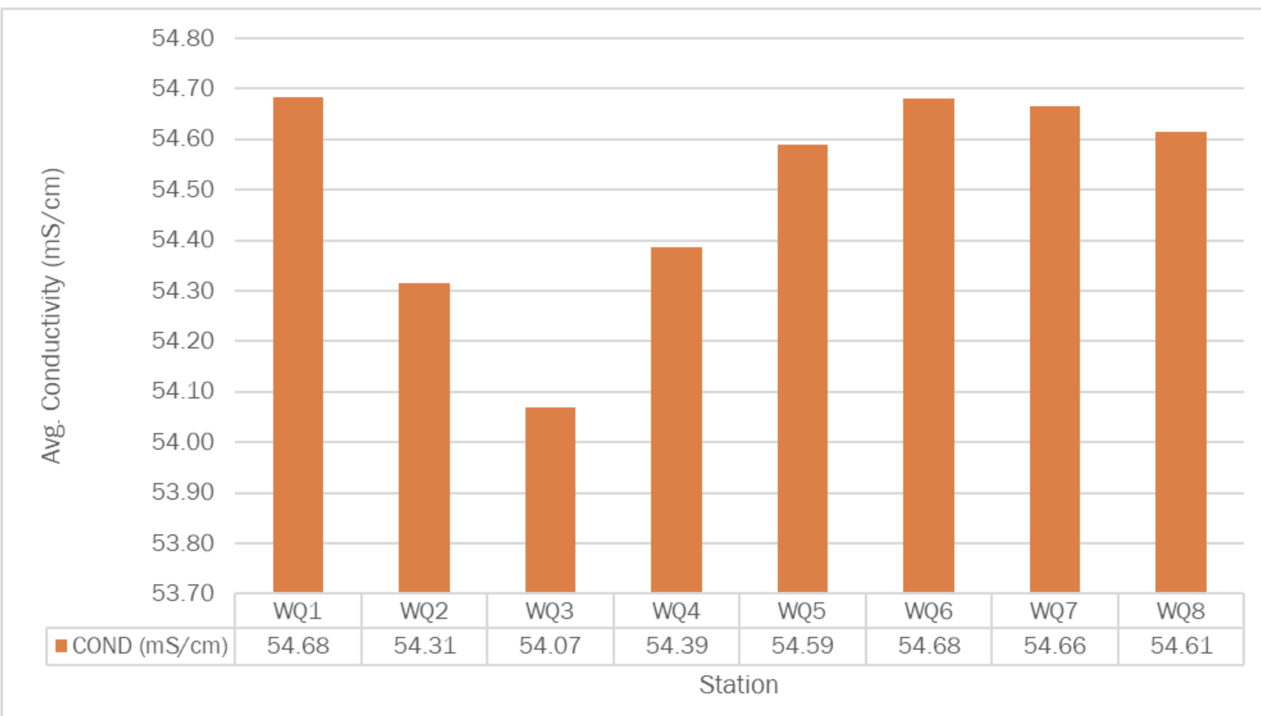


Figure 5-36 Average Conductivity Values (mS/cm) at the Eight Stations

Salinity

Salinity values recorded (and trends noted) were similar to that of conductivity readings obtained during the monitoring exercise. They support the general inferences and conclusions discussed under the section on Conductivity.

Figure 5-37 shows the salinity reading recorded for all eight stations, with the lowest readings occurring at stations 2, 3 and 4.

The mean salinity for the five runs was 36.11(ppt), with low fluctuations about the mean, demonstrated by a low coefficient of variation (1.89%CV). The spatial coefficient of variations across the eight stations sampled demonstrated low fluctuations with %CV values ranging from 0.94% to 4.31% with similar results for the temporal values, which ranged from 0.10% to 2.75% across the five runs. These results indicate that there was little variation across the eight stations for the five months sampled. There were no significant spatial or temporal differences in salinity (ANOVA $p>0.05$). Salinity values peaked during September, while the lowest salinities were observed during January.

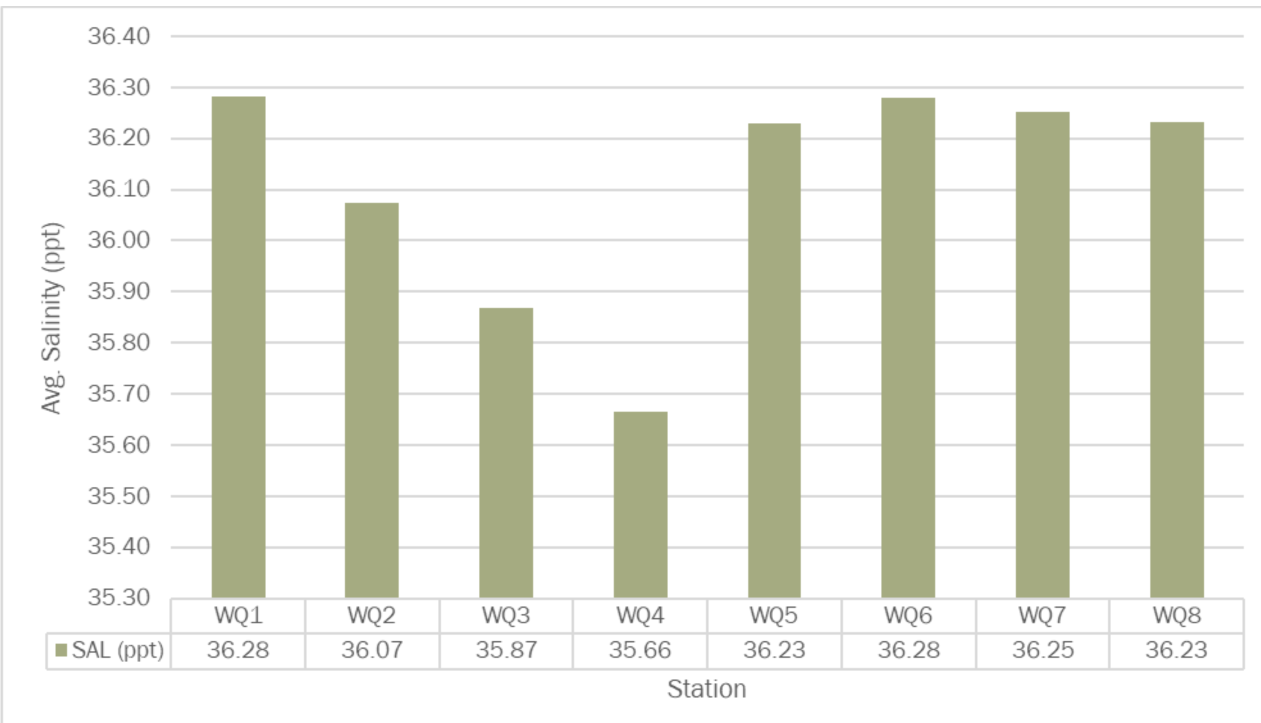


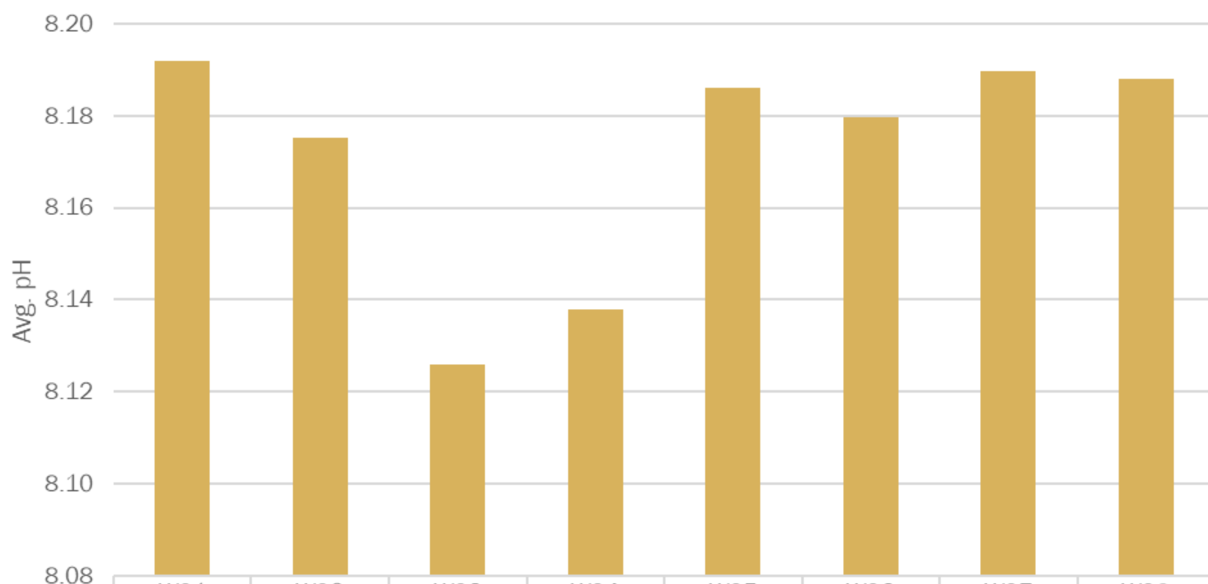
Figure 5-37 Average Salinity Values (ppt) at the Eight Stations

pH

pH is a measure of how acidic or basic a substance is, average seawater pH is around 8.1, with the NRCA marine water quality standard being 8.0-8.4.

Figure 5-38 shows the average pH values for the eight stations, all stations were compliant with the NRCA marine water quality standard, with station 3 having the lowest value most likely due to freshwater from the outflow from Parsons Gully.

The mean pH for the five runs was 8.17, with low fluctuations about the mean, demonstrated by a low coefficient of variation (1.35%CV). The spatial coefficient of variations across the eight stations sampled demonstrated low fluctuations with %CV values ranging from 0.68% to 1.94% with similar results for the temporal values, which ranged from 0.39% to 0.91% across the five runs. These results indicate that there was little variation across the eight stations for the five months sampled. There were no significant spatial or temporal differences in pH (ANOVA $p>0.05$). pH values peaked during January, while the lowest pHs were observed during July.



	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8
pH	8.19	8.18	8.13	8.14	8.19	8.18	8.19	8.19

Figure 5-38 Average pH Values at the Eight Stations

Dissolved Oxygen (DO)

Dissolved oxygen (DO) is a measure of how much oxygen is dissolved in water, or the amount of oxygen which is available to living aquatic organisms. DO is often used as a measure to water quality, as moving water tends to have more DO than stagnant water. Additionally bacterial respiration and organic matter decay causes the depletion of DO.

Figure 5-39 shows the average DO values for the eight stations, all locations were all within acceptable levels (>4 mg/l) and above the level that may be considered detrimental to aquatic life (< 3 mg/l). The lowest D.O. value was recorded at Station 6.

The mean D.O. for the five runs was 6.67(mg/l), with significant fluctuations about the mean, demonstrated by a high coefficient of variation (16.76%CV). The spatial coefficient of variations across the eight stations sampled demonstrated high fluctuations with %CV values ranging from 4.27% to 33.44% with similar results for the temporal values, which ranged from 3.96% to 30.20% across the five runs. These results indicate that there was high variation across the eight stations for the five months sampled. There were no significant spatial or temporal differences in DO (ANOVA p>0.05). D.O. values peaked during January, while the lowest D.O. was observed during September.

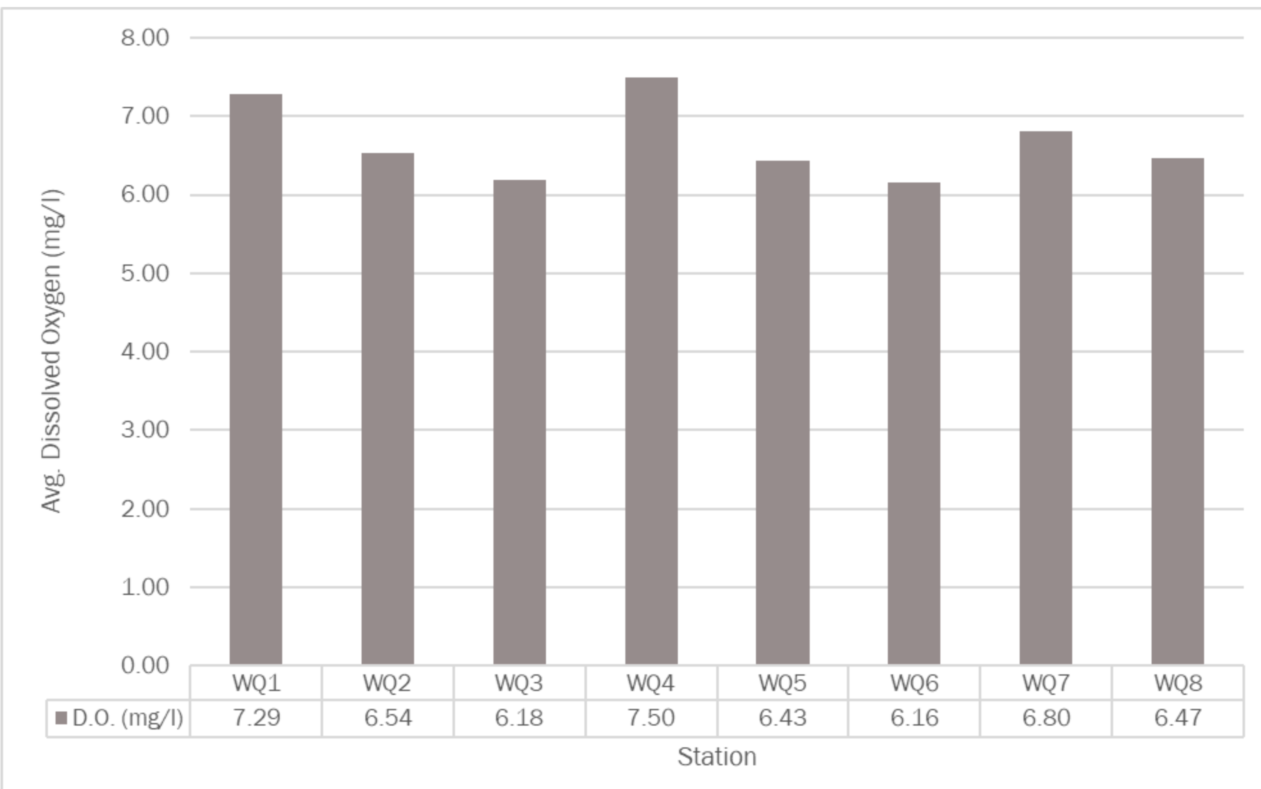


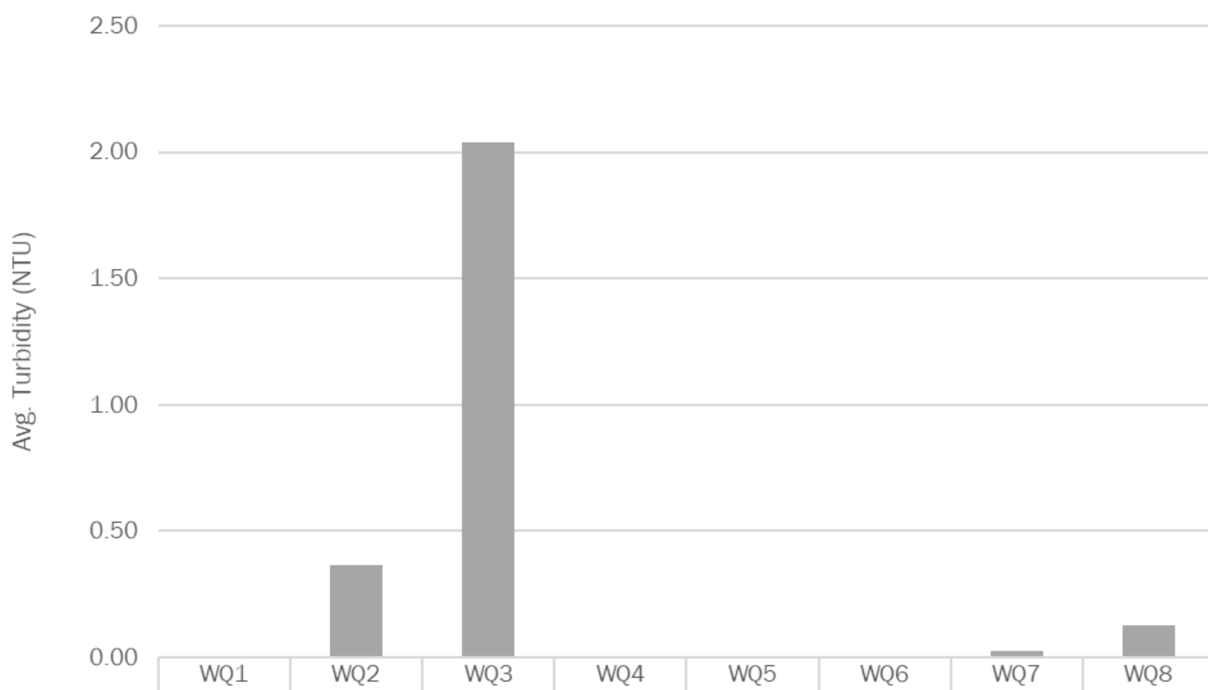
Figure 5-39 Average Dissolved Oxygen Values (mg/l) at the Eight Stations

Turbidity

Turbidity is the amount of cloudiness in the water, caused by suspended material, such as dirt and contaminants. This can vary from a river full of mud and silt where it would be impossible to see through the water (high turbidity), to a spring water which appears to be completely clear (low turbidity)

Figure 5-40 shows the average turbidity values for the eight stations, turbidity was low across all stations, with the highest value being 2.04 for station 3. The higher value at station 3 was most likely due to the outflow from the nearby Parsons Gully, however all stations had low and acceptable turbidity levels.

The mean turbidity for the five runs was 0.32, with high fluctuations about the mean, demonstrated by a high coefficient of variation (356.48%CV). The spatial coefficient of variations across the eight stations sampled demonstrated high fluctuations with %CV values ranging from 137.16% to 223.61% with similar results for the temporal values, which ranged from 206.65% to 282.84% across the five runs. These results indicate that there was large variation across the eight stations for the five months sampled. There were significant spatial and temporal differences in turbidity (ANOVA $p>0.05$). Turbidity values peaked during October, while the lowest turbidity was observed during September.



	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8
Turb (NTU)	0.01	0.37	2.04	0.00	0.00	0.00	0.02	0.13

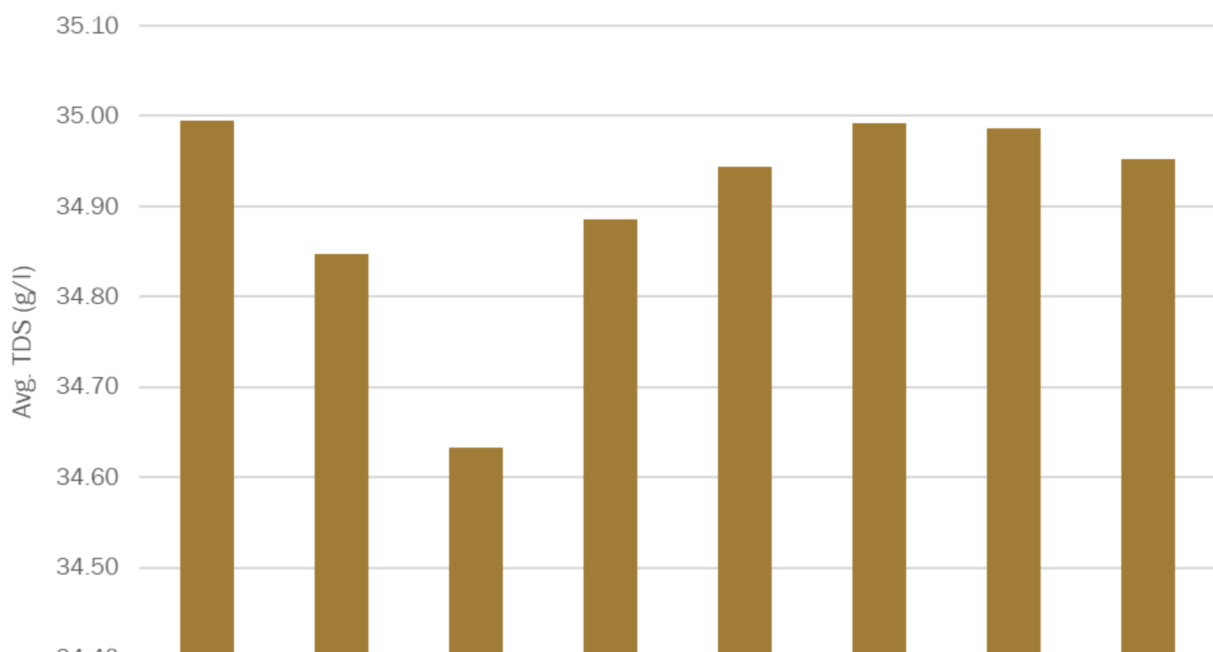
Figure 5-40 Average Turbidity Values (NTU) at the Eight Stations

Total Dissolved Solids (TDS)

Total dissolved solids (TDS) is a measure of dissolved combined content, organic and inorganic substances, within the water. Seawater typically contains TDS concentrations around 35.00 g/l due to the high salt content.

Figure 5-41 shows the average TDS values for the eight stations, with the lowest value being for station 3. The lower value was most likely due to freshwater influence form the nearby Parsons Gully which would lower the TDS. All TDS values were found to be acceptable and within the expected range.

The mean TDS for the five runs was 34.90(g/l), with low fluctuations about the mean, demonstrated by a low coefficient of variation (1.23%CV). The spatial coefficient of variations across the eight stations sampled demonstrated low fluctuations with %CV values ranging from 0.84% to 2.12% with similar results for the temporal values, which ranged from 0.07% to 1.19% across the five runs. These results indicate that there was little variation across the eight stations for the five months sampled. There were no significant spatial or temporal differences in TDS (ANOVA $p>0.05$). TDS values peaked during September, while the lowest TDS values were observed during January.



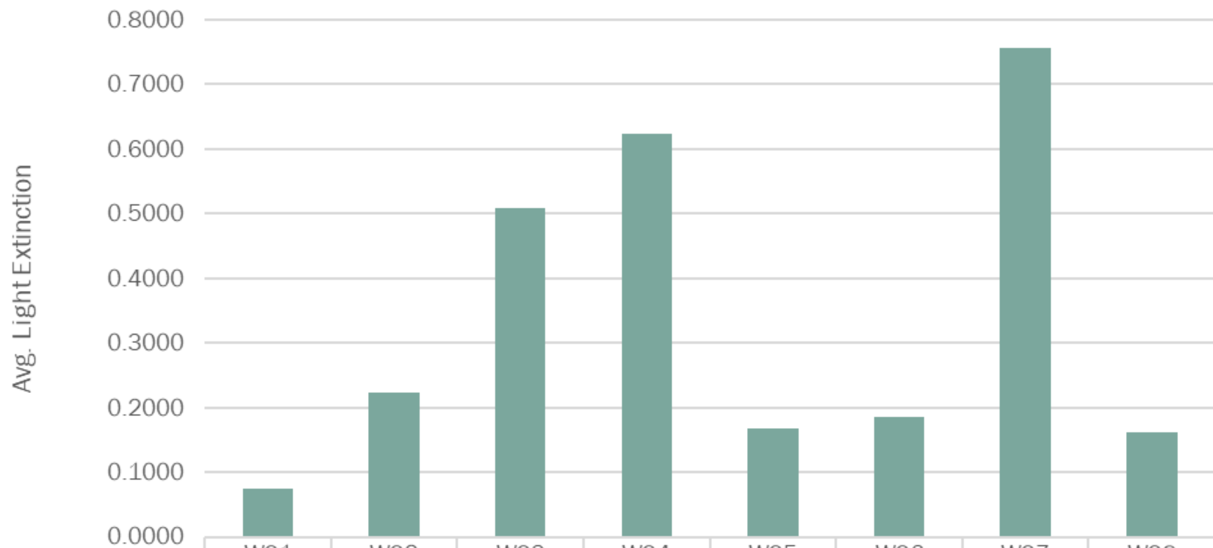
	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8
TDS (g/l)	34.99	34.85	34.63	34.89	34.94	34.99	34.99	34.95

Figure 5-41 Average Total Dissolved Solid Values (g/l) at the Eight Stations

Light Extinction Coefficient (EC)

Light Extinction Coefficient (EC) refers to measures of light absorption within water or the rate of loss of light with depth. The larger the extinction coefficient the more particles (Biological or Non-Biological) are present within the water column which affect light penetration.

Station 1 had the lowest EC value whereas the highest value was obtained at Station 7. Stations 4 and 7 showed the greatest loss of light with depth, indicating a greater presence of particles. (Figure 5-42)



	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8
Light Extinction	0.0753	0.2235	0.5076	0.6239	0.1673	0.1859	0.7561	0.1610

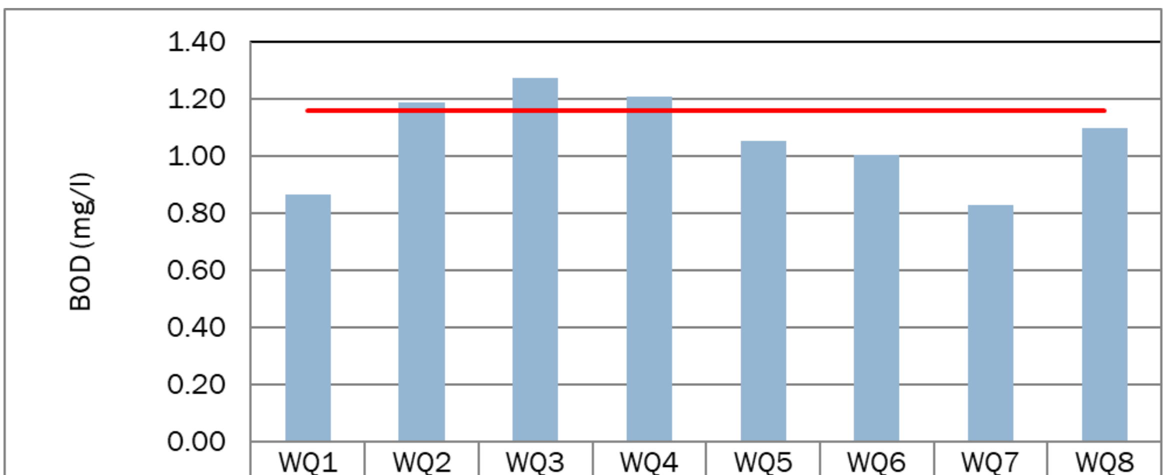
Figure 5-42 Average Light Extinction Values at the Eight Stations

Biological Oxygen Demand (BOD)

Biological oxygen demand (BOD) represents the amount of oxygen which is consumed by bacteria and other microorganisms while they decompose organic matter. Some common BOD sources include decomposing plants and animals, wastewater and urban and terrestrial run off.

Average BOD values were mostly compliant, except for stations 2, 3 and 4 which were slightly above the NRCA Marine Water Quality Standard of 1.16 mg/l (Figure 5-43). Stations 2, 3 and 4 were all located within the nearby bay and were most likely affected by terrestrial run off and pollutants from the nearby Parsons Gully. Station 3 which had the highest average BOD value was located closest to the nearby Parsons Gully outflow.

The mean BOD for the five runs was 1.07(mg/l), with high fluctuations about the mean, demonstrated by a high coefficient of variation (53.87%CV). The spatial coefficient of variations across the eight stations sampled demonstrated high fluctuations with %CV values ranging from 34.14% to 69.56% with similar results for the temporal values, which ranged from 20.23% to 94.23% across the five runs. These results indicate that there was high variation across the eight stations for the five months sampled. There were no significant spatial or temporal differences in BOD (ANOVA $p>0.05$). BOD values peaked during December, while the lowest BOD values were observed during October.



	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8
B.O.D.(mg/l)	0.87	1.19	1.28	1.21	1.06	1.00	0.83	1.10
NEPA Std.	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16

Figure 5-43 Average Biological Oxygen Demand Values (mg/l) at the Eight Stations

Total Suspended Solids (TSS)

Total suspended solids (TSS) refer to waterborne particles that exceed 2 microns in size. TSS values lower than 20mg/l often indicate clear water.

All average TSS values were lower than 5mg/l for all eight stations (Figure 5-44), indicating relatively clear waters, this value is also reinforced by the station's low turbidity levels.

The mean TSS for the five runs was 4.91(mg/l), with low fluctuations about the mean, demonstrated by a low coefficient of variation (0.45%CV). The spatial coefficient of variations across the eight stations sampled demonstrated low fluctuations with %CV values ranging from 0.00% to 0.91% with similar results for the temporal values, which ranged from 0.00% to 0.94% across the five runs. These results indicate that there was little variation across the eight stations for the five months sampled. There were no significant spatial or temporal differences in TSS (ANOVA p>0.05). TSS values peaked during July, while the lowest TSS values were observed throughout all other months.

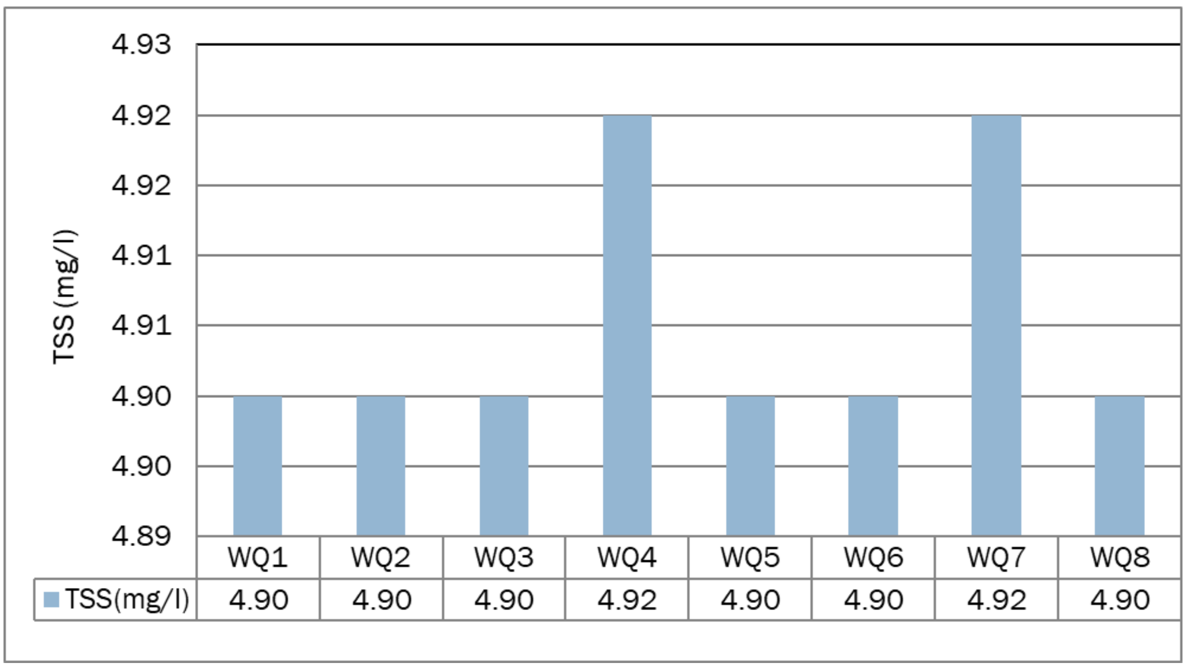
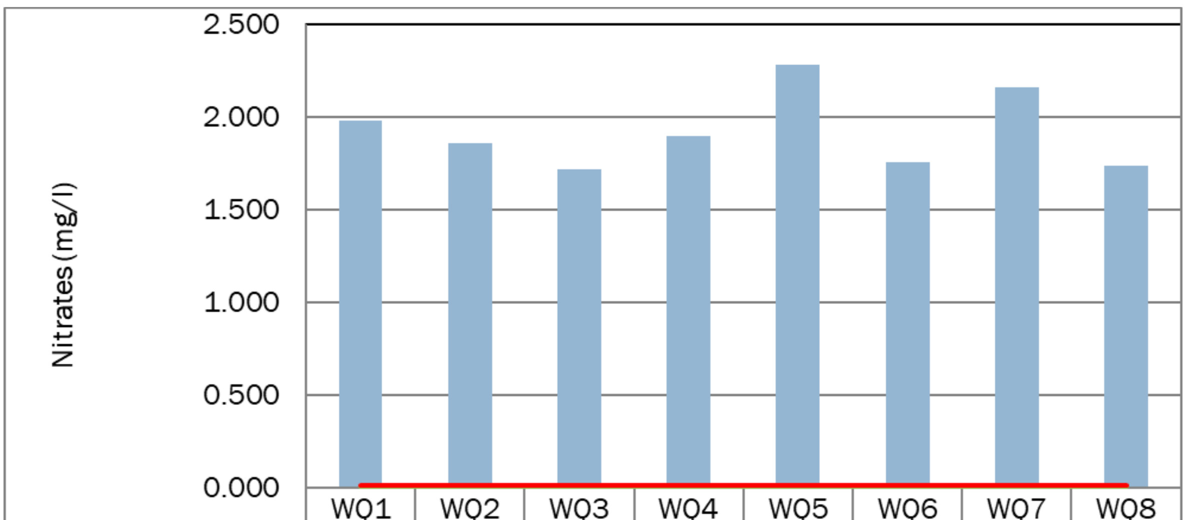


Figure 5-44 Average Total Suspended Solid Values (mg/l) at the Eight Stations

Nitrates

Nitrate values varied across the stations ranging from 1.720 – 2.280 mg/l. All stations were above the NRCA marine standard for Seawater for nitrates. These nitrate values are typical for Jamaican coastal waters and seldom vary outside this range. High nitrate levels are due to water contamination from wastewater or fertilizer. The highest value was at Station 5 (Figure 5-45). Nitrate concentrations were non-compliant with NRCA Marine Water Quality Standards of 0.007 – 0.014 mg/l.

The mean nitrates for the five runs were 1.93(mg/l), with noticeable fluctuations about the mean, demonstrated by a high coefficient of variation (28.30%CV). The spatial coefficient of variations across the eight stations sampled demonstrated high fluctuations with %CV values ranging from 12.06% to 36.48% with similar results for the temporal values, which ranged from 10.65% to 30.51% across the five runs. These results indicate that there was high variation across the eight stations for the five months sampled. There were no significant spatial or temporal differences in nitrates (ANOVA p>0.05). Nitrates values peaked during October, while the lowest nitrates were observed during January.



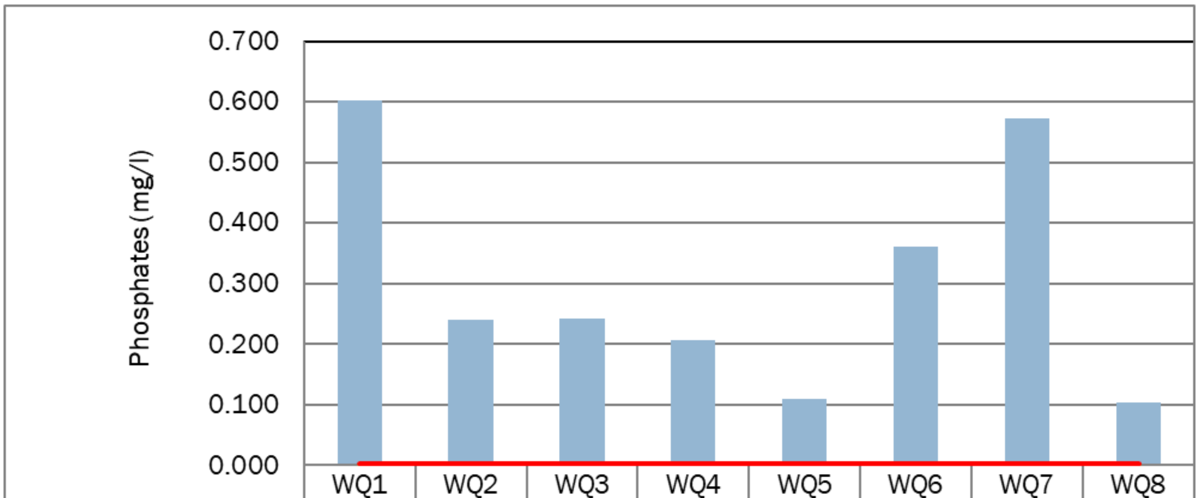
	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8
Nitrates(mg/l)	1.980	1.860	1.720	1.900	2.280	1.760	2.160	1.740
NEPA std(lower)	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
NEPA std(upper)	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014

Figure 5-45 Average Nitrate Values (mg/l) at the Eight Stations

Phosphates

All stations were above the NRCA marine standard for Seawater for phosphates however these phosphate values are typical for Jamaican coastal waters. High phosphate levels are due to water contamination from poor agricultural practices, runoff from urban areas, or discharges from sewage treatment plants. Too much phosphorus can cause increased growth of algae and large aquatic plants, which can result in decreased levels of dissolved oxygen leading to eutrophication. Phosphate concentrations were non-compliant with NEPA Marine Water Quality Standards of 0.001-0.003 mg/l with phosphate values ranging from 0.104 – 0.602 mg/l (Figure 5-46).

The mean phosphates for the five runs were 0.31(mg/l), with noticeable fluctuations about the mean, demonstrated by a high coefficient of variation (164.76%CV). The spatial coefficient of variations across the eight stations sampled demonstrated high fluctuations with %CV values ranging from 64.28% to 173.19% with similarly high results for the temporal values, which ranged from 32.21% to 118.17% across the five runs. These results indicate that there was high variation across the eight stations for the five months sampled. There were no significant spatial or temporal differences in phosphates (ANOVA $p>0.05$). Phosphates values peaked during September, while the lowest phosphate values were observed during December.



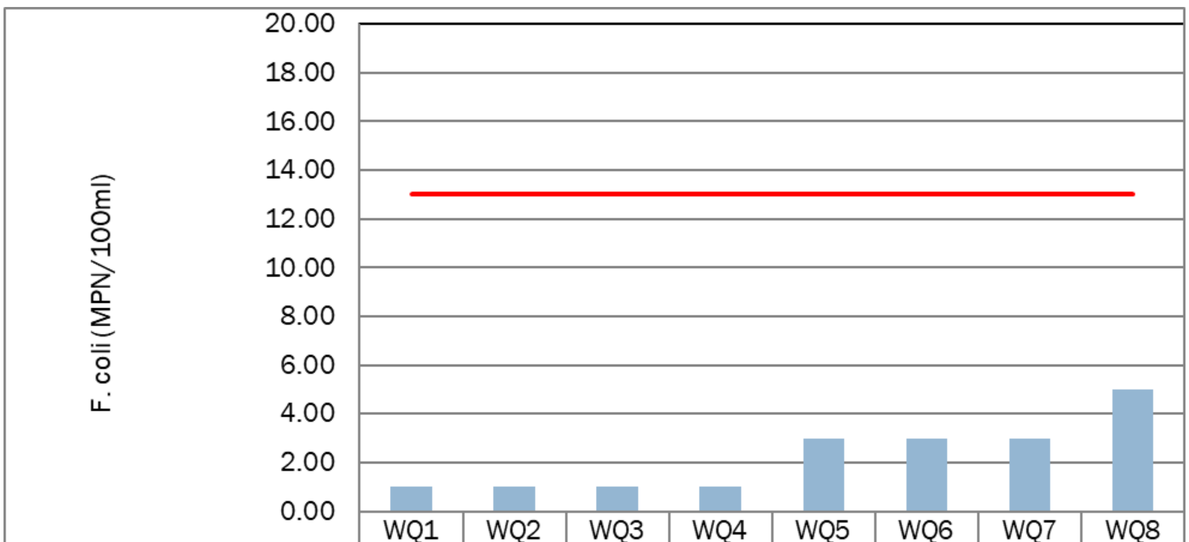
	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8
Series1	0.602	0.240	0.242	0.206	0.110	0.360	0.572	0.104
NEPA std (lower)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
NEPA std(upper)	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003

Figure 5-46 Average Phosphate Values (mg/l) at the Eight Stations

Faecal Coliform

Faecal Coliform values varied across the stations ranging from 1.00 – 5.00(MPN/100mL). All stations were compliant with the NRCA marine standard for Seawater for faecal coliform of <2 – 13(MPN/100mL). The highest value was at Station 8 (Figure 5-47). High faecal coliform levels are due to water contamination from wastewater and terrestrial run off.

The mean F.Coliform for the five runs was 2.25(MPN/100ml), with noticeable fluctuations about the mean, demonstrated by a high coefficient of variation (148.65%CV). The spatial coefficient of variations across the eight stations sampled demonstrated high fluctuations with %CV values ranging from 0.00% to 149.07% with similar results for the temporal values, which ranged from 0.00% to 157.14% across the five runs. These results indicate that there was high variation across the eight stations for the five months sampled. There were no significant spatial or temporal differences in F.Coliform (ANOVA $p>0.05$). F.Coliform values peaked during September, while the lowest F.Coliform values were observed during December and January.



	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8
Faecal Coliform(MPN/100ml)	1.00	1.00	1.02	1.00	3.00	3.00	3.00	5.00
NEPA Std.	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00

Figure 5-47 Average Faecal Coliform Values (MPN/100m) at the Eight Stations

5.1.8 Noise

5.1.8.1 Methodology

Noise level readings were taken from 12:00am Tuesday November 30th, 2021, to 12:00am Friday December 3rd, 2021, by using Brüel & Kjaer noise analysers setup in outdoor monitoring kits. The octave band analysis was conducted concurrently with the noise level measurements. Measurements were taken in the third octave which provided thirty-three (33) octave bands from 12.5 Hz to 20 kHz (low, medium and high frequency bands).

The noise meters were calibrated pre-and post-noise assessment by using a Brüel & Kjaer Type 4231 sound calibrator (Appendix 4). The meters were programmed to collect third octave, average sound level (Leq) over the period, Lmin (The lowest level measured during the assessment) and Lmax (The highest level measured during the assessment) every second.

Noise meters with outdoor monitoring kits were set up at six (6) noise monitoring stations (Table 5-17, Figure 5-48). These meters were left for the entire seventy-two (72) hour assessment period in an outdoor measuring system and programmed to collect data every second. A windscreen (sponge) was placed over the microphone to prevent measurement errors due to noise caused by wind blowing across the microphone. The microphone of the meters was at a height of approximately 1.5m above ground. There were no vertical reflecting surfaces within 3 m (10 feet) of the microphone. Noise statistics (L_{10} and L_{90}) were also calculated at each location.

Table 5-17 Noise and particulate monitoring location coordinates (JAD2001)

Station	X	Y
N1P1	726251.5635	699977.2074
N2P2	726161.3112	700074.2485
N3P3	726082.2406	700180.4746
N4P4	726246.3720	700186.0655
N5P5	726392.5327	700101.4041
N6P6	726309.0693	699999.9701

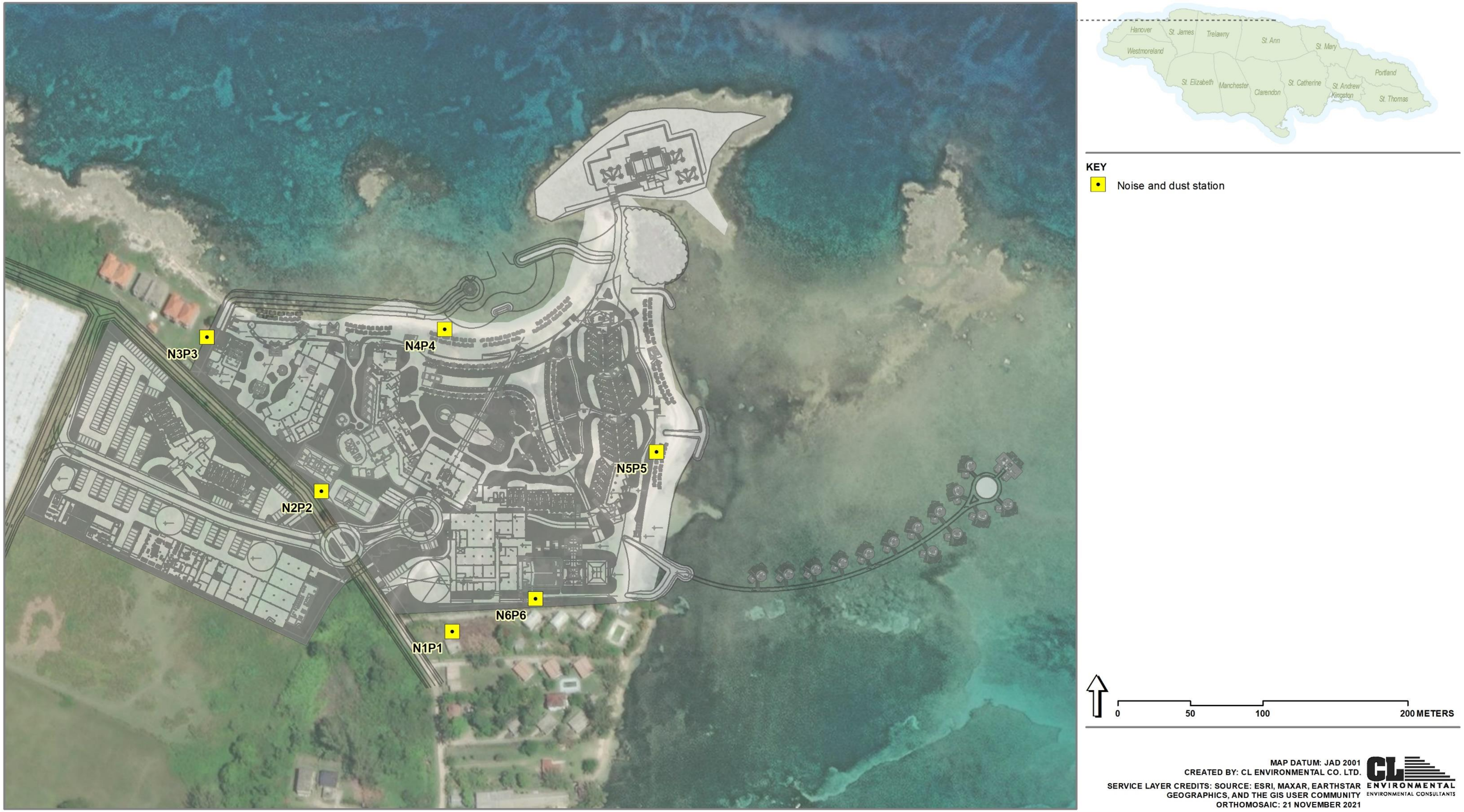


Figure 5-48 Location of noise and particulate monitoring stations

5.1.8.2 Results

Table 5-18 shows the minimum, maximum and average noise levels over the 72-hour assessment period, as well as the geometric mean centre frequencies obtained at each station.

Table 5-18 Ambient Noise data at all stations

Stn.#	Average Leq (72 hr)	Min (dBA)	Max (dBA)	Geometric Centre Frequency (Hz)	Octave Band Range (Hz)
N1	53.0	35.2	73.0	12.5	11-14
N2	57.0	38.2	77.6	12.5	11-14
N3	57.1	40.8	74.0	12.5	11-14
N4	58.5	43.8	73.7	12.5	11-14
N5	52.4	41.0	74.3	12.5	11-14
N6	61.8	36.3	80.0	4000	3565 - 4488

STATION 1

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 35.2 dBA to a high (Lmax) of 73.0 dBA. Average noise level for this period was 53.0 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 5-49.

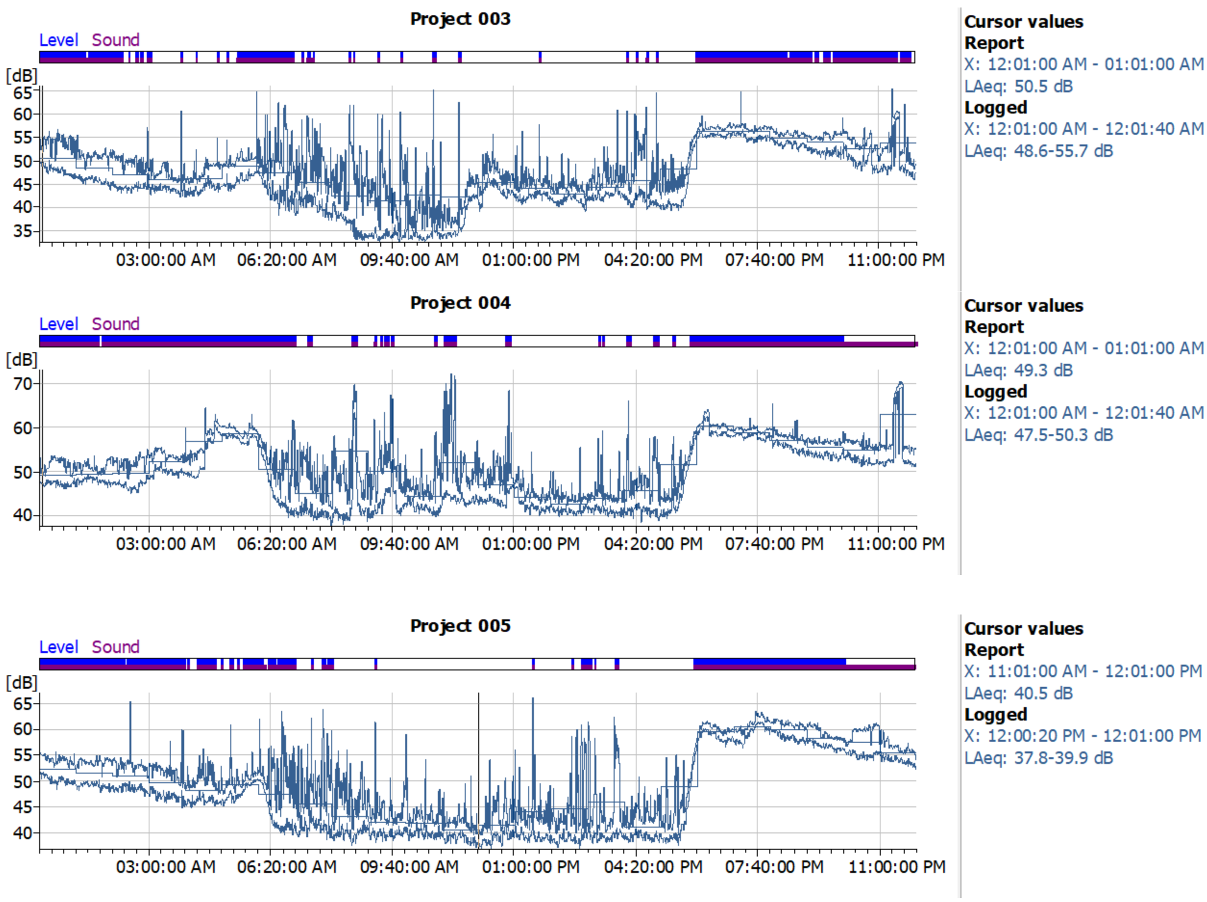


Figure 5-49 Noise fluctuation (Leq) over 72 hours at Station 1 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

OCTAVE BAND ANALYSIS AT STATION 1

The noise at this station during the 72-hour period was in the low frequency band with a dominant geometric mean frequency of 12.5 Hz. (Octave frequency range is 11 - 14 Hz) (Figure 5-50).

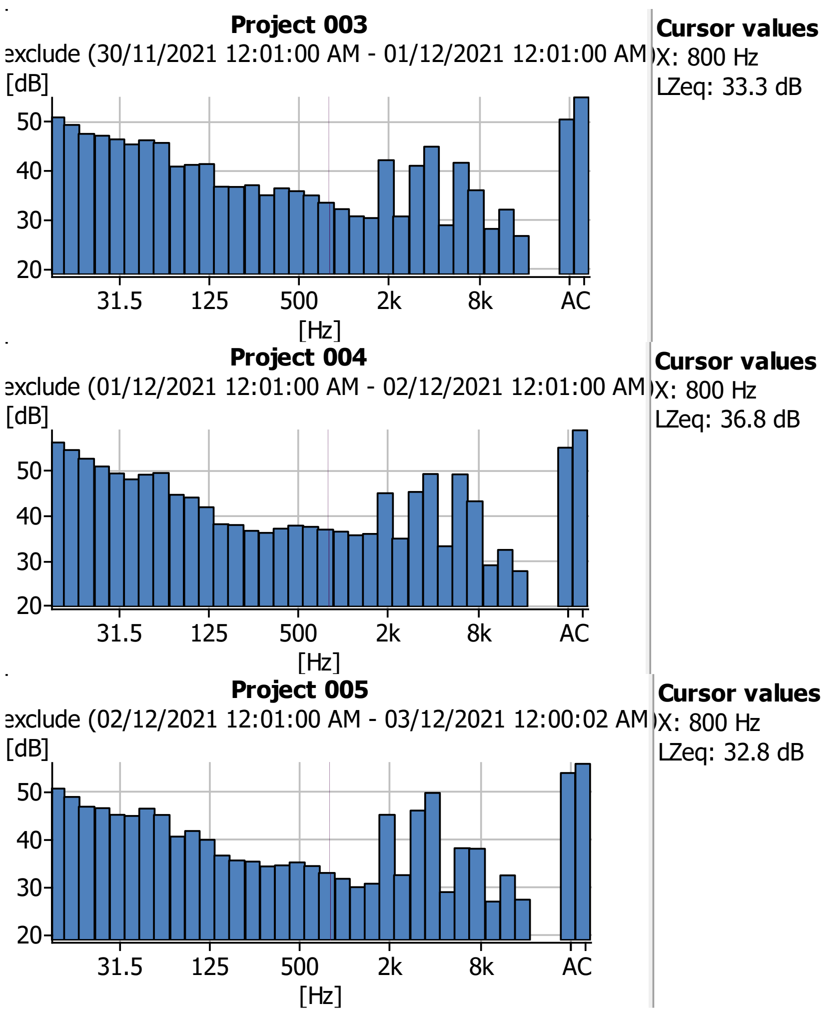


Figure 5-50 Octave band spectrum of noise at Station 1 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

L10 AND L90

The two most common **L_n** values used are **L_{10}** and **L_{90}** and these are sometimes called the 'annoyance level' and 'background level' respectively. **L_{10}** is almost the only statistical value used for the descriptor of the higher levels, but **L_{90}**, is widely used to describe the ambient or background level. L10-L90 is often used to give a quantitative measure as to the spread or "how choppy" the sound was.

L10 is the noise level exceeded for 10% of the time of the measurement duration. This is often used to give an indication of the upper limit of fluctuating noise, such as that from road traffic. L90 is the noise level exceeded for 90% of the time of the measurement duration.

The overall L10 and L90 at this station for the time assessed were 59.3 dBA and 39.9 dBA respectively.

STATION 2

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 38.2 dBA to a high (Lmax) of 77.6 dBA. Average noise level for this period was 57.0 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 5-51.

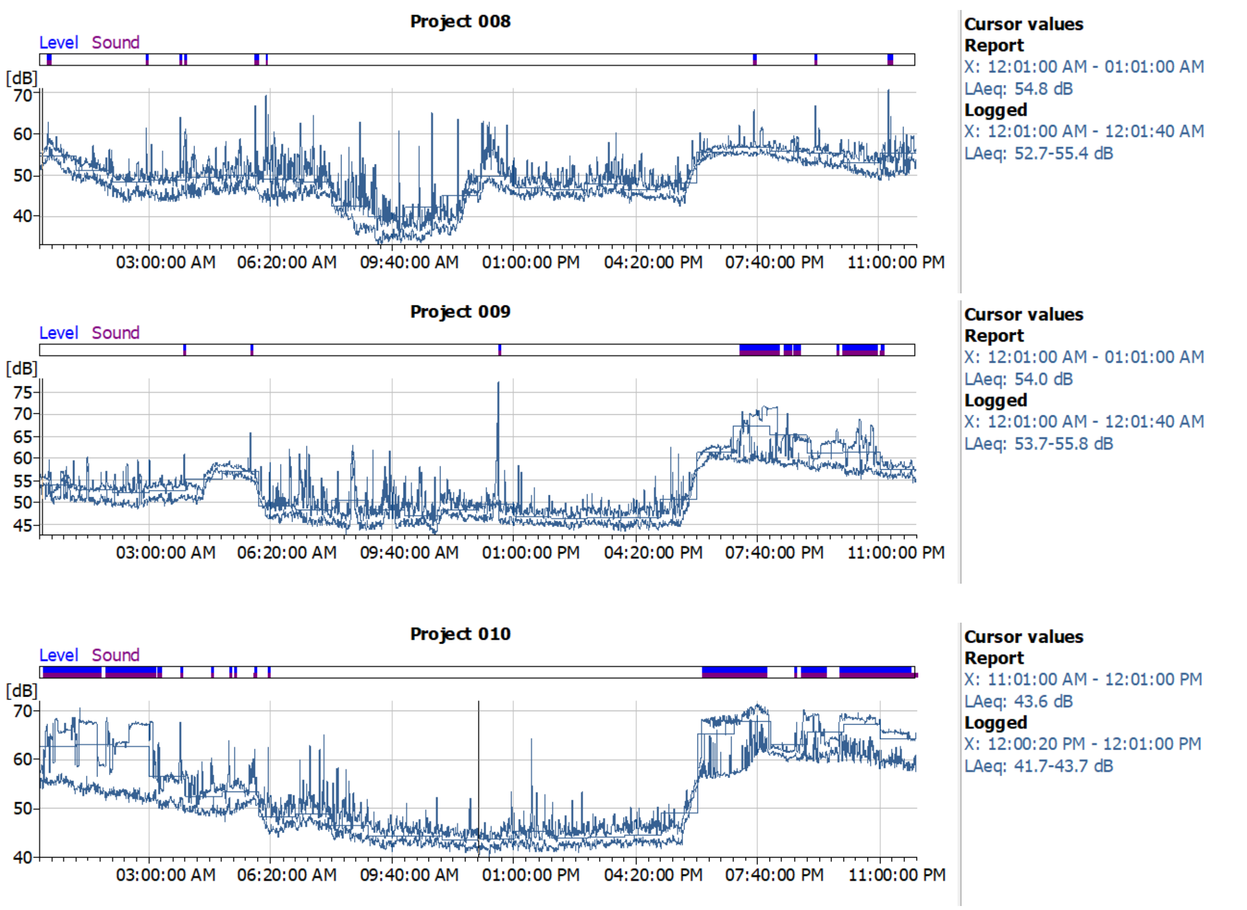


Figure 5-51 Noise fluctuation (Leq) over 72 hours at Station 2 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

OCTAVE BAND ANALYSIS AT STATION 2

The noise at this station during the 72-hour period was in the low frequency band with a dominant geometric mean frequency of 12.5 Hz. (Octave frequency range is 11 - 14 Hz) (Figure 5-52).

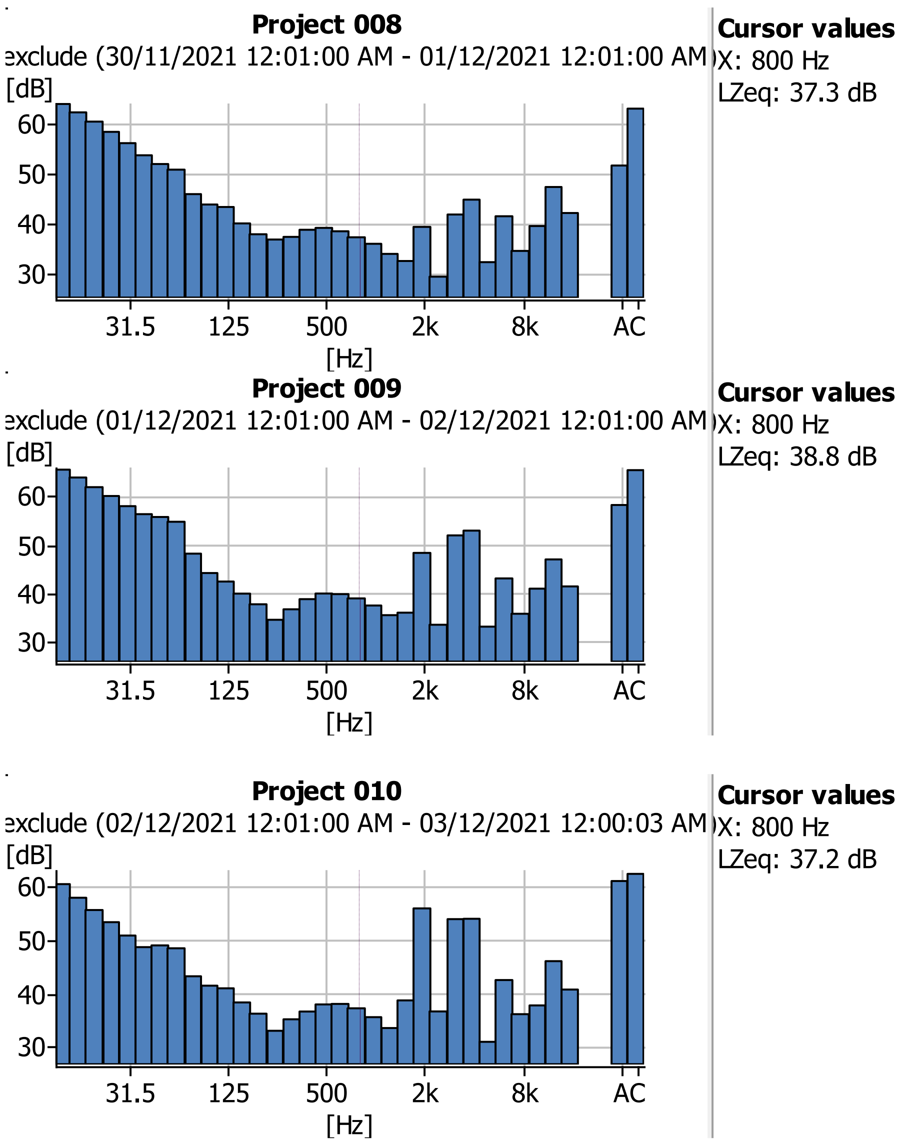


Figure 5-52 Octave band spectrum of noise at Station 2 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

L10 AND L90

The overall L10 and L 90 at this station for the time assessed were 61.7 dBA and 45.9 dBA respectively.

STATION 3

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 40.8 dBA to a high (Lmax) of 74.0 dBA. Average noise level for this period was 57.1 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 5-53.

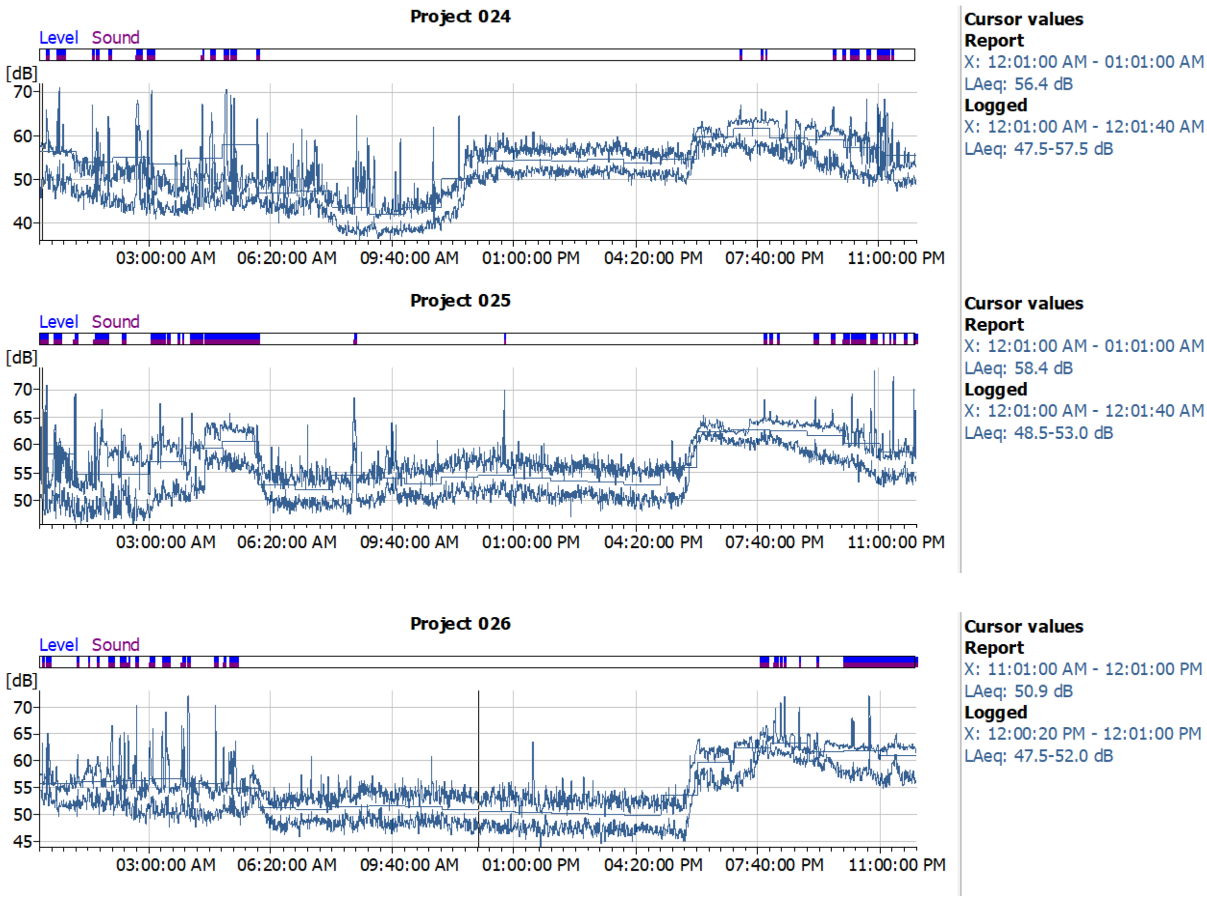


Figure 5-53 Noise fluctuation (Leq) over 72 hours at Station 3 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

OCTAVE BAND ANALYSIS AT STATION 3

The noise at this station during the 72-hour period was in the low frequency band centred around the geometric mean frequency of 12.5 Hz. (Octave frequency range is 11 - 14 Hz) (Figure 5-54).

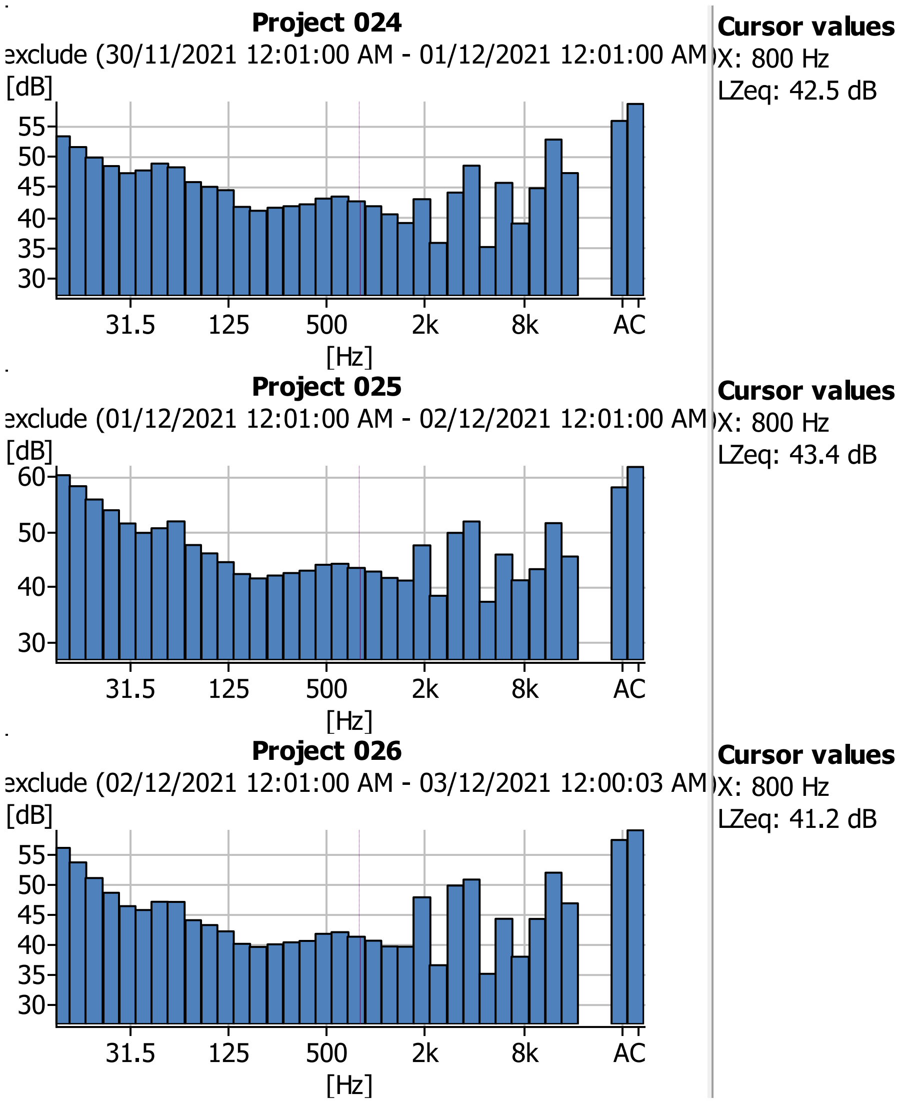


Figure 5-54 Octave band spectrum of noise at Station 3 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

L10 AND L90

The overall L10 and L90 at this station for the time assessed were 61.9 dBA and 49.0 dBA respectively.

STATION 4

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 43.8 dBA to a high (Lmax) of 73.7 dBA. Average noise level for this period was 58.5 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 5-55.

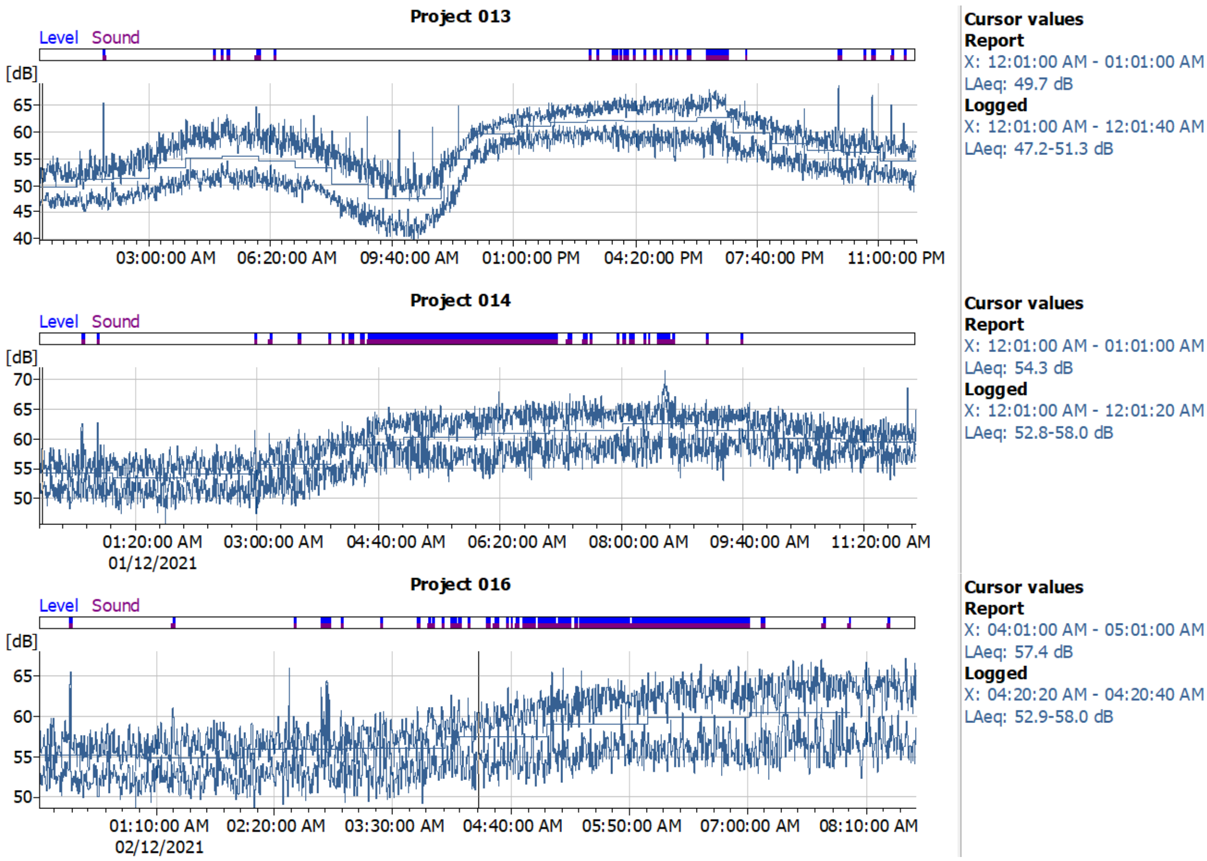


Figure 5-55 Noise fluctuation (Leq) over 72 hours at Station 4 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

OCTAVE BAND ANALYSIS AT STATION 4

The noise at this station during the 72-hour period was in the low frequency band with a dominant geometric mean frequency of 12.5 Hz. (Octave frequency range is 11 - 14 Hz) (Figure 5-56).

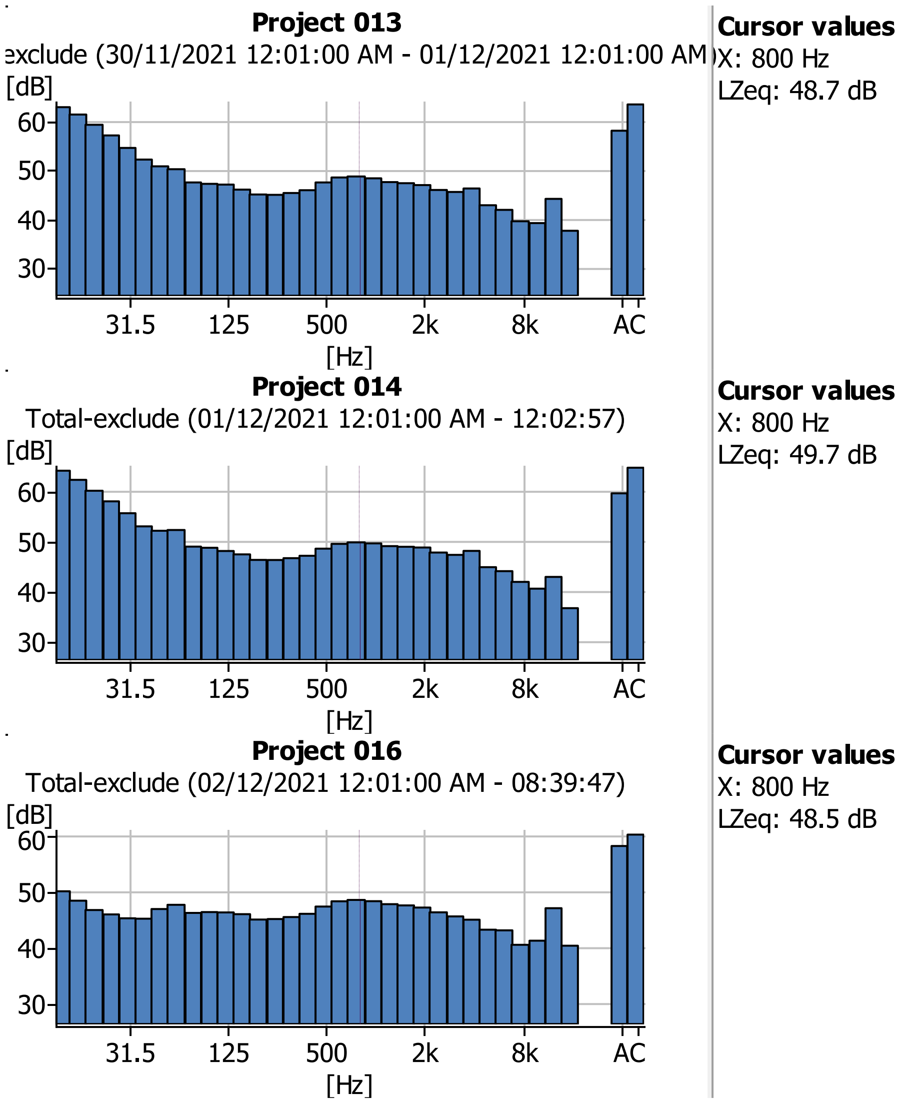


Figure 5-56 Octave band spectrum of noise at Station 4 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

L10 AND L90

The overall L10 and L 90 at this station for the time assessed were 62.2 dBA and 48.2 dBA respectively.

STATION 5

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 41.0 dBA to a high (Lmax) of 74.3 dBA. Average noise level for this period was 52.4 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 5-57.

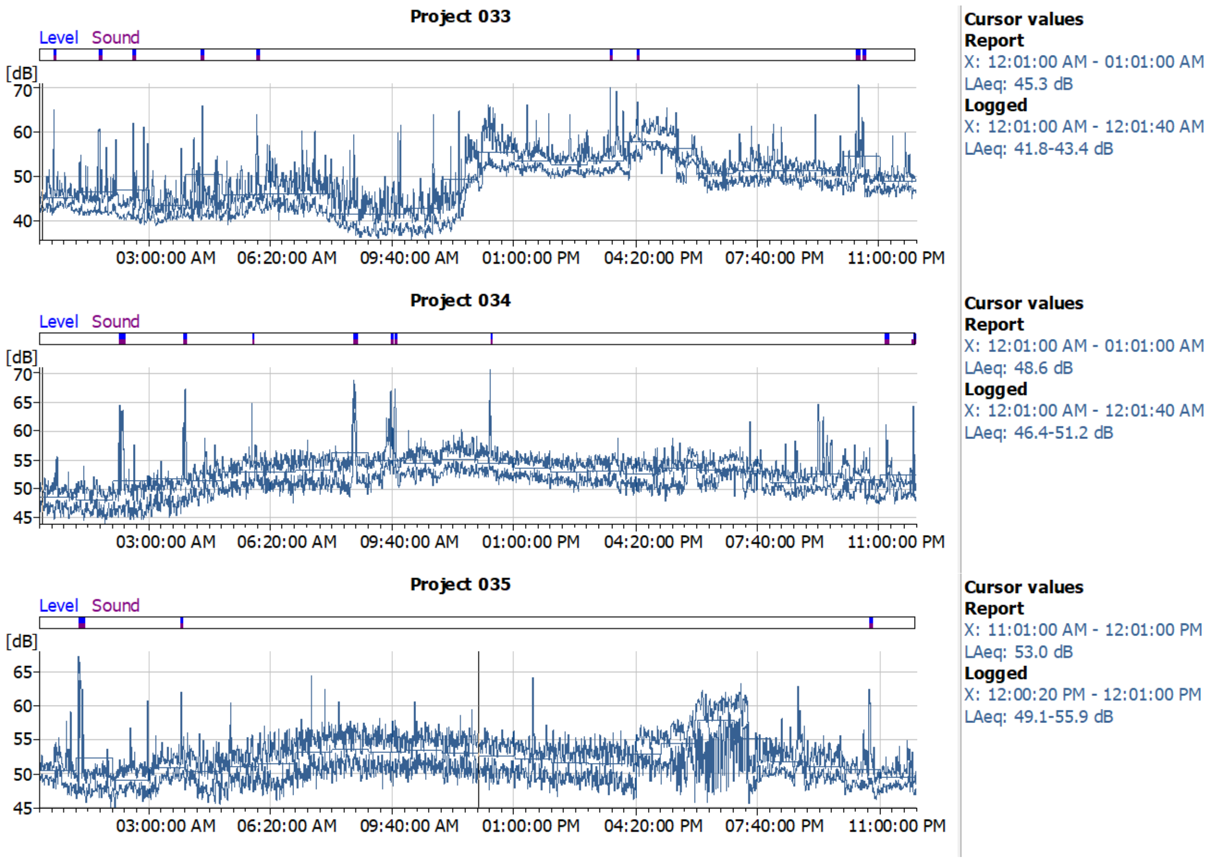


Figure 5-57 Noise fluctuation (Leq) over 72 hours at Station 5 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

OCTAVE BAND ANALYSIS AT STATION 5

The noise at this station during the 72-hour period was in the low frequency band centred around the geometric mean frequency of 12.5 Hz (octave frequency range is 11 - 14 Hz) (Figure 5-58).

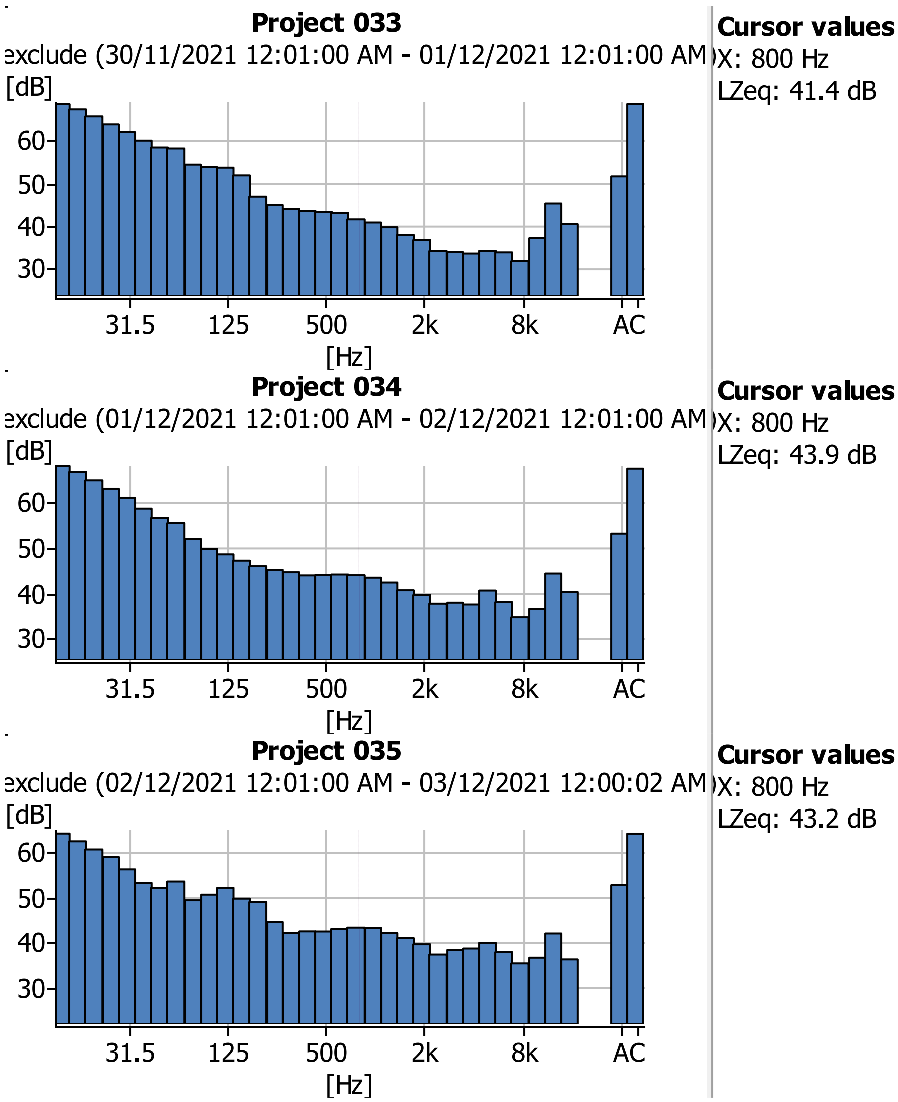


Figure 5-58 Octave band spectrum of noise at Station 5 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

L10 AND L90

The overall L10 and L90 at this station for the time assessed were 54.9 dBA and 48.7 dBA respectively.

STATION 6

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 36.3 dBA to a high (Lmax) of 80.0 dBA. Average noise level for this period was 61.8 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 5-59.

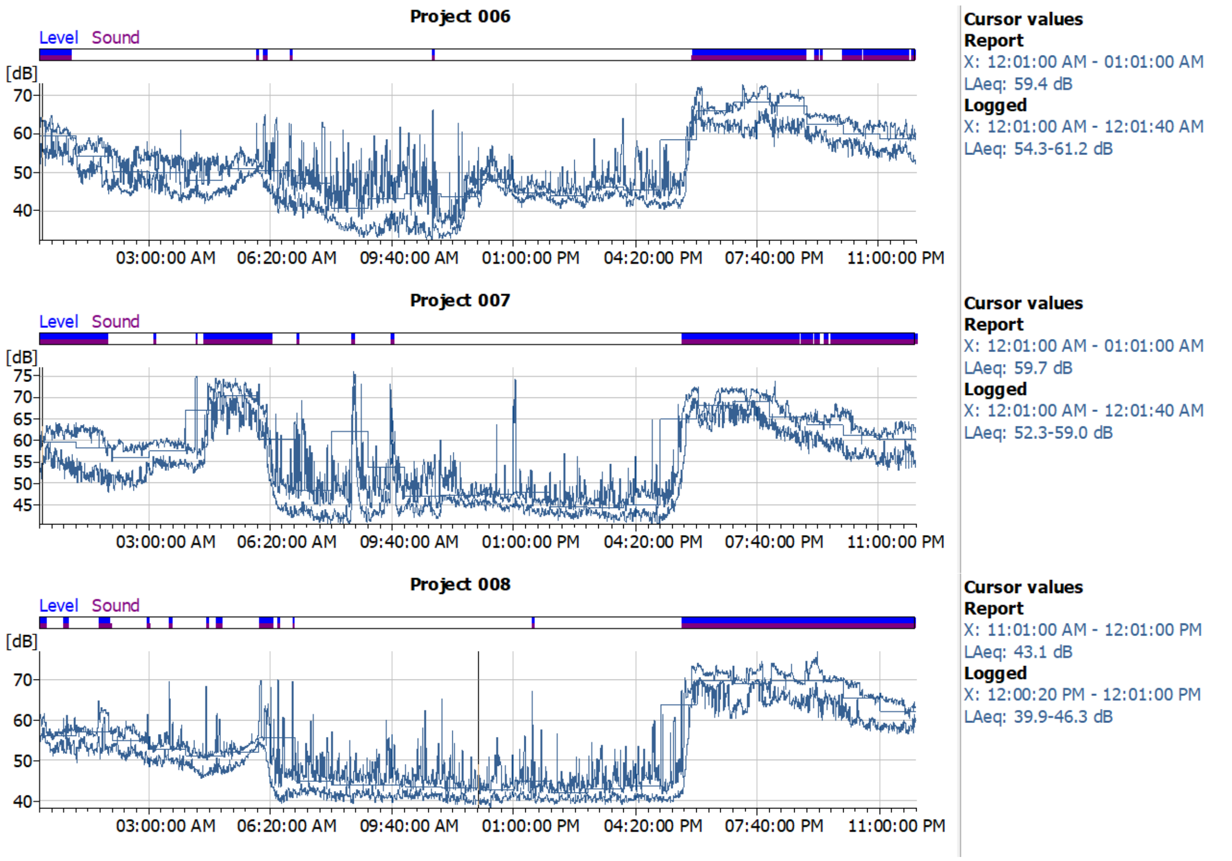


Figure 5-59 Noise fluctuation (Leq) over 72 hours at Station 6 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

OCTAVE BAND ANALYSIS AT STATION 6

The noise at this station during the 72-hour period was in the high frequency band centred around the geometric mean frequency of 4000 Hz (octave frequency range is 3565 - 4488 Hz) (Figure 5-60).

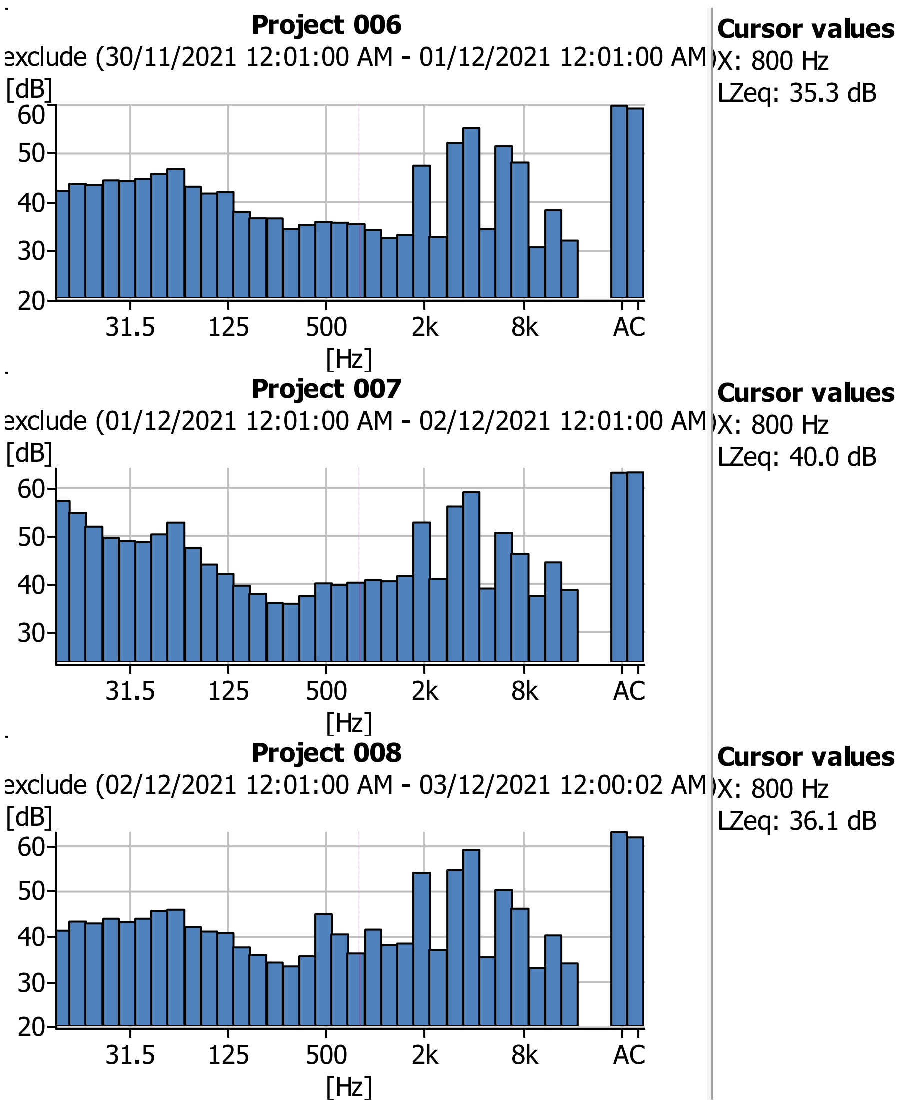


Figure 5-60 Octave band spectrum of noise at Station 6 (top: Nov. 30, middle: Dec. 1, bottom: Dec. 2)

L10 AND L90

The overall L10 and L90 at this station for the time assessed were 69.2 dBA and 41.3 dBA respectively.

Comparisons of Ambient Noise Levels with NRCA Daytime and Night-Time Guidelines

Comparison of the ambient noise levels in the study area with the Natural Resources and Conservation Agency (NRCA) Standards are shown in Table 5-19. During the daytime, noise levels at all Stations were compliant with respective NRCA daytime standards. During the night-time, noise levels at all Stations were compliant with respective NRCA night-time standards.

Table 5-19 Comparison of daytime and night-time noise levels at the stations with the NRCA guidelines

Stn.#	Zone	7 am. - 10 pm (dBA)	NRCA Standard (dBA)	10 pm. - 7 am (dBA)	NRCA Standard (dBA)
1	Commercial	47.1	*65*	52.6	*60*
2	Commercial	51.5	*65*	56.0	*60*
3	Commercial	53.2	*65*	57.8	*60*
4	Commercial	57.1	*65*	53.7	*60*
5	Commercial	53.2	*65*	50.6	*60*
6	Commercial	51.0	*65*	58.0	*60*

NB. Numbers in red are non-compliant with the standard/guideline.

5.1.9 Particulates

5.1.9.1 Definitions

Coarse particles are airborne pollutants that fall between 2.5 and 10 micrometres in diameter. Fine particle are airborne pollutants that fall below 2.5 micrometres in diameter. Sources of coarse particles include crushing or grinding operations and dust stirred up by vehicles traveling on roads. Sources of fine particles include all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.

5.1.9.2 Methodology

PM10 and PM2.5 particulate sampling exercises were conducted at the six (6) locations (where noise monitoring was conducted) for 24 hours each on three (3) separate sampling occasions using Airmetrics Minivol Tactical Air Samplers (Calibration Certificate in Appendix 5). The locations are listed in Table 5-17 and illustrated in Figure 5-48. The PM10 sampling exercises were conducted from 12:00am – 12:00am on November 30, 2021, December 4, 2021, and September 30, 2022, whilst the PM2.5 sampling exercises were conducted from 12:00am – 12:00am on December 2, 2021, December 6, 2021 and September 30, 2022.

5.1.9.3 Results

PM10

All locations had PM10 particulate concentrations which were relatively low and compliant with the 24-hour NRCA standard of 150 μg/m³. Detailed PM10 results are shown in Table 5-20.

Table 5-20 Detailed PM10 Results

Sampling Date	STATION	Result $[PM_{10}]/ugm^{-3}$	NRCA PM10 24-hr Std [PM10]/ugm-3
November 30, 2021	STN 1	10.14	150
	STN 2	18.06	
	STN 3	14.44	
	STN 4	10.28	
	STN 5	8.33	
	STN 6	11.81	
December 4, 2021	STN 1	21.67	150
	STN 2	12.64	
	STN 3	27.22	

Sampling Date	STATION	Result [PM_{10}]/ugm^{-3}	NRCA PM10 24-hr Std [PM10]/ugm-3
	STN 4	20.00	
	STN 5	13.61	
	STN 6	14.57	
September 30, 2022	STN 1	14.72	150
	STN 2	6.53	
	STN 3	17.89	
	STN 4	11.92	
	STN 5	6.91	
	STN 6	11.11	

Values in red are non-compliant with NRCA standards.

PM2.5

All locations had particulate PM2.5 concentrations which were relatively low and compliant with the 24-hour USEPA PM2.5 standard of 35µg/m^3. Detailed PM2.5 results are shown in Table 5-21.

Table 5-21 Detailed PM2.5 Results

Sampling Date	STATION	Result [PM2.5]/ugm^{-3}	USEPA PM2.5 24-hr Std [PM2.5]/ugm-3
December 2, 2021	STN 1	8.06	35
	STN 2	9.31	
	STN 3	4.31	
	STN 4	10.00	
	STN 5	8.47	
	STN 6	10.83	
December 6, 2021	STN 1	16.67	35
	STN 2	16.94	
	STN 3	16.39	
	STN 4	17.08	
	STN 5	17.08	
	STN 6	10.14	
September 30, 2022	STN 1	4.44	35
	STN 2	4.31	
	STN 3	7.58	
	STN 4	10.97	
	STN 5	1.25	
	STN 6	7.50	

Values in red are non-compliant with NRCA standards.

5.1.10 Existing Pollution Sources

Pollution sources on site include indiscriminate solid waste dumping, solid waste being deposited in the marine environment via the waterway/gully southeast of the project site, which in turn get strewn along the shoreline (Plate 5-6 to Plate 5-7). There is heavy foot traffic through the site which contributes to the solid waste issue observed. Evidence of burning on site was also observed.

Plate 5-6 Solid waste and debris along shoreline

Plate 5-7 Solid waste and debris along shoreline

Plate 5-8 Batteries regularly seen littering the project area.

5.2 BIOLOGICAL ENVIRONMENT

5.2.1 Overview of Habitats

5.2.1.1 Habitat Description

The general terrestrial vegetation was classified primarily as open fields by the Forestry Department land use map 1998; however, the coastline is dominated by coastal vegetation, including small Stands of young and dwarfed mangroves to the north and southeast of the property (Figure 5-61).

Plate 5-9 Open fields on the property

Plate 5-10 Coastal sections on the property

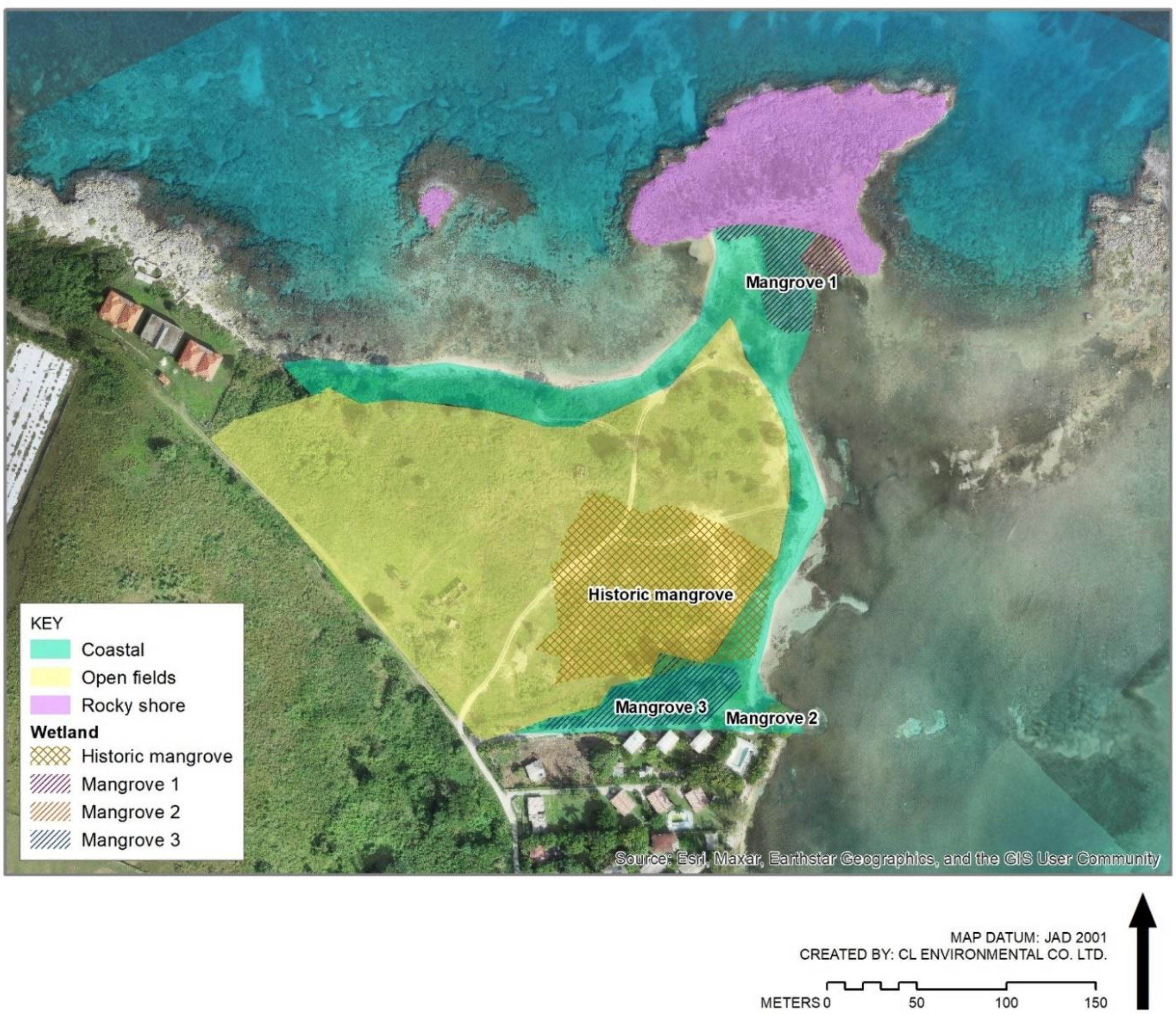


Figure 5-61 Overview of terrestrial vegetation

The project area consists of two bays, a smaller west bay and larger eastern bay, both sheltered by an extensive fringing reef system, rocky shore cays and coastline. Both bays possess sandy beaches, actively used by turtles for nesting. A larger deeper reef also extends beyond the proposed project area.

The marine community located within Richmond Cay is an extensive backreef community, dominated by the seagrass *Thalassia testudinum*, present in both eastern and western bays. In the smaller western bay, seagrasses are present within scattered stands on mainly coarse sandy substrate as well as, rock and pavement. Protected by a rocky shore headland to its east and a fringing reef system, seagrasses within the western bay experience reduced effects from wave activity but occur on a rocky rubble substrate. The eastern bay being larger and more exposed to hydrodynamic activity, has pavement, rocks and coral rubble and silt throughout an extensive seagrass bed, as well as inputs from a nearby river. However, the occurrence of seagrasses within this area varies depending on substrate type present, as well as intensity of hydrodynamic activity. Along the coastline within the eastern bay, seagrasses are present in dense mats in sand and silty substrate. This distribution is seen to change with distance offshore, where the seagrass meadow becomes less dense with scattered stands of *Thalassia testudinum* as it transitions to coral dominated communities.

The shallow reef areas around both bays and the rocky shore headland have significant populations of the critically endangered *Acropora palamta*, while sections of the eastern bay in particular have unusually dense colonies *of Porites divaricata*, dominating sections of the substrate. These dense *P. divaricata* areas are likely occurring to these areas remaining largely undisturbed by foot and boat traffic. Shallow pavement areas in both bays have dense colonies of *Echinometra*, and Sun anemones. Other common coral species include *Pseudodiploria* (these tend to be large) and numerous small (5 cm or less) *Siderastrea* colonies.

The coastal and terrestrial project areas in particular, have been highly modified and reflects a community influenced by anthropogenic impacts; it is used by the public for fishing and various recreational activities.

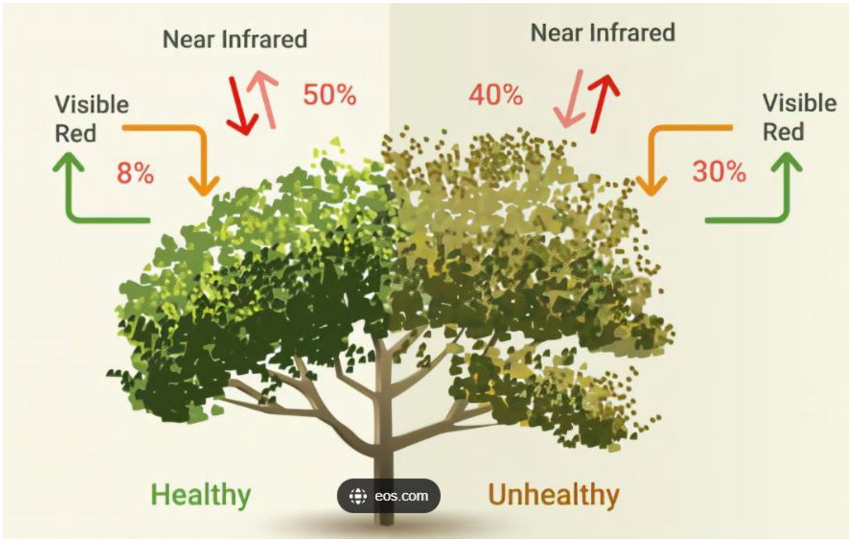
5.2.1.2 Vegetation Health

Normalized Difference Vegetation Index (NDVI)

Normalized Difference Vegetation Index (NDVI) quantifies vegetation based on differences in near-infrared (NIR) and visible red-light reflectance (Equation 5-1), and provides an indication of vegetation density, health, and land cover. Chlorophyll reflects near-infrared (NIR) light (700 to 1100 nm), however absorbs visible light (400 to 700 nm) for use in photosynthesis. This means that high photosynthetic activity, commonly associated with dense healthy vegetation, will have less reflectance in the red band and higher reflectance in the near-infrared band (Figure 5-62).

Equation 5-1 Normalized Difference Vegetation Index (NDVI)

$$\text{NDVI} = \frac{(\text{NIR - Red})}{(\text{NIR + Red})}$$



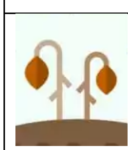
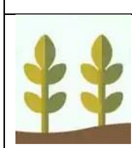
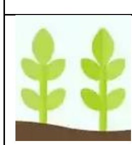
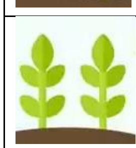
Source: NDVI FAQs: Top 23 Frequently Asked Questions About NDVI (eos.com)

Figure 5-62 Illustration of absorption and reflectance of visible red and NIR light by health and unhealthy plants.

Resulting NDVI values range between -1 and 1. If the result yields high NDVI values, this signifies more or healthier vegetation, and vice versa with low NDVI values, less or no vegetation. NDVI may also give indications for other types of land cover and Table 5-22 provides the classification utilised in this assessment.

Table 5-22 Interpretation of NDVI

Source of images: NDVI FAQs: Top 23 Frequently Asked Questions About NDVI (eos.com)

NDVI	Vegetation description	Other descriptors
 -1 - 0	• Dead plants • Absence of vegetation	• Inorganic objects such as stones and man-made built-up areas • Clouds • Snow fields • Water bodies (slightly negative NDVI)
 0-0.33	• Unhealthy/ diseased plants • Very sparse vegetation cover/ early stages of cultivation/ senescing • Minimal Chlorophyll levels • Bare soil	• Water bodies (very low positive NDVI values) • Some soil types (that exhibit a near-infrared spectral reflectance somewhat larger than the red)
 0.33-0.66	• Moderately healthy plant • Moderate vegetation cover • Moderate Chlorophyll levels	
 0.66-1	• Very healthy plant • Dense vegetation cover • High Chlorophyll levels	

Terrestrial Vegetation

HISTORICAL

Although Landsat imagery is not considered high-resolution imagery (30 m), the availability of historical images allowed for changes in vegetation health to be assessed over time. Landsat 8 Level-2 (atmospherically corrected) images, and specifically the near-infrared (NIR) and visible red bands (Bands 5 and 4 respectively) were used to calculate NDVI for each image pixel using GIS-tools (Equation 5-1). Images with minimal cloud cover for following months and years were used:

- August 2013
- January 2014
- September 2017
- February 2018
- January 2022
- August 2022

At the project site, vegetation cover may be described as moderately healthy between August 2013 and 2022, with NDVI values ranging between 0.33 and 0.66. Lower NDVI values, and therefore unhealthy or sparse vegetative cover is seen in the eastern sections for September 2017 and February 2018. Changes in vegetation cover are also evident along the western periphery of the access road, in which vegetation health/ cover decreased in January 2022.

CURRENT

A 10-band image mosaic was created using images captured by a RedEdge-MX Dual Camera Imaging System fitted to a Quantum Systems Trinity F90 plus drone on 18 August 2022. Using the NIR and red bands (bands 4 and 3 respectively), the NDVI was calculated for the land portion of the proposed project. Like the historical vegetation analysis, the NDVI results show that the project site is primarily comprised of moderately healthy terrestrial vegetation, with NDVI values of 0.34 and greater; however, the 0.08-m resolution of the input mosaic allowed for details to be revealed at a much finer scale. Roadways and trails with an absence of vegetation are easily identifiable as linear features with negative and very low positive NDVI values. Similar NDVI values with rectangular shapes correspond with buildings, whilst those in a linear pattern to the west of the access road represent cultivated fields. Non-linear, sporadic groupings of negative and very low NDVI values signify areas of bare soil or sand, with very sparse or unhealthy vegetative cover.

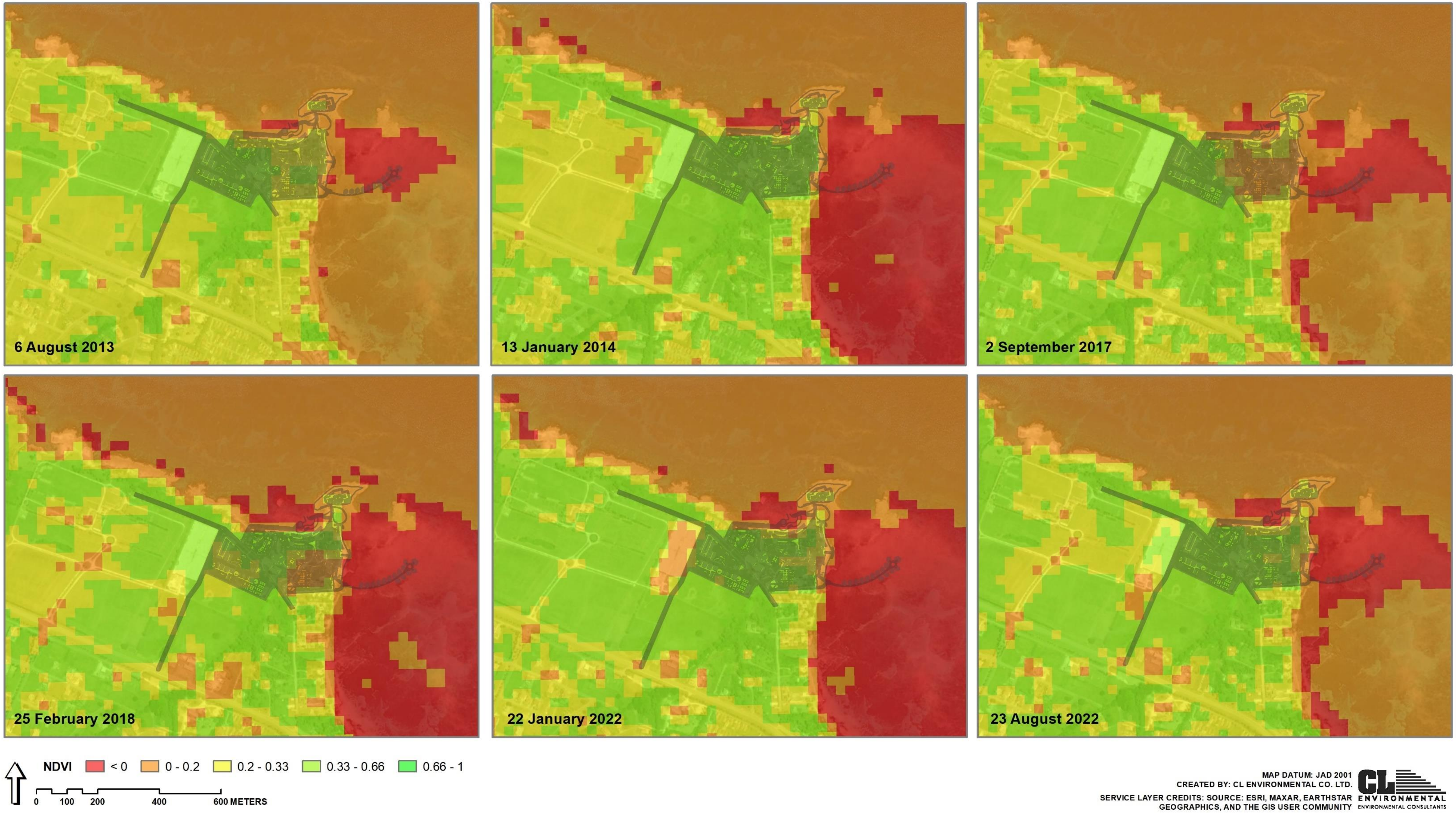


Figure 5-63 Normalized Difference Vegetation Index (NDVI) calculated using Landsat 8 Level-2 for months between August 2013 and August 2022.

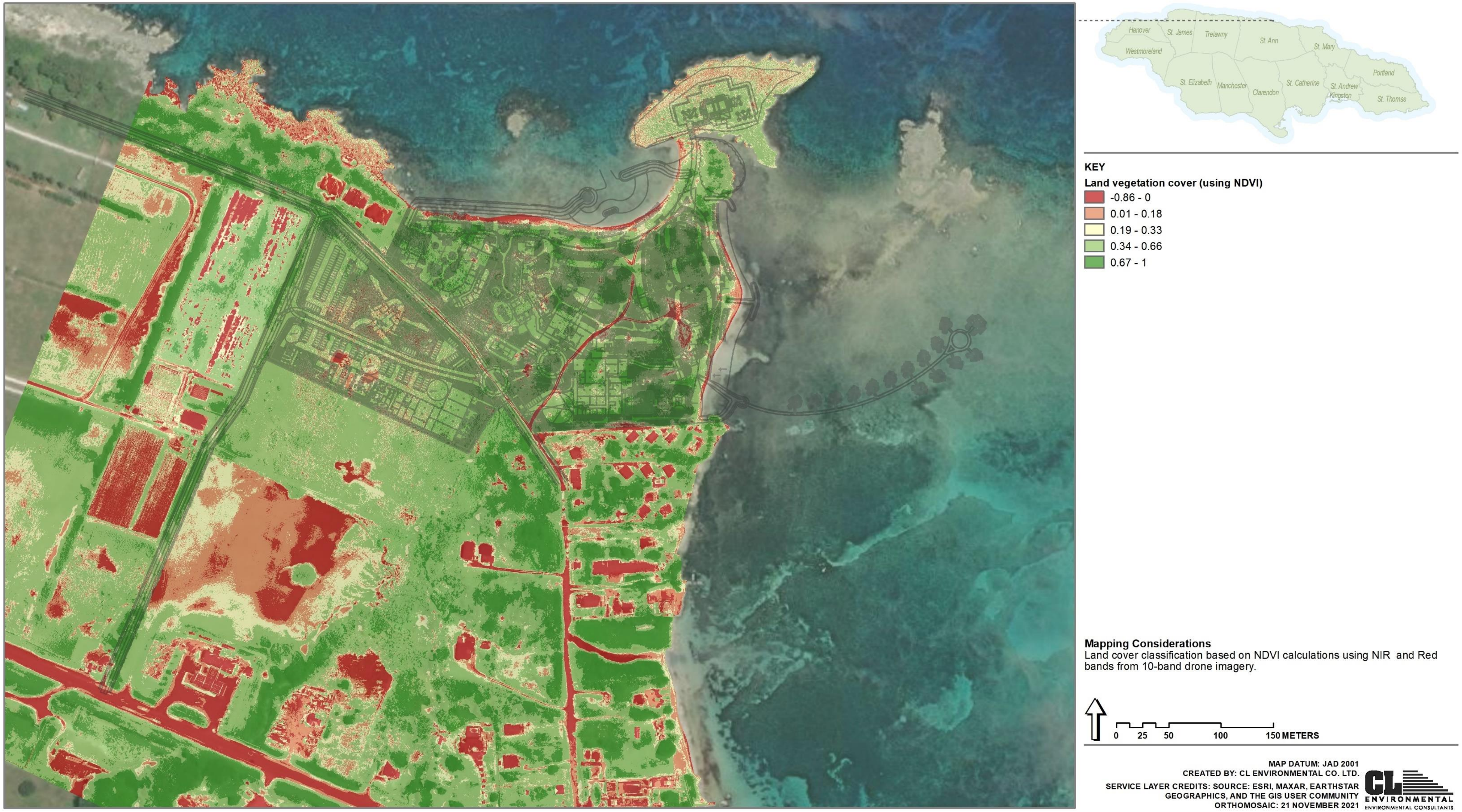


Figure 5-64 Normalized Difference Vegetation Index (NDVI) representing land vegetation cover at and surrounding the project site.

Coastal

Various band combinations and vegetation indices were assessed at the project site, and it was found that a variation of the NDVI using red edge and green image bands, named ReGNDVI by Li (2018) was best suited for classifying the coastal waters at the study area (Equation 5-2). Bands 5 (red edge) and 2 (green) of the 10-band image mosaic created from images captured by the RedEdge-MX Dual Camera Imaging System on 18 August 2022 were used to calculate the ReGNDVI. Thresholds were visually established to demarcate the benthos into bare substrate and gradually increasing Chlorophyll content. It should be noted that Chlorophyll was used as the main descriptor since Chlorophyll exists in coastal waters in various forms at the project site, including seagrass, coral and algae.

Equation 5-2 ReGNDVI

Source: Li (2018)

$$\text{ReGNDVI} = (\text{Red edge-Green})/(\text{Red edge+Green})$$

The resulting ReGNDVI-based classification corresponds well with field-collected data (see section 5.2.2). In the eastern bay, bare substrate is found predominantly along the shoreline and in patches amongst moderately dense seagrass beds further offshore. The nearshore patches of sparse Halodule seagrass mapped in the field correspond with areas having ReGNDVI values between -0.11 and 021 in the nearshore areas. The areas with higher Chlorophyll content throughout the eastern bay were observed to be Thalassia-dominated seagrass beds. In the western bay, negative ReGNDVI values represent bare substrate (rock, rubble and sand) and higher NDVI values with field-mapped nearshore mixed macroalgae and *Thalassia.*

Figure 5-65 Normalized Difference Vegetation Index (NDVI)-based benthic classification at the project site

5.2.2 Flora

5.2.2.1 Terrestrial Vegetation

Approach

The assessment of the vegetation present on site was done by utilising a series of walkthroughs (trails) within the boundaries of the development site (Figure 5-66). All plant species encountered within the boundary were recorded. The name, perceived dominance, and growth form were noted for each species. DAFOR rank of relative abundance used to categorize the fauna and flora species encountered during the assessments (Table 5-23).

Table 5-23 DAFOR Ranking Scale

DAFOR rank	Total number of individuals observed during the survey
Dominant	≥ 20
Abundant	15 – 19
Frequent	10 – 14
Occasional	5- 9
Rare	< 4

The common names of most of the species sighted were assigned in situ. In the case of unknown species, voucher specimens were collected and identified at the University of the West Indies (UWI) Herbarium. All plants were identified at the species level by examining morphological features such as leaf arrangement, leaf pattern, and pattern of branching and morphology of floral and fruiting structure in conjunction with the use of Flowering Plants of Jamaica (Adams, 1972) and preserved reference specimens of the herbarium.

Figure 5-66 Trails and locations of the AudioMoths used in the terrestrial habitat study.

Results and Discussion

The plant diversity on the property was relatively low, 49 plant species from 28 families were encountered, most of them were trees and shrubs; some grasses were also recorded.

The general vegetation was classified primarily as open fields by the Forestry Department land use map 1998. It should be noted that closer to the coastline is dominated by coastal vegetation, including a small patch of mangroves to the northeast of the property. The study area is located on a property that has been heavily modified by human activity, and the natural vegetation has been significantly impacted. Several roads, trails and derelict buildings exist throughout the study area. Garbage was seen littering all sections of the study area, suggesting the area is used as a dump site.

The terrestrial plant species recorded in the survey are either ornamental plants or plants associated with anthropogenic disturbances.

Most of the trees encountered at the site were relatively small (<20 cm DBH), with the exception of a few Willow (*Casuarina equisetifolia*) and West Indian Almond (*Terminalia catappa*) trees. Most of the species encountered during the assessment are classified (Adams, 1972) as being very common, commonly found in thickets and wastelands, and commonly found in secondary woodlands. The plant species' distribution is even across Jamaica, especially in places with significant anthropogenic impacts.

Of the 48 plant species found within the study site, one endemic species was observed, Swamp Cabbage (*Roystonea princeps*). Roystonea princeps is classified as Near Threatened on the IUCN Red List for Threatened Species, none of the othercspecies encountered during this study is deemed to have any special conservation status; neither was any species listed as rare in Jamaica.

A total of 4 plants classified as invasive alien species (IAS) were recorded during the assessment. These IAS included Willow (*Casuarina equisetifolia*), Lead Tree (*Leucaena leucocephala*), Guinea Grass (*Panicum maximum*), and African Tulip (*Spathodea campanulata*).

Table 5-24 Floral species identified along transects in the assessed area.

Family	Scientific Name	Common Name	Range	DAFOR
Mimosaceae	*Acacia maracantha*	Park Nut	Common locally, in secondary thickets on arid limestone	R
Polygalaceae	*Antigonon leptopus*	Coralita	Common in cultivation and escaping on fences and hedges	O
Poaceae	*Arundo donax*	Giant Reed	Locally abundant, gregarious along sheltered or open streambanks and riverbanks	R
Bataceae	*Batis maritima*	Jamaican Samphire	Locally abundant and often forming large communities at the margins of salinas and estuarine flats, mainly along the south coast and on the cays	O
Sapindaceae	*Blighia sapida*	Ackee	Commonly cultivated and naturalised	R
Nyctaginaceae	*Boerhavia coccinea*	Hog Weed	Common, as a weed of rough disturbed pastures, waste places and sand dunes	A
Asteraceae	*Borrichia arborescens*	Seaside Ox-eye	Rather common on limestone cliffs, gravelly beaches and in pastures or on bare coral rocks near the sea	O
Caesalpiniaceae	*Caesalpina pulcherrima*	Pride of Barbados	Common in cultivation at lower elevations	R
Fabaceae	*Canavalia maritima*	Seaside Bean	Very common, on the strand and sandy wastes near the sea	D
Casuarinaceae	*Casuarina equisetifolia*	Willow		D
Fabaceae	*Centrosema virginianum*		Common, in waste places, rough pastures and thickets	A

Family	Scientific Name	Common Name	Range	DAFOR
Polygalaceae	*Coccoloba uvifera*	Sea Grape	Common and locally dominant along the seacoast on strands, dunes and in thickets inland	F
Arecaceae	*Cocos nucifera*	Coconut	Cultivated and naturalised	O
Commelinaceae	*Commelina diffusa*	Water Grass	A typical weed of cultivations, waste places and pastures	O
Combretaceae	*Conocarpus erectus*	Button Mangrove	Common at the inner margins of mangrove swamps and in thickets on salinas and also on the cays	O
Poaceae	*Cynodon dactlon*	Bermuda Grass	Commonly cultivated or encouraged as lawn grass, particularly in drier areas, also as a weed of roadsides, pastures and waste places	A
Cyperaceae	*Cyperus alternifolius*		Gregarious and locally abundant in gravel along streams and rivers and at margins of ponds	O
Cyperaceae	*Cyperus elegans*		Occasional in salina margins and low-lying seasonally inundated pastures, mostly near sea	O
Sterculiaceae	*Guazuma ulmifolia*	Bastard Cedar	Very common along roadsides, in pastures and in open secondary woodlands	R
Malvaceae	*Hibiscus tiliaceus*	Seaside Mahoe	Rather local, in brackish swamps and inner margins of mangroves	F
Convolvulaceae	*Ipomoea pes-caprae*		Common on beaches and sandy waste places near the sea	F
Verbenaceae	*Lantana camara*	White Sage	Very common in rough pastures, waste places and thickets	A
Mimosaceae	*Leucaena leucocephala*	Lead Tree	Common along roadsides and in sandy waste places and thickets	F
Convolvulaceae	*Merremia dissecta*	Know You	Cultivated and widely escaped onto fences and in thickets and waste ground	A
Asteraceae	*Mikania micrantha*	Caucus	Common, especially in wet places	F
Mimosaceae	*Mimosa pudica*	Shame Old Lady	A common weed of pastures and open stabilised waste places	O
Rubiaceae	*Morinda citrifolia*	Noni	Locally common in open places near the sea, cultivated inland	F
Rubiaceae	*Morinda royoc*	Strongback	Very common in pastures and thickets on limestone, also on some of the cays in the coral sand	F
Poaceae	*Panicum maximum*	Guinea Grass	Very common in rough pastures, ditches and sheltered thickets	F
Poaceae	*Panicum muticum*	Para Grass	Common in ditches, swamps and along riverbanks, sometimes forming extensive colonies, mostly at low elevations	O
Phytolaccaceae	*Petiveria alliacea*	Guinea Hen Weed	Locally common as a weed of semi-shaded roadsides and rough well, drained undisturbed ground	F
Fabaceae	*Piscidia piscipula*	Dogwood	Common, mostly in relatively arid areas on sand or gravel or in	R

Family	Scientific Name	Common Name	Range	DAFOR
			woodlands on limestone, also on some cays	
Myrtaceae	*Psidium guajava*	Guava	Common in pastures and wayside thickets, sometimes cultivated	R
Rhizophoraceae	*Rhizophora mangle*	Red Mangrove	Common along muddy shores and in estuarine swamps, occasional inland	O
Euphorbiaceae	*Ricinus communis*	Castor Oil	Common as a cultivated plant and on waste grounds	O
Arecaceae	*Roystonea princeps**	Royal Palm	Uncommon and rather, restricted to the western parishes, in small colonies or as scattered individuals on poorly drained lowlands and in the morass	R
Mimosaceae	*Samanea saman*	Guango	Common in inhabited areas and old pastures were planted and naturalised in riparian forests and secondary communities on level ground	R
Goodeniaceae	*Scaevola plumieri*		Occasional in sandy places near the sea	O
Aizoaceae	*Sesuvium portulacastrum*	Seaside Purslane	Common, on salinas, at mangrove margins and on sandy or rocky brackish wastes	F
Fabaceae	*Sophora tomentosa*		Occasional, in dry coastal thickets and on some of the cays	O
Bignoniaceae	*Spathodea campanulata*	African Tulip	Commonly planted	R
Poaceae	*Sporobolus domingensis*		Local around the coast of the central and western parishes in salinas and on coral limestone	O
Poaceae	*Stenotaphrum secundatum*	Crab Grass	Common in pastures on heavy, poorly drained soils or coral limestone	A
Fabaceae	*Stylosanthes hamata*		Common, especially in waste places on limestone and exposed pastures near the sea	O
Simaroubaceae	*Suriana maritima*	Bay Cedar	Frequent on coastal limestone rocks and in sandy places near the sea, also on the cays	O
Combretaceae	*Terminalia catappa*	West Indian Almond	Commonly planted and naturalised, especially near the sea in wet areas	A
Turneraceae	*Turnera ulmifolia*	Ram Goat Dashalong	Common along roadsides and on waste ground, and in thickets on limestone or coral near the sea	O
Poaceae	*Zoysia tennuifolia*		Cultivated for lawns	A

5.2.2.2 Mangrove Community

Clusters of mangroves can be found to the northern sections within rocky shore (dwarfed trees) and scattered along the northern and eastern edges, and one other cluster of mangroves on the south-eastern end. These mangrove areas accounted for approximately 2,305 m^2 of mangroves. Dwarfed trees can be found on the rocky shore as well as several seedlings in the nearshore seagrass beds. These smaller mangroves are young to middle level in age, living atop limestone bedrock. As a result, these trees have not attained the expected or significant height or other ecological parameters, nor have the roots been able to extend. Though not accessed, it is not expected that these mangroves will show any significant carbon deposits or rich soil organics due to the low productivity of the trees.

Overview and Survey Method

The southern section of the property is made up of predominantly marl with depressions that hosts an array of wetland species. This area is covered with almost 100% wetland vegetation, has no standing water however the substrate is easily penetrable. It is used by fishermen as is evident by the range of degrading as well as functional fishing paraphernalia such as nets, fishing lines seen, and piles of old batteries used in flashlights. Several young seedlings were seen along and within the nearshore seagrass beds, while dwarfed trees can be found along sections of the rocky shore and island.

A total of the fourteen (14) (10m x 10m) quadrats were laid to assess the mangrove trees and seedlings present on property (Figure 5-67), giving a total survey area of 1,400 m^2.

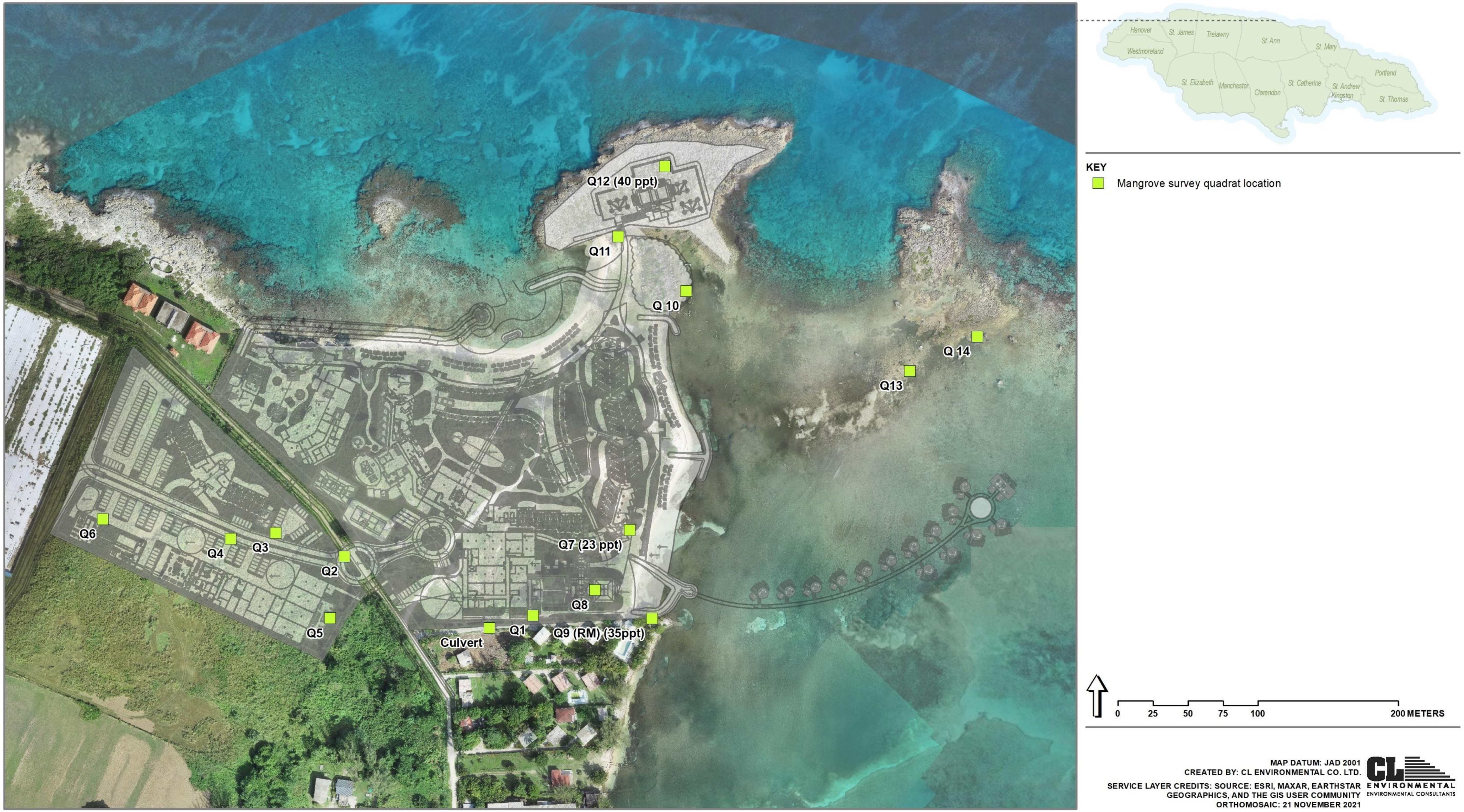


Figure 5-67 Mangrove survey quadrat locations

Results and Discussion

Table 5-25 shows that mangrove trees were present in only seven (7) of the fourteen (14) quadrats laid. Based on the density of trees recorded in each 100m^2 quadrat, a tree density was recorded for each. The mean tree density derived from all areas surveyed was 0.32 mangrove trees per m^2.

Table 5-25 Mangrove tree density, seedling density and salinity of each sub-sampled plot (quadrat)

Quadrat	Plot Coordinates	Mangrove Tree Density				Avg. Height (m)	Average DBH(m)	Seedling Density	Salinity
		Rhizophora mangle	*Laguncularia racemosa*	*Conocarpus erectus*	Density per m^2				
1	18.451606, -77.224348	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
2	18.451983, -77.225622	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
3	18.452136, -77.226088	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
4	18.452097, -77.226391	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
5	18º27'09.5" N, 77º 13'349" W	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
6	18.452224, -77.227256	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
7	18.452159, -77.223696	2	5	n/a	0.07	0.45	n/a	n/a	23 ppt
8	18.451770, -77.223929	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
9	18.451587, -77.223545	9	n/a	n/a	0.09	6.5	9.3	2 reds	35 ppt
10	18°27'13.32"N, 77°13'23.93"W	88	20	20	1.28	1.25	0.5	n/a	n/a
11	18.454050, -77.223776	2	13	n/a	0.15	~<1	n/a	n/a	n/a
12	18.454504, -77.223461	n/a	n/a	32	0.32	0.4	n/a	n/a	40 ppt
13	18.453186, -77.221804	9	n/a	n/a	0.09	1.3	3	n/a	n/a
14	18°27'12.27"N, 77°13'16.85"W	19	2	n/a	0.21	0.75	n/a	2 red	35 ppt
				Average Tree Density	0.32				

Sections of the property (northern sections within rocky shore) contained clusters of trees scattered along the northern and eastern edges, and one other cluster of mangroves on the south-eastern end (quadrat 9, Plate 5-11). These mangrove areas accounted for approximately 2,305 m^2 as seen in Figure 5-61, Area 1 = 2,098 m^2 and Area 2 = 207 m^2. This approximate area of 2,305 m^2 of mangrove equates to 738 dwarf mangrove trees and seedlings (area x mean tree density).

Quadrat 9 had the tallest assemblage of mangrove trees, with "normal" heights expected of an estuarine mangrove area (Table 5-26). The southern wetland area appears seasonal and had no standing water during the visits. The area is approximately 2,400 m^2 but did not possess mangrove trees.

The scattered and sparse mangroves on the Eastern cays were not quantified.

Table 5-26 Average tree height and average DBH of plants in transects with mangrove vegetation.

Mangrove Species	Transect	Average Height(m)	Average DBH (m)
Rhizophora mangle	7	0.4	n/a
Laguncularia racemosa		0.5	n/a
Rhizophora mangle	9	6.5	9.3
Rhizophora mangle	10	1	n/a
Laguncularia racemosa		1.5	0.5
Rhizophora mangle	11	1	n/a
Laguncularia racemosa		<1	n/a
Conocarpus erectus	12	0.4	n/a
Rhizophora mangle	13	1.3	3
Rhizophora mangle	14	1	n/a
Laguncularia racemosa		0.5	n/a

Plate 5-11 Mangrove stand at Q9, at the south-eastern property boundary

Quadrat 10 was laid within the rocky shore, and it was evident that some trees present had been cut. The trees generally were dwarfed and bent which could be a result of high winds. This area of the property had the highest tree density of 128 mangrove trees in the 100m^2 quadrat. There was a partial creek between transects 10 and 11, connecting the eastern cove to the western, that was closed mostly by silt. This area was bordered by limestone to the northern side.

Plate 5-12 Red mangrove saplings found near Q 10

Transect 13 and 14 displayed dwarfed mangroves (Plate 5-13) and mangrove associate species (buttonwood) occurring on the Eastern rocky shore area. Though these trees may be over 20 years old, the windy conditions, limestone substrate with minimal nutrients available and living with infrequent fresh water prevents them from attaining normal tree heights. A summary of the trees within this rocky shore area is provided in Table 5-27. A total of 351 of these small trees were found in the rocky shore area and were not accounted for in the other wetland areas surveyed.

Table 5-27 Summary of trees within eastern rocky shore area

Species	Count on limestone headland
Rhizophora mangle (red mangroves)	3
Laguncularia racemosa (white mangrove)	13
Conocarpus erectus (buttonwood)	335
TOTAL	**351**

Plate 5-13 Dwarfed red mangroves observed at Q 14

Plate 5-14 Mangrove seedlings along the nearshore and in the seagrass bed

Plate 5-15 Rock pools surrounded by dwarfed buttonwood and runners at northern limestone headland.

Plate 5-16 Vegetation and a small pool of water observed at Q 7

Visible Hydrology

To understand the hydrology of the site, salinities of standing water bodies were collected where possible. Figure 5-68 shows that the property is mostly devoid of standing water bodies, with just 3 locations on the development footprint having standing water.

Fresh water (1ppt) was recorded in crab holes at the Southern end of the property, coinciding with wetland type vegetation in this area. Despite the area not being waterlogged during the visit, the guttering, culvert presence across the roadway, and being adjacent to a wetland to the West, is a clear sign that this area is occasionally subject to freshwater flow. An area of tidal influence (double sided arrow) was observed, having a salinity of 23ppt (Figure 5-68). This area had a negligible assemblage of mangrove saplings, but the salinity indicates that there is an exchange of seawater at this location, and fresh water that dilutes the water (seawater is 35ppt). Historical aerial images show that there was a thicket of coastal vegetation in that location up to 2009 (Figure 5-61 and Figure 5-69), and anecdotal information from residents suggests that these plants were mangroves.

Figure 5-68 Salinity and observed flow of water (red arrows) at the project site.

2009 2022

Figure 5-69 Location of historic mangrove (red circle in 2009 image)

An assemblage of dwarfed mangroves is also found on the northern limestone headland. The standing waters there were 40ppt, indicating that water reaches these rock pools and does not flow out, getting saltier due to evaporation. A tidal exchange does cross from East to West where the mainland meets the northern cay/limestone headland area. White and red mangroves were also found in this location, surviving relatively well in the seawater here, having no fresh water source.

5.2.2.3 Rocky Shore

The rocky shore bordering the northern section of the property had several rock pools with rocky shore snails. The rock pool closest to transect 12 had a salinity of 40 ppt. Saltwater bush and dwarfed mangroves were common in this area. Much of the rocky shore is littered with solid waste and marine debris. The rocky shore tapers towards the shoreline forming where an intertidal area and sand separate both bays. Table 5-28 lists all non-mangrove species found in and along the rocky shore. Plate 5-17 - Plate 5-20 shows sections of the rocky shore survey area.

Table 5-28 Non-Mangrove Flora Observed throughout Survey Site

Flora Observed	DAFOR ranking
Almond (*Terminalis catappa*)	O
Lead tree (L*eucaena sp.)*	A
Willow *(Salix* sp.)	O
Sedge (*Carex* sp.)	D
Guinea grass (*Megathyrsus sp.)*	D
Cord grass (*Spartina* sp.)	A
Sea-purslanes (*Sesuvium* sp.)	F
Wild cane (*Saccharum spontaneum*)	A
Sugar cane (*Saccharum officinarum*)	F
Bullrush (*Typha* sp.)	D
Tansy (*Lantana* sp.)	R

Flora Observed	DAFOR ranking
Spanish needle (*Bidens alba*)	O
Seaside daisy (*Erigeron* sp.)	O
Guango (*Albizia saman*)	O
Flame of the forest (*Butea monosperma*)	F
Dalbergia sp. (Rosewood)	A
Trumpet tree (Tabebuia sp.)	O
Cerasee (*Momordica* sp.)	O
Baceda (*Guazuma ulmifolia*)	A
Shame 'ole' lady (Mimosa pudica)	R
Papaw (*Carica papaya*)	R
Sea grape (*Coccoloba uvifera*)	F
Saltwater Bush (*Rachicallis americana*)	D

Plate 5-17 Rocky shore headland dividing eastern and western sections of the property

Plate 5-18 Dwarfed mangroves along the rocky shore and tidal pool areas.

Plate 5-19 Section of the channel area along the rocky shore

Plate 5-20 Solid waste littering the rocky shore.

5.2.3 Fauna

5.2.3.1 Avifauna

Methods

The line transect method was selected for the avifauna assessment owing to the number of accessible footpaths, trails, and roads throughout the property. This method entailed walking slowly along established routes and noting all the birds seen or heard in the area (Bibby et al. 2000). Notably, birds observed for the first time while conducting other faunal surveys were added to the list. In addition, people encountered in the project area were informally interviewed about the birds they observed, emphasizing nocturnal birds on the property.

Audio devices (AudioMoth) were deployed in the field to conduct the nocturnal bird survey (Figure 5-70). The devices were active from 17:30 to 06:30 over 8 days. The audio files were processed using the Kaleidoscope Pro software from Wildlife acoustics and the process audio file ID by experts.

Reference material used in species identification (pictures and calls) includes Merlin App (Cornell University, 2021), Ebird (Fink, et al., 2018), and Bird of the West Indies (Raffaele, et al., 1998).

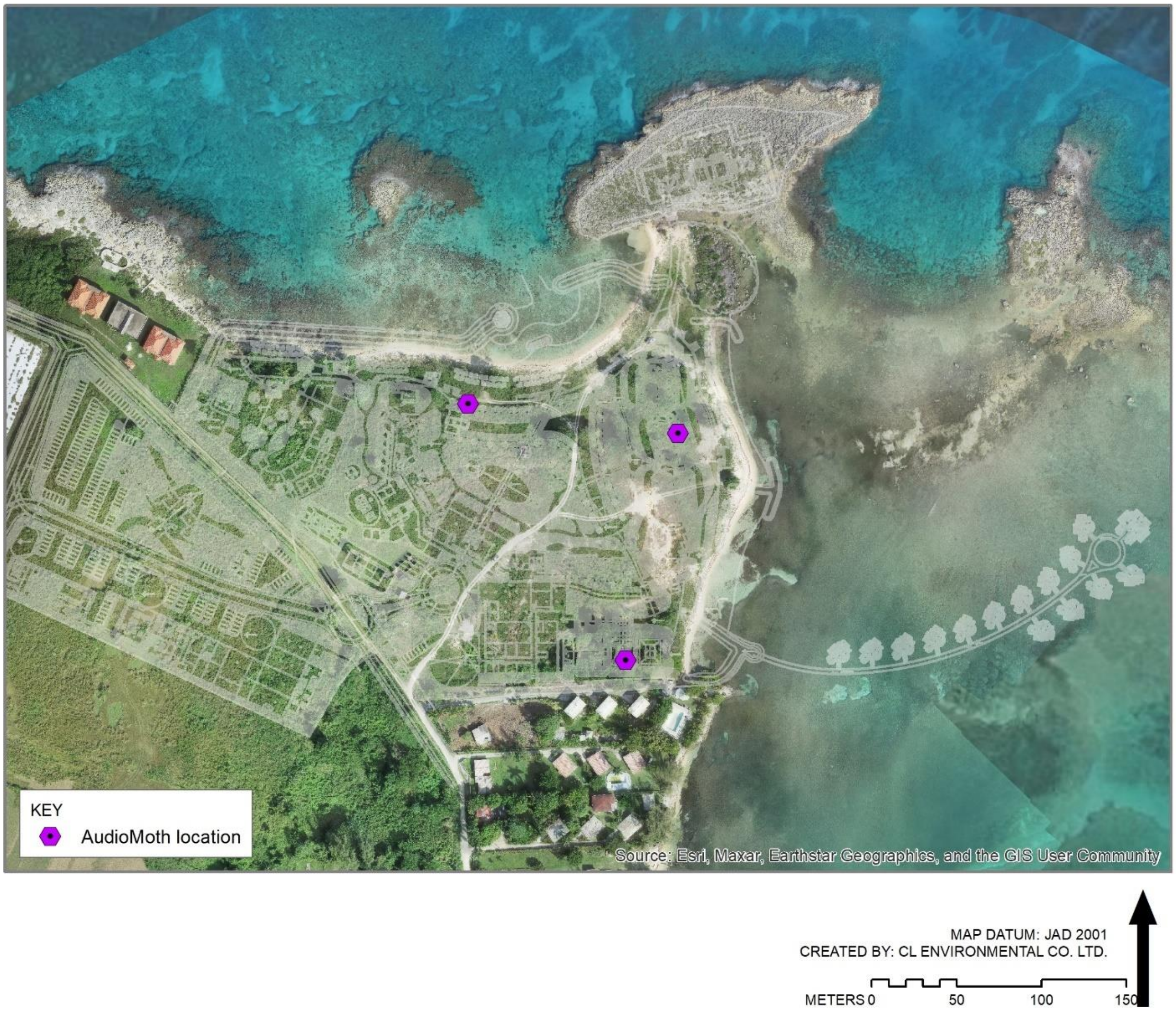


Figure 5-70 AudioMoth locations at project site

Results and Discussion

Twenty-seven (27) species of birds were identified during the assessment (Table 5-29). This includes 2 resident (endemic), 22 resident (non-endemic) and 3 migrants.

The bird species composition observed is typical of a dry limestone forest (Downer and Sutton 1990). These birds included Parakeets, Hummingbirds, Jamaican Woodpeckers, and Warblers. Of the endemic birds identified, all were non-forest dependent. It should be noted that the woodland and the surrounding forest provide a habitat for birds classified as forest specialists.

The migrants observed include two summer migrants, which include the Antillean Nighthawk, and Gray Kingbird were observed during the assessment. The Royal Tern, which is listed as a migrant, and there are records of resident species, was also observed in the study. No winter migrant Warblers were observed in the study, as the survey was carried out before their arrival, which is as early as September, and they depart Jamaica as early as April.

A few costal birds were observed on the coast this include Royal Tern, Black-crowned Night-Heron, Little Blue Heron, Snowy Egret, Magnificent Frigate Bird, and Brown Pelican. None of the birds reproduce on site. The egrets were seen foraging along the rocky shore section of the property.

Only two bird species with special designated status by the IUCN were observed across the study area: White-crowned Pigeon (*Patagioenas leucocephala)* and Jamaican Parakeet (*Eupsittula nana*) are both classified as near threatened species.

Table 5-29 Avifauna observed during the survey.

Common Name	Scientific Name	Range	IUCN	Open Field	Coastal
American Kestrel	*Falco sparverius*	Resident	LC	R	
Antillean Nighthawk	*Chordeiles gundlachii*	Migrant	LC	O	
Antillean Palm-Swift	*Tachornis phoenicobia*	Resident	LC	O	
Bananaquit	*Coereba flaveola*	Resident	LC	R	
Black-crowned Night-Heron	*Nycticorax nycticorax*	Resident	LC	R	R
Black-faced Grassquit	*Melanospiza bicolor*	Resident	LC	R	
Brown Pelican	*Pelecanus occidentalis*	Resident	LC	R	R
Cattle Egret	*Bubulcus ibis*	Resident	LC	R	
Common Ground Dove	*Columbina passerina*	Resident	LC	R	
Gray Kingbird	*Tyrannus dominicensis*	Migrant	LC	O	
Greater Antillean Grackle	*Quiscalus niger*	Resident	LC	O	
Jamaican Woodpecker	*Melanerpes radiolatus*	Endemic	LC	R	
Little Blue Heron	*Egretta caerulea*	Resident	LC	R	R
Loggerhead Kingbird	*Tyrannus caudifasciatus*	Resident	LC	R	
Magnificent Frigatebird	*Fregata magnificens*	Resident	LC	R	R
Northern Mockingbird	*Mimus polyglottos*	Resident	LC	O	
Jamaican Parakeet	*Eupsittula nana*	Endemic	NT	O	
Royal Tern	*Thalasseus maximus*	Migrant	LC	R	R
Smooth-billed Ani	*Crotophaga ani*	Resident	LC	O	
Snowy Egret	*Egretta thula*	Resident	LC	R	R
Turkey Vulture	*Cathartes aura*	Resident	LC	R	
Vervain Hummingbird	*Mellisuga minima*	Resident	LC	R	
White-crowned Pigeon	*Patagioenas leucocephala*	Resident	NT	O	
White-winged Dove	*Zenaida asiatica*	Resident	LC	R	
Yellow-crowned Night-Heron	*Nyctanassa violacea*	Resident	LC	R	
Yellow-faced Grassquit	*Tiaris olivaceus*	Resident	LC	O	
Zenaida Dove	*Zenaida aurita*	Resident	LC	O	

5.2.3.2 Herpetology

Survey Approach

The amphibian and reptile surveys were conducted across the different microhabitat types within the project area. The habitat searched includes trees, stone piles, abandoned structures and other debris. All specimens seen were identified, and a DAFOR ranking was assigned to reflect their relative dominance; pictures were taken for further study if necessary. Herpetofauna which could not be identified in the field were collected and identified using Amphibians and Reptiles of Caribbean Islands keys (Caribherp, 2015) and Amphibians and reptiles of the West Indies (Schwartz & Henderson, 1991).

Amphibian

Only two amphibians were recorded on the property (Table 5-30); this includes the endemic *Eleutherodactylus gossei* and the introduced Eleutherodactylus *johnstonei.* No amphibians of special conservation status were identified in the study.

Table 5-30 Herpetofauna identified in the study area

Class	Family	Scientific Name	Common Name	Range	IUCN Status	Open Field	Coastal
Amphibia	Eleutherodactylidae	*Eleutherodactylus gossei*	Jamaican Forest Frog	End	VU	R	
Amphibia	Eleutherodactylidae	*Eleutherodactylus johnstonei*	Lesser Antillean Frog	Int	LC	F	
Reptilia	Anguidae	*Celestus crusculus*	Jamaican Brown Galliwasp	End	LC	R	
Reptilia	Dactyloidae	*Anolis lineatopus*	Jamaican Brown Anole	End	LC	O	
Reptilia	Dactyloidae	*Anolis grahami*	Jamaican Turquoise Anole	End	LC	O	
Reptilia	Dactyloidae	*Anolis sagrei*	Brown Anole	Int	LC	O	
Reptilia	Sphaerodactylidae	*Aristelliger praesignis*	Jamaican Croaking Gecko	Nat	LC	R	
Reptilia	Cheloniidae	Eretmochelys imbricata	hawksbill sea turtle	Nat	CR	R	R

Reptiles

Three tree lizards were identified in the study, and they are endemic. The other lizards include the native Jamaican Croaking Lizard and the endemic Jamaican Brown Galliwasp.

Plate 5-21 *Anolis grahami* observed on a tree on the property.

Plate 5-22 Aristelliger praesignis on a termite mound in the day on the property

Sea Turtles

Four sea turtle species have been recorded in Jamaica: Green Turtle (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Loggerhead (*Caretta caretta*), and Leatherback (*Dermochelys coriacea*) (Haynes-Sutton, Bjorkland, and Donaldson 2011). The IUCN Redlist Status of the sea turtle in Jamaica: Green turtle (Endangered), Loggerhead (Critically Endangered), Leatherback (Vulnerable) and Hawksbill (Vulnerable). The Hawksbill is the most abundant of the four species in Jamaica. Several nests have been reported on the North Coast.

Four old nests with old eggshells (Plate 5-24) were observed on the beach on the site (Figure 5-71). Two mounds on the property could be active nests or test digs observed during the study (Plate 5-26). The Hawksbill is the common turtle species regularly seen in the parish. These nests are highly vulnerable to poaching by fishermen, one of the nests appeared to have been poached. The nest and turtles are also vulnerable to dogs regularly seen on the property. Solid waste (Plate 5-7) also threatens both the potential nesting turtles as well as the hatchlings. One nest in particular was at risk of being driven on by cars and trampled by users.

Figure 5-71 Location of the nest observed on the property.

Plate 5-23 Shells found in an old nest on the property.

Plate 5-24 Old turtle nest with shells

Plate 5-25 Possible active sea turtle nest on the property

Plate 5-26 Sea turtle nest (test dig) observed on the beach on the property.

5.2.3.3 Invertebrates

Methods

The invertebrate assessment consisted of a series of walkthroughs within the project area. Various microhabitats within the project area were carefully searched or examined, these included tree trunks, leaves, dry wood, and sticks. A sweep net was also used to sample insects from the foliage, and insects in flight were recorded.

The arthropods encountered in the field were identified on the spot; however, arthropods which could not be identified in the area were later identified using Insects Keys (Triplehorn, et al., 2005), iNaturalist App and collections at the University of the West Indies if necessary.

Results and Discussion

Twelve butterfly species were observed in the study area. Of the twelve species, two endemic subspecies were identified in the study (Table 5-31). The larval food plant for the endemic sub species were not seen on the property and they were observed feeding from the flowers on the property. None of the butterfly species identified is of any special conservation needs.

Table 5-31 Butterfly species observed

Family	Scientific name	Common Names	Distribution	DAFOR Open field	DAFOR Coastal
Lycaenidae	*Hemiargus ceraunus*	The Hanno Blue	Widespread and very common	R	
Lycaenidae	*Leptotes cassius*	Cassius Blue	The Caribbean, Central and northern South America extend as far north as southern Texas and the tip of Florida,	O	
Nymphalidae	*Anartia jatrophae*	White Peacock	Widespread and common. Southern US to Argentina	O	
Nymphalidae	*Dione vanillae*	The Tropical Silverspot	Widespread and very common	R	
Nymphalidae	*Dryas iulia delilah*	Julia	Endemic Ss.; widespread, common	O	
Nymphalidae	*Heliconius charithonia simulator*	Zebra Longeing	Endemic subspecies Jamaica	O	
Nymphalidae	*Phyciodes frisia frisia*	The Cuban Crescent-Spot	Subspecies found in Jamaica and Cuba	O	
Pieridae	*Anteos maerula*	yellow angled-sulphur	Widespread, not very common. Southern US to Peru	O	R
Pieridae	*Ascia monuste*	Great Southern White; Antillean Great White	Widespread, common and pest of crucifers. Southern US to Argentina	R	
Pieridae	*Phoebis argante*	Giant Sulphur	Widespread, common. Southern US to Argentina	R	R
Pieridae	*Phoebis sennae*	Cloudless Sulphur	Widespread and common. Southern US to Argentina	R	
Pieridae	*Pyrisitia lisa*	Little Yellow	Widespread, common. Southern US to Argentina	O	

Nineteen non-butterfly arthropod species were observed in during the study. The majority were observed in the open fields while a few was seen in the coastal vegetation. Of note, there were no species of special conservation status.

Table 5-32 Arthropods observed

Order	Family	Scientific name	Common Names	Status, Range	Open field	Coastal
Araneae	Araneidae	Argiope sp.	Orbweavers	Native, Common	R	
Diptera	Muscidae	Musca domestica	Housefly	Native, Common	R	
Diptera	Dolichopodidae	Condylostylus sp	Green Fly	Native, Common	R	
Hemiptera	Pyrrhocoridae	Dysdercus andreae	Cotton Stainer Bugs	Native, Common	O	
Hemiptera	Pentatomidae	Nezara viridula	Stink bug	Native, Common	**R**	
Homoptera	Cicadidae	Odopoea sp.	Cicada	Native, Common	O	
Hymenoptera	Vespidae	Polistes crinitus		Native, Common	R	
Hymenoptera	Vespidae	Polistes major		Native, Common	O	
Hymenoptera	Apidae	Apis mellifera		Native, Common	O	
Hymenoptera	Sphecidae	Prionyx thomae		Native, Common	R	
Hymenoptera	Formicidae	Pheidole sp.	Black ants	Native, Common	O	
Hymenoptera	Formicidae	Camponotus hannani	Red Ants	Native, Common	O	
Isopetera	Termitidae	Nasutitermes costalis	Termites, Duck ants Widespread.	Native, Common	F	
Odonata	Libellulidae	Orthemis sp	Green Dragonfly	Native, Common	**O**	**R**
Odonata	Libellulidae	Orthemis macrostigma	Red Dragonfly or Tropical King Skimmers	Native, Common	**A**	**R**
Odonata	Libellulidae	Orthemis sp	Antillean Skimmer	Native, Common	**O**	
Odonata	Libellulidae	Erythemis vesiculosa	Great Pondhawk	Native, Common	**O**	
Orthoptera	Gryllidae		Cricket	Uknown	**O**	
Spirobolida	Rhinocricidae	Anadenobolus monilicornis	Yellow-banded millipede; Jamaican Bumble bee Millipede. Caribbean; introduced to southeastern US	Native, Common	**O**	

5.2.3.4 Bats

Methods

A total of 3 AudioMoth® acoustic recorders were deployed in selected areas on the property (coats, open grassland and woodland, Figure 5-70). The AudioMoth detectors were configured to start recording from 18:30 to 06:00 for 8 nights. The sample rate was 384 kHz, and the gain was set at medium. The sleep duration was 5 seconds, and the recording duration was for 5 seconds.

The devices were deployed at least 3m above the ground, primarily on trees. The Kaleidoscope Pro® software was used to process and ID the bat calls from all acoustic devices. Please note that the software can only auto ID ten of Jamaica's 21 species of bats. The other species were identified using a call library from Windsor Research Centre and internet resources.

Results and Discussion

A total of 8 species of bats were recorded across the study area, all of which are native to Jamaica (Table 5-33). Six of the bats are insectivores, one fish-eating bat and the other species a frugivore. The same species of bats were found in the coastal and the open fields vegetation categories. It was uncertain if the bats were flying through or foraging on the property. None of the species recorded during the assessment has a special conservation station designation by the IUCN; all bats observed are classified as least concerned by the IUCN.

Table 5-33 Bat species Identified from AudioMoth Recordings

Scientific name	Common name	Diet	Roost	Foraging Behaviour
Artibeus jamaicensis	Jamaican Fruit Bat	Frugivore	Cave, man-made structure, foliage	Fruit Feeder: trees in the forested and disturbed area
Molossus molssus	Pallas' Mastiff Bat	Insectivore	Cave, man-made structures	Open-space, aerial awking
Moormops blainvillei	Antillean Ghost-faced Bat	Insectivore	Obligate cave	semi-cluttered space; fluttering hunter
Noctilio leporinus	Fishing Bat	Piscivore	Cave, crevice, Tree hollow	Slow-moving water surface; along the edge and open fields
Pteronotus macleayii	MacLeay's Mustached Bat	Insectivore	Obligate cave	Background-cluttered space; fluttering hunter
Pteronotus parnellii	Parnell's Mustached Bat	Insectivore	Obligate cave	Highly cluttered space; fluttering hunter
Pteronotus quadridens	Sooty Mustached Bat	Insectivore	Obligate cave	Background-cluttered space
Tadarida brasiliensis	Free-tailed Bat	Insectivore	Cave, man-made structures	Open-space, aerial awking

5.2.3.5 Rocky Shore and Intertidal Communities

Several transect lines were run along the rocky shore headland between the eastern and western bays (Figure 5-72) as well as observations of intertidal areas along the waterline and. The transect lines also included some inter-tidal pools.

The survey area included several rock pools, areas with bare rock and areas with varying levels of and dwarfed mangroves and coastal vegetation. Some zonation was seen along the outer edges of the rocky shore. The typical zonation and species composition were not seen in areas closer to the sandy beaches. There is an uneven distribution of species composition, density and abundance, but in general species diversity and abundance decreases further away for water sources. Small corals were seen in some permanent tidal pools and channel areas. Other areas also had crabs and small fish.

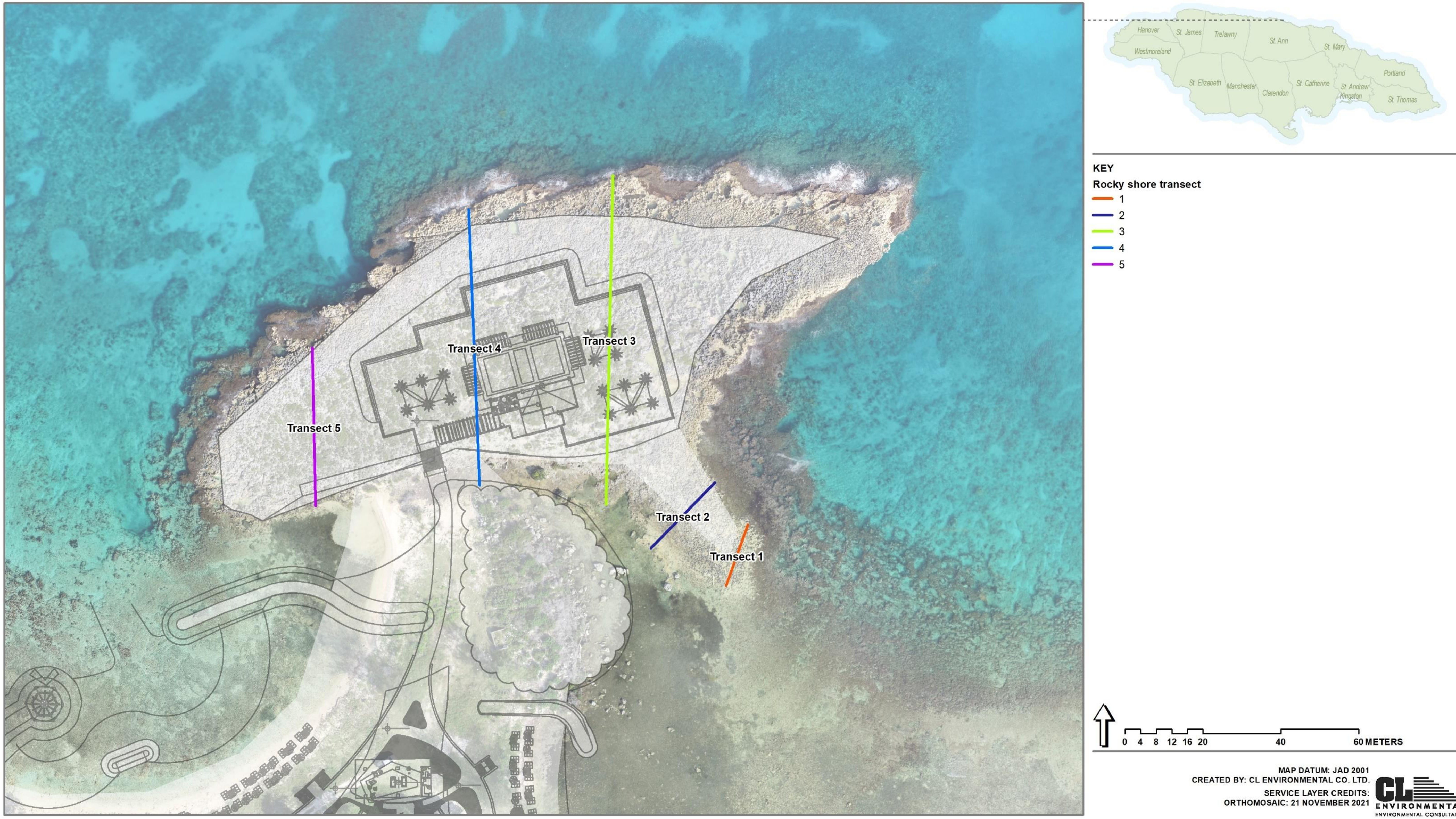


Figure 5-72 Rocky shore transect lines

The partially submerged channel area had some zonation along rocks but was greatly reduced. This area also had a few small colonies of Siderastrea, fish and crabs. Dwarfed red and white mangroves can also be found in and along this area. The species found during the survey are given in Table 5-34.

Table 5-34 Intertidal and Rocky Shore Species List

Common Name	Scientific Name
Common Periwinkle	*Litorina sp.*
Black Nerite	*Nerita sp.*
Zebra Periwinkle	*Echinolittorina sp.*
Wilks	*Cittarium pica sp.*
Soldier Crab	*Paguroidea sp.*
Chiton	*Polyplacophora sp.*
Massive Starlet Coral (only present in rock pools)	*Siderastrea sp.*

Figure 5-73 illustrates the changes in species abundance across the rocky shore. Species density is highest in the intertidal area and rock pools. Density decreases significantly as you move away from the shoreline. Density increases towards the end of the transect, where channel occurs.

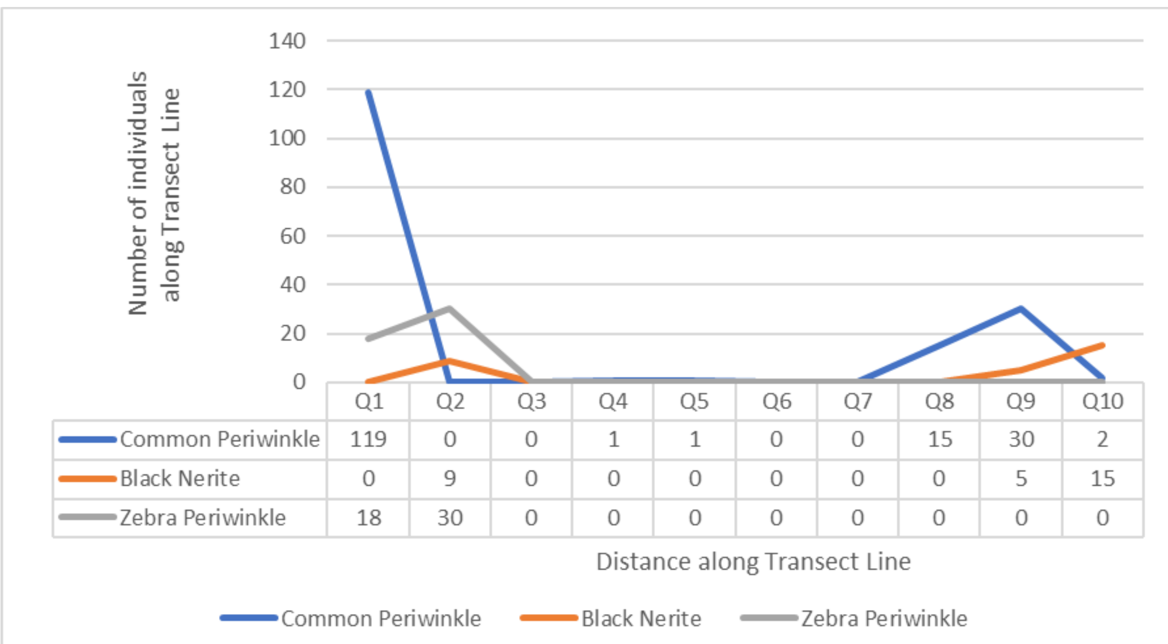
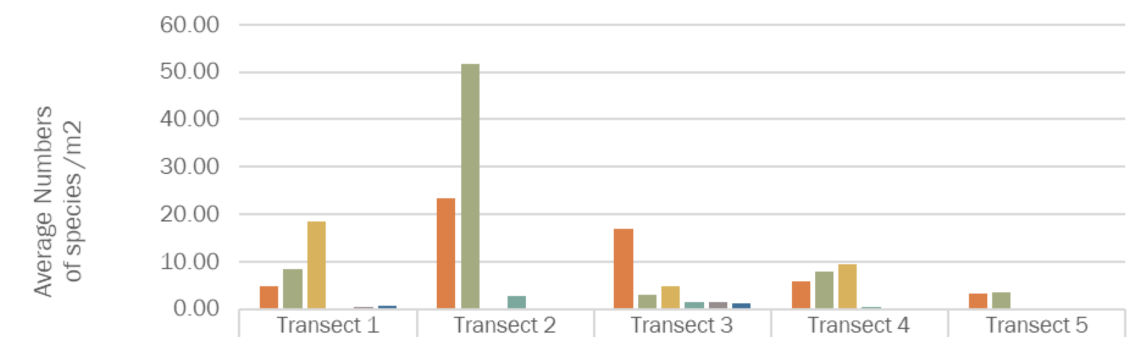


Figure 5-73 Species variation along Transect 3

Figure 5-74 shows species diversity of each transect. T3 was the most diverse as it is low lying and partially submerged and experiences high wave action. This area is more representative of an intertidal community, while T2 is more representative of a rocky shore community.



	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5
Common Periwinkle	4.86	23.30	16.80	5.70	3.36
Black Nerite	8.43	51.80	2.90	7.80	3.55
Zebra Periwinkle	18.57	0.00	4.80	9.40	0.00
West Indian top shell	0.07	2.70	1.40	0.40	0.00
Soilder Crab	0.43	0.00	1.40	0.00	0.00
Chiton	0.71	0.20	1.20	0.00	0.00

Figure 5-74 Species abundance for each transect.

Examples of vegetation, rock pools and species seen along transect lines and intertidal areas are given in Plate 5-28 - Plate 5-30.

Plate 5-27 Example of a permanent rock pool

Plate 5-28 Dwarfed vegetation seen along the transect.

Plate 5-29 Chitons and snails along in the intertidal zone

Plate 5-30 Snails seen further inland of the rock shore.

5.2.4 Benthic Community

5.2.4.1 Overview and Survey Approach

Mapping of Benthic Communities

The proposed project footprint includes some coastal modification along the entire property shoreline. This length of coastline has several different substrate types, varying seagrass bed density and diversity, coral, pavement, rocky shores and intertidal communities. Various survey methods were used to assess the benthic community, these included transect lines, quadrats and roving surveys. Figure 5-75 gives the benthic survey area. An additional reef survey was conducted outside the immediate project area.

A total of 487 large (10cm or greater) hard coral colonies and 167 soft corals were mapped. Of these hard corals mapped 49 of were *Acropora palmata*. A total of 48,446.5m^2 of seagrass was mapped for the project area.

Figure 5-75 Benthic Survey area

The seagrass beds and other distinct communities within and nearby the proposed project footprint were mapped and surveyed using a Trimble Geo 7x Global Positioning System (GPS). The beds were mapped by walking along the boundaries where possible. Aerial imagery was obtained by using a Quantum Trinity F90+ fixed wing drone, and georeferenced orthorectified imagery of the project area was created. Habitat maps were then created for each bay.

Plate 5-31 Mapping of seagrass beds

Seagrasses

The proposed project area consists of two bays, a smaller western bay and a larger eastern bay, both containing seagrass. The western bay is smaller with grass mainly in rock, rubble and sand, which is moderately dense. The larger eastern bay contains an expansive seagrass bed, which extends way beyond the survey area into the bay. Substrate here varies, as does the seagrass in terms of density and distribution. Three species of seagrass were identified in the project area, *Thalassia testudinum* (the dominate species*), Syringodium* and *Halodule* were also seen.

Plate 5-32 Seagrass in the larger Eastern Bay

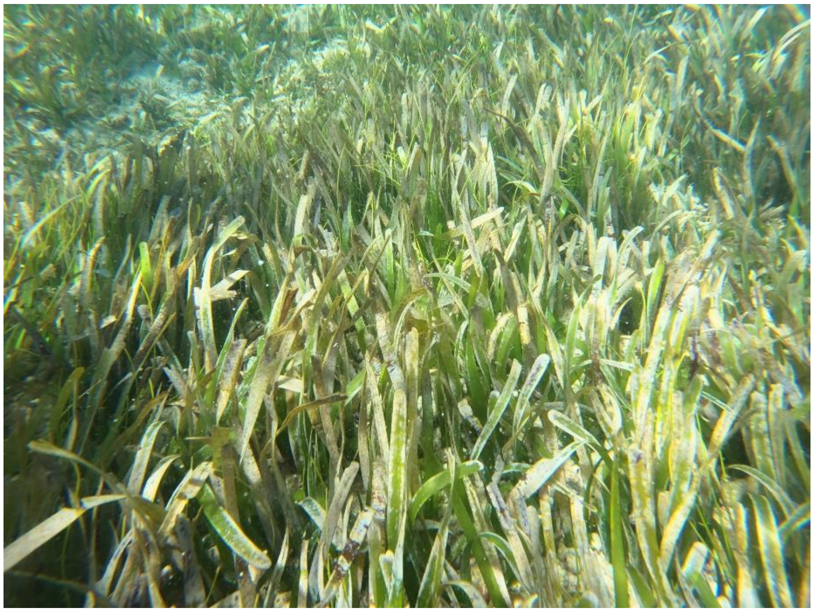


Plate 5-33 Dense section a seagrass

SURVEY METHODS

Random quadrats were used to sample both bays. 05. X 0.5 m and 1 x 1m quadrat were used in either bay. Six belt transect lines were used in the larger eastern bay for sampling the benthic community further into the bay, within seagrass beds and other habitats within the proposed project footprint. Shoot density, percentage cover, leaf blade length, overall health and appearance and other organisms located within the seagrass beds were all recorded. Seagrass blades were assessed within several quadrats, in both bays, along with shoot density, which was recorded within 5 random 10cmx10cm squares in each of these quadrats. Percentage cover was also recorded by counting the number of 10cmx10cm squares which contained seagrass. Leaf blade length was recorded by measuring 10 random lead blades within each quadrat thrown. Roving surveys were conducted, and general observations were made. A species lists and photo inventory was also generated.

CARBON SEQUESTRATION

Within the project area a total of seven (7) seagrass cores were extracted. At each site, diving was utilized to extract core data using a PVC core and sledgehammer. The core was then capped and removed. GPS locations were then taken at the site of core extraction Table 5-35. The removed core and contents (vegetative and soil plug) were then carried to the surface and stored for later processing as seen in Plate 5-34. This process was repeated for each sample taken.

Plate 5-34 Labelled core samples taken from Richmond Cay

Table 5-35 Coordinates of seagrass cores taken at Richmond Cay (JAD2001)

Core Name	Eastings	Northings
R0	726478.6741	700073.0623
R1	726605.0007	700072.6555
R2	726468.102	699984.7461
R3	726789.890	699883.2530
R4 A	726831.6098	699912.0963
R4 B	726325.6702	700224.2086
R5	726424.1097	700183.3684

Figure 5-76 Map of core extraction points at Richmond Cay

In lab, each blade per sample was removed and measured for blade length and width. Samples were then weighed for wet weight and recorded with epiphytes still attached. Prominent epiphytes present on the blades were noted and removed using ten percent (10%) hydrochloric acid (HCL). Blades were then wiped clean of all remaining epiphytes, weighed and recorded for weight after epiphyte removal (epiphyte weight). Entire root biomass was also removed from each sample, weighed and recorded. Samples were then packaged and dried for seventy-two (72) hours at sixty degrees (60°) after which dry weights for both root and grass were recorded.

The remaining soil collected in the core was split into two replicates, placed into labelled aluminium containers and weighed for wet weight. Samples were dried for seventy-two (72) hours at sixty degrees (60°). After drying, samples were allowed to cool for one (1) hour after which they were weighed for dry weight and placed into a muffle furnace for five (5) hours at four hundred and fifty degrees (450°). Samples were then removed, ash free dry weights recorded, and resultant data analyzed.

5.2.4.2 Western Bay

West Bay Habitats

The western bay is shallow back reef protected by a fringing reef system and rocky shore headland. Most of the substrate throughout the area is hard with little to no sand. Sparse seagrass in pavement and rock and rubble dominated the eastern section of the bay while the western side is a mixture of iron shore and algal reefs. Dense *Echinometra* zones are also found within the shallow, sheltered bay. The fringing reef is dominated by seafans, in particular on the eastern side and around the middle cay.

Most hard coral species are encrusting on pavement and shallow crest areas. These include *Pseudodiploria*, *Millipora* and most notable *A. palmata*. Single incidence of disease was observed on a large *Pseudodiploria.* Areas with seagrass, rock, rubble and pavement were colonised by mostly small colonies of *Siderastrea (*small colonies are considered to be anything less than 10cm.). *Porites divaricata* colonies were also common in sections of the bay with seagrass. These colonies which tend to be free moving and branching, have most of the living tissue towards the tips of the branches, with much of the skeleton buried under sand. In some areas these branched colonies are consolidated and held together by various encrusting biota. These dense collections area a notable feature in some sections of the area. It is likely that these have been allowed to form over time because it has been undisturbed by trampling or boat damage. The western most sections of the bay are dominated by macroalgae, forming a large algal reef area. The algal reef has a sparse distribution of coral and *Millepora*. The much of the west bay is difficult to access.

17 A. palmata colonies and 209 hard coral>10cm were mapped.

3,935.7m^2 of seagrass was mapped.

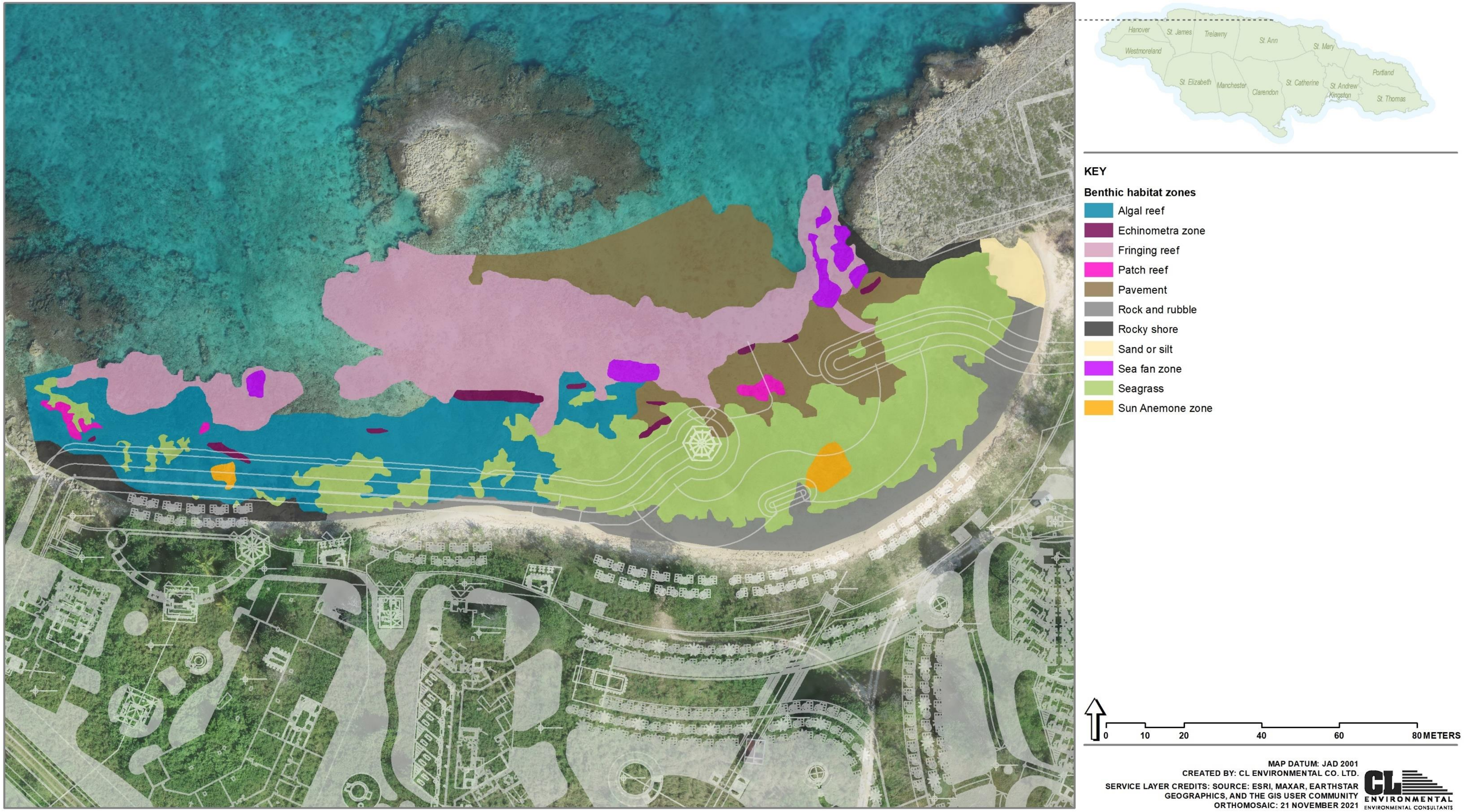


Figure 5-77 West Bay Habitat Map

Plate 5-35 Aerial photo of the west bay

The habitat map (Figure 5-77) illustrates the benthic composition of the west bay. Details of each habitat type are given in Table 5-36. The west bay is dominated by a fringing reef and seagrass bed with pavement and a shallow algal reef accounting for other large habitats of the bay.

Table 5-36 Estimated habitat areas for the Western Bay

Benthic zone	Western bay (sqm)
Algal reef	2568.1
Echinometra zone	136.7
Fringing reef	3844.0
Patch reef	93.2
Pavement	2324.5
Rock and rubble	1215.6
Rocky shore	506.0
Sand or silt	186.4
Sea fan zone	231.3
Seagrass	3935.7
Sun Anemone zone	128.9
Estimated surveyed/mapped area	**15170.4**

WEST BAY SPECIES COMPOSITION

Random quadrats were thrown in the west bay (where suitable) in order to estimate the number of species composition and density. Roving surveys were also conducted in order to generate a phot inventory and species list. Hard corals counted in this survey area were small (less than 10cm). Larger corals were mapped where possible.

Table 5-37 Estimated species per m^2 for each Habitat.

Coral per m^2					
Habitat	*Siderastrea sp.*	*Porites asteriodes*	*Porites divaricata*	*Millepora sp*	*Gorgonia ventalina*
Seagrass	18.7	0.3	6.8	0.0	0.0
Echinometra zone	8.7	1.7	0.0	0.3	1.3
Pavement	21.0	0.0	6.0	0.0	0.0

Urchins per m^2					
Habitat	*Echinometra*	*Lytechinus*	*Diadema antillarum*	*Tripneustes*	*Eucidaris tribuloides*
Seagrass	9.1	1.6	0.2	0.3	0.0
Echinometra zone	46.0	0.3	0.0	0.0	0.0
Pavement	4.0	2.0	0.0	0.0	0.0

WEST BAY CORAL COMMUNITY

A total of 209 hard coral>10cm, of which 17 were *A. palmata*, were mapped in the west bay. All coral mapped were 10cm or larger. Many corals and fire corals could not be mapped due to wave action and their location in very shallow or hazardous areas. Dense areas of seafans were seen along the submerged sections of the Ironshore and reef areas. Millepora and macro algae dominated sections of the shallow reef crest.

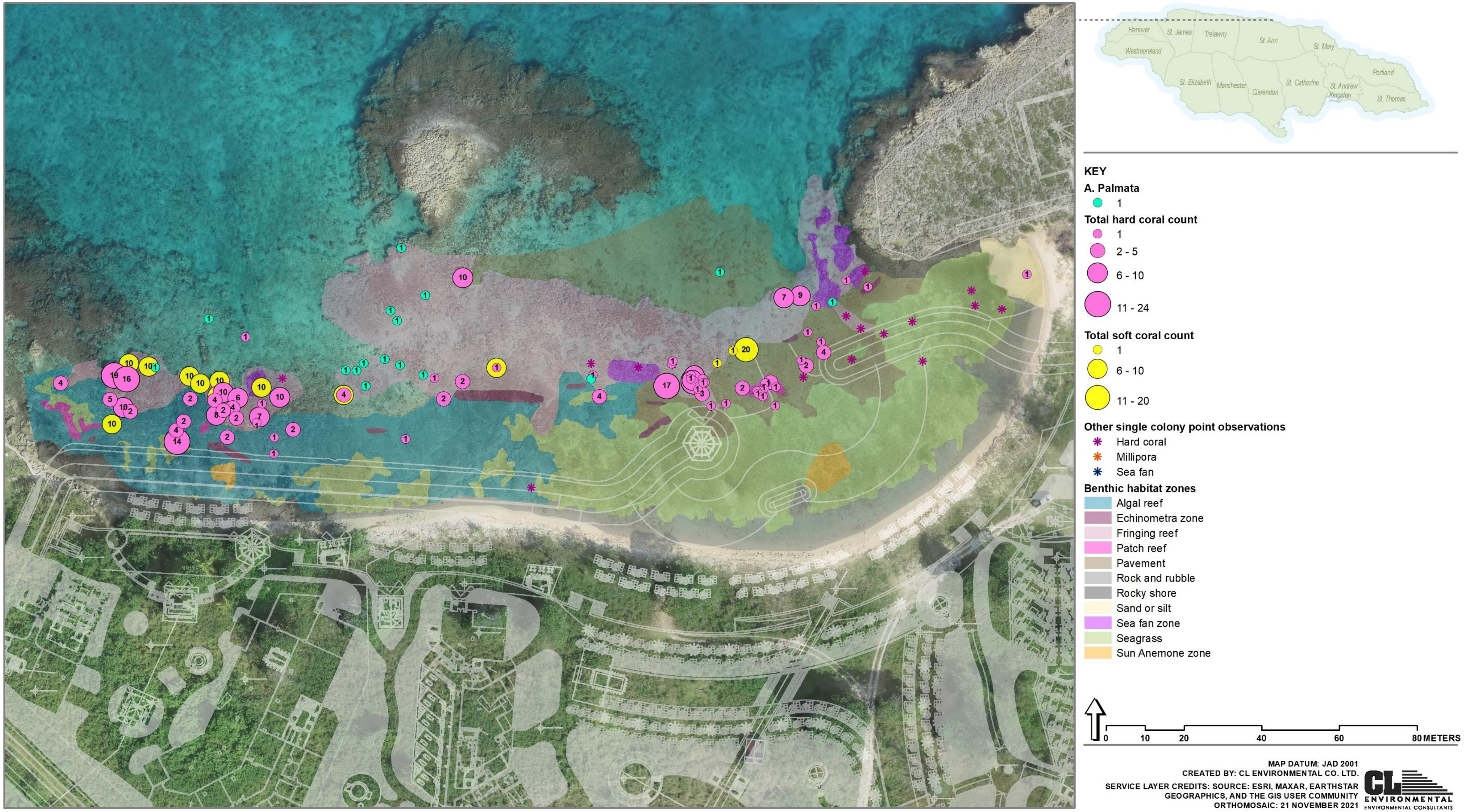


Figure 5-78 Hard and Soft Coral Community in the West Bay

Species found with the west bay are given in Table 5-38.

Table 5-38 Benthic species seen in the West Bay

CORAL	
SOFT CORAL	
Common Name	**Scientific Name**
Common Sea Fan	Gorgonia ventalina
HARD CORAL	
Common Name	**Scientific Name**
	Agaricia spp.
Elkhorn Coral	Acropora palmata
Finger Coral	Porites porites
Golfball Coral	Favia fragum
Great Star Coral	Montastraea cavernosa
Knobby Brain Coral	Pseudo diploria clivosa
Lobed Star Coral	Orbicella annularis
Massive Starlet Coral	Siderastrea siderea
Mustard Hill Coral	Porites astreoides
Smooth Brain Coral	Pseudo diploria strigosa
Thin Finger Coral	Porites divaricata
HYDROCORAL	
Common Name	**Scientific Name**
Branching Fire Coral	Millepora alcicornis
Blade Fire Coral	Millepora complanata
ANEMONE	
Common Name	**Scientific Name**
Cork Screw	Macrodactyla doreensis
Knobby Anemone	Ragactis lucida
Sun Anemone	Stichodactyla helianthus
Tube Dwelling Anemone	Cerianthus membranaceus
ECHINODERM	
Common Name	**Scientific Name**
BRITTLE STAR	
Brittle Star	Ophioderma sp
Inflated Sea Biscuit	Clypeaster rosaceus
SEA CUCUMBER	
Brown Sea Cucumber	
Three-Rowed Sea Cucumber	Isostichopus badionotus
SEA STAR	
Common Comet Star	Linckia guildingii
Cushion Sea Star	Oreaster reticulatus
SEA URCHINS	
Long-Spined Urchin	Diadema antillarum
Reef Urchin	Echinometra viridis
Rock Boring Urchin	Echinometra lucunter lucunter
Slate-Pencil Urchin	Eucidaris tribuloides
West Indian Sea Egg	Tripneustes ventricosus

Examples of various habitat seen in the west bay are given in Plate 5-36 - Plate 5-45.

Plate 5-36 Section of the algal reef

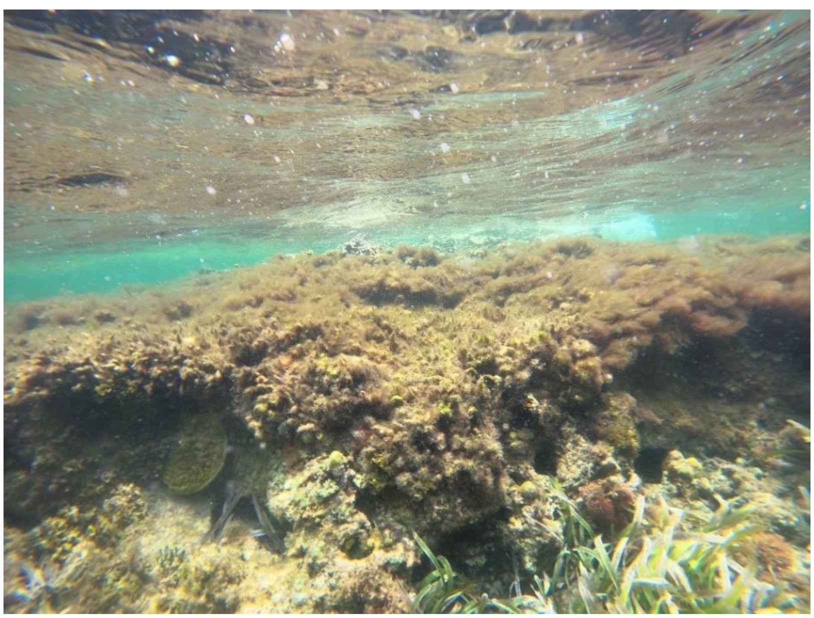


Plate 5-37 Section of the reef crest dominated by algae.

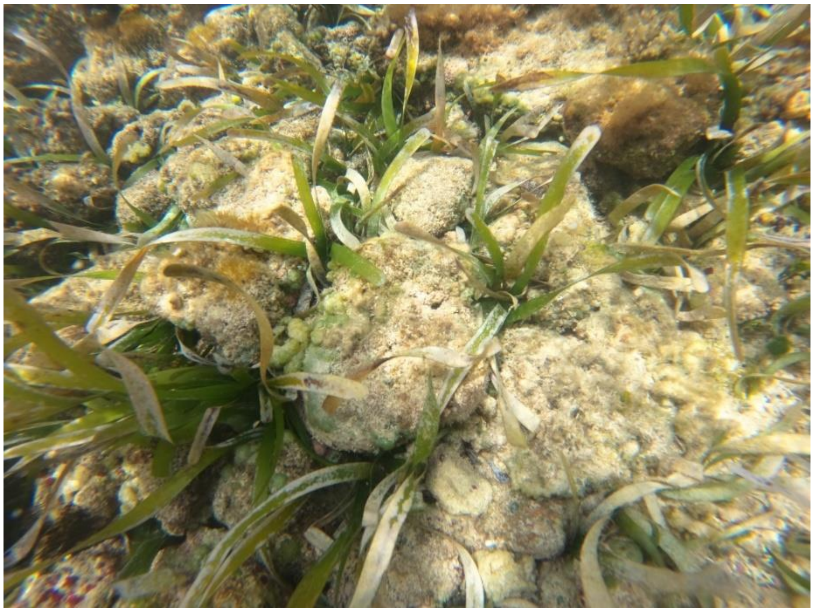


Plate 5-38 Seagrass in rock and rubble

Plate 5-39 Large Pseudodiploria colony

Plate 5-40 Millepora on pavement

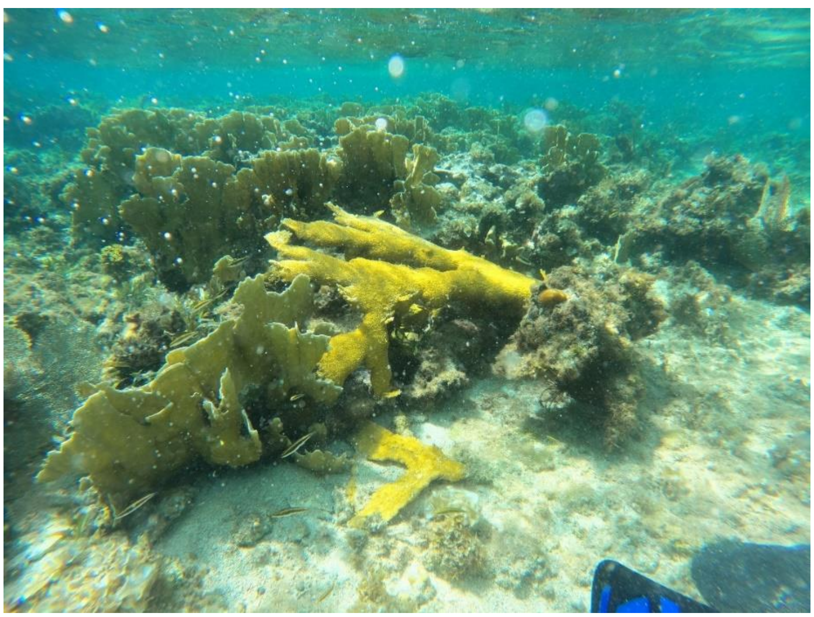


Plate 5-41 Recently topples *A. palmata*

Plate 5-42 Section of pavement

Plate 5-43 Dense, consolidated *P. divaricata* in seagrass

Plate 5-44 Dense, consolidated *P. divaricata* in seagrass

Plate 5-45 Sun anemone zone

WEST BAY SEAGRASS

The marine vegetative community within the western bay at Richmond Cay is dominated by sparse stands of the seagrass *Thalassia testudinum* in a rock and rubble substrate.

With a characteristically shallow depth profile in comparison to the east bay, the seagrasses present within western bay experiences spatial limitations for growth and development. As a result, low growth parameters are experienced here as these plants are forced to operate efficiently under habitat circumstances. In comparison to the eastern bay, the western bay seagrasses are seen to possess much smaller blade length, width and shoot density values with an overall low percentage cover.

The total area of mapped Thalassia was 3935.7 m^2 (Figure 5-79). However, the average percentage cover for the West Bay was 60%, thus the total seagrass area was 2361.4 m^2.

The amount of carbon stored within the substrate is highly dependent on its composition and stability. Where large amounts of organic inputs are present (whether through faunal contributions, outputs from nearby streams and rivers, proximity to mangrove ecosystems or the trapping of organic matter due to dense grasses and a lack of flushing), substrate carbon values tend to be increased. Sediment composition and stability will determine the ability of seagrasses to trap and store carbon continuously. Coarse sandy sediment is typically loose and therefor more prone to displacement by moderate wave activity in comparison to mud and silty sediments which are more likely to be held together. Within areas dominated by pavement a reduced amount of carbon is expected as trapping of substrate is limited. Of less significance are sources of particulate inorganic carbon which are unable to be reincorporated into the ecosystem. Particulate inorganic carbon may be present as rock, coral rubble and shells which tend to have a significantly lower blue carbon contribution.

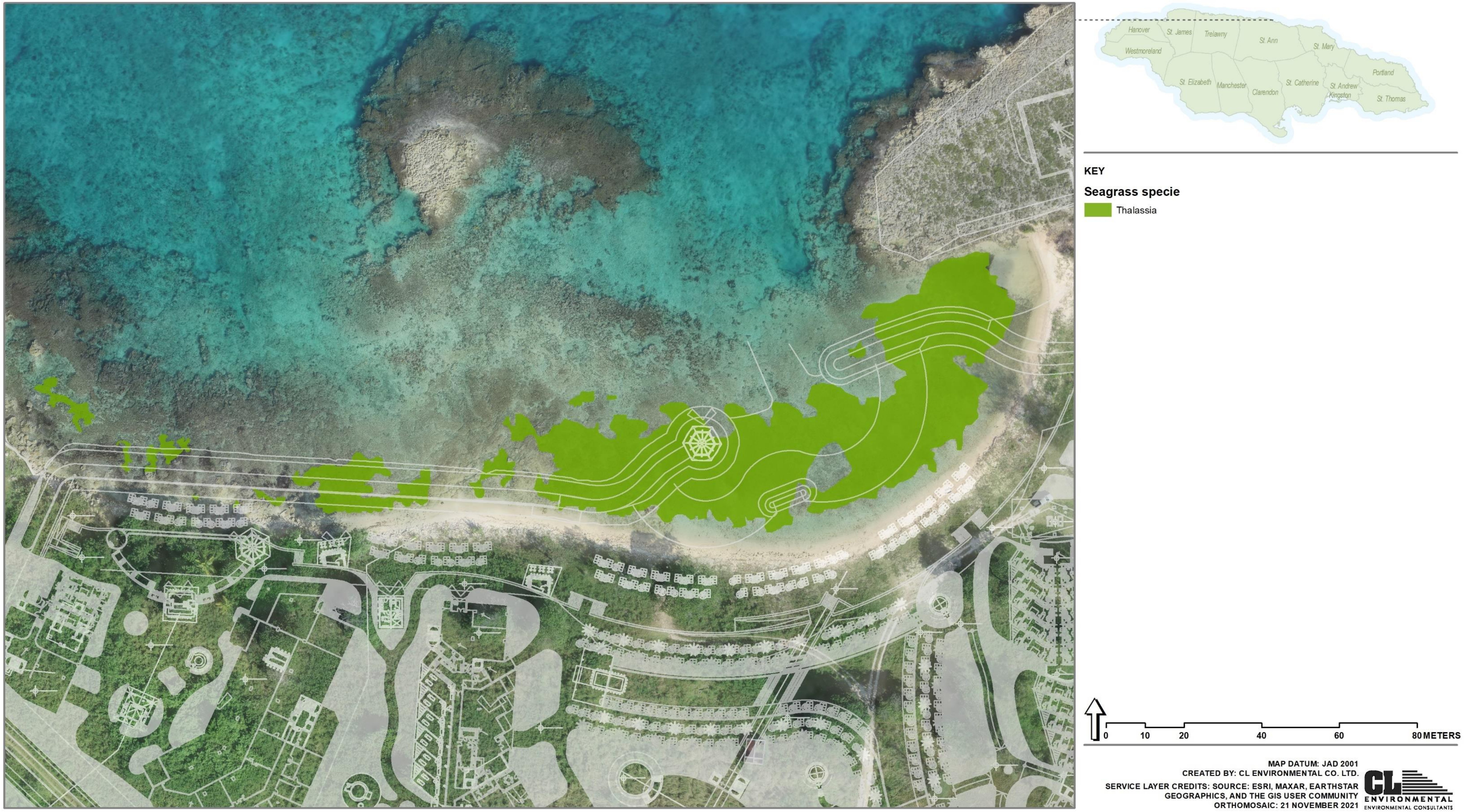


Figure 5-79 Mapped Seagrass in the West Bay

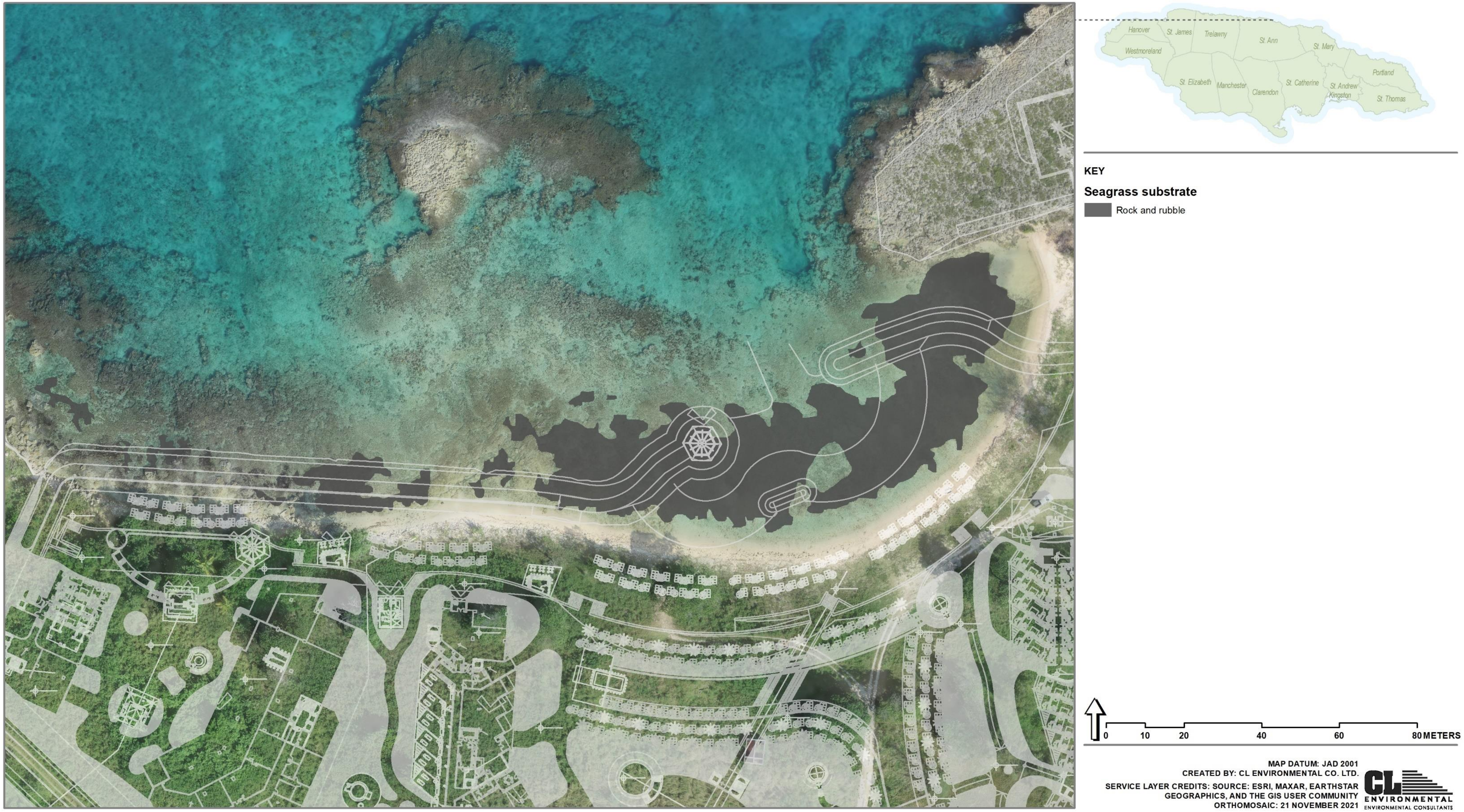


Figure 5-80 Seagrass substrate composition in the west bay

Carbon Sequestration

Across the dataset for carbon sequestration results taken within the west and east bay, seagrass vegetative component parameters were higher within the east bay area. Within the east bay, a total vegetative carbon storage value of 1.03MgC derived from core analysis was found along with a soil carbon value of 32.83 MgC. The west bay yielded a total vegetative carbon value of 0.28 MgC with an associated soil carbon value of 14.52 MgC. Individual values for each parameter collected per site can be seen in the section below.

VEGETATION COMPONENT

Among the sites which were assessed it was determined that the site with the highest blade density was R1 which had a total of seventeen (17) blades while the site with the lowest blade density was R5 which had a total of five (5) blades retrieved within the corer (Figure 5-81).

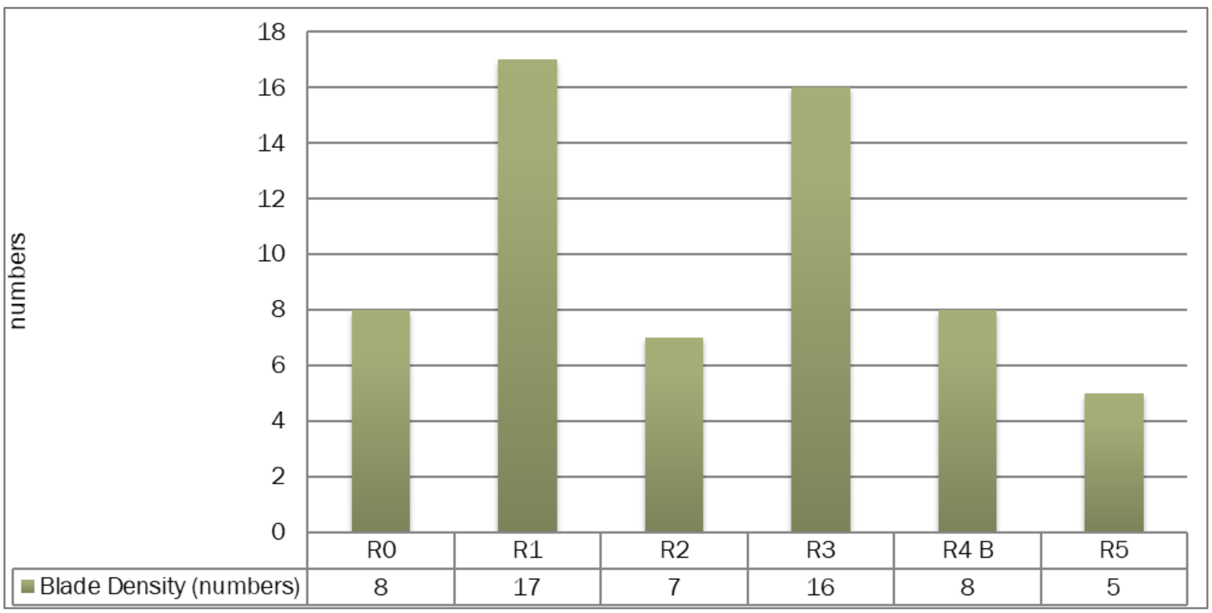


Figure 5-81 Blade density (numbers) seagrasses collected in core samples per site within Richmond Cay

Values for mean blade length ranged between ten and 15 centimetres with the highest mean blade length being found at R4 B while the lowest length was located at R3 (Figure 5-82).

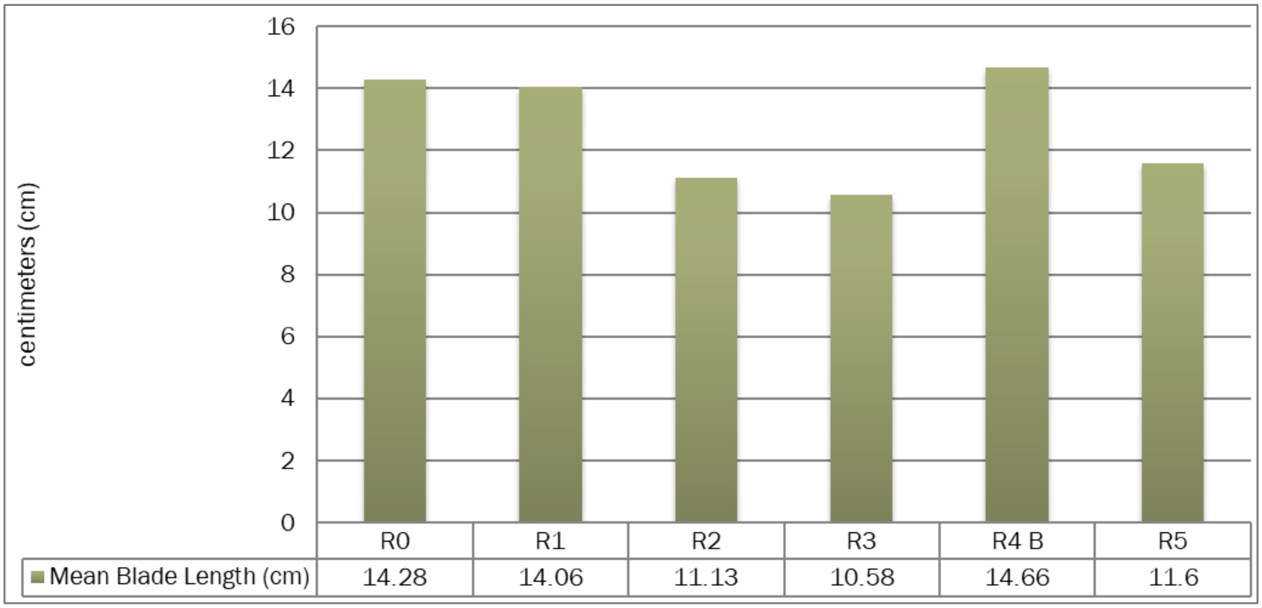


Figure 5-82 Mean blade length (cm) of seagrasses collected in core samples per site within the Richmond Cay

Mean blade widths ranged from 0.55 centimeters which was seen at R0 to 1.01 centimeters recovered at R3 (Figure 5-83).

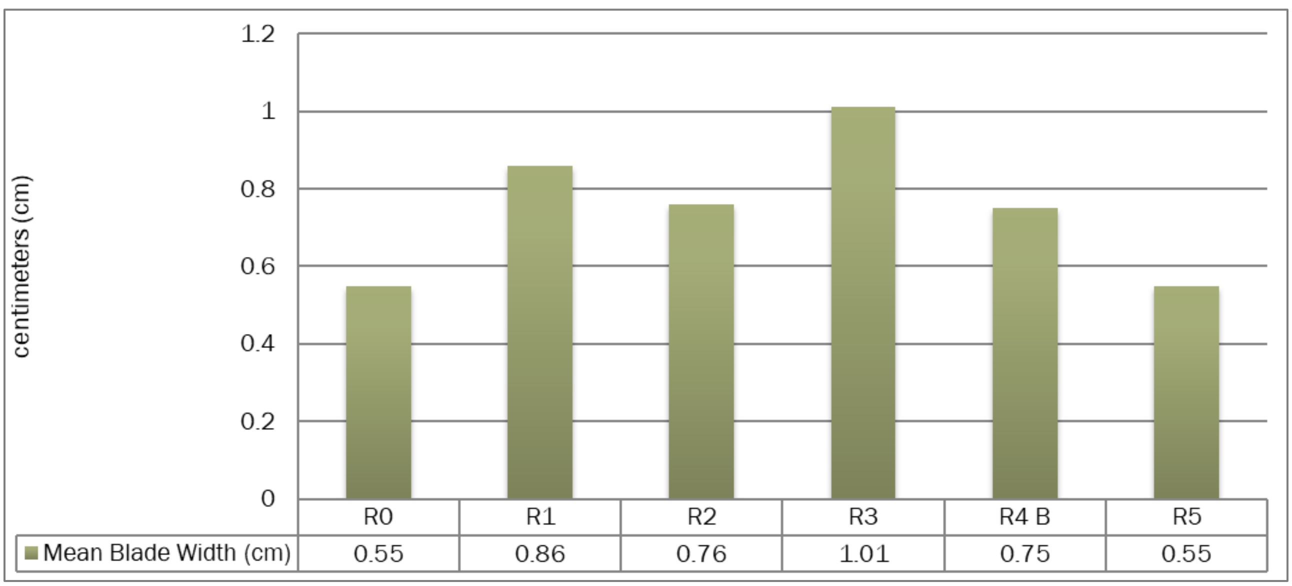


Figure 5-83 Mean blade width (cm) of seagrasses collected in core samples per site within the Richmond Cay

Mean above ground wet weight between sites varied between 9.1grams (R1) and 1.8grams (R2) (Figure 5-84).

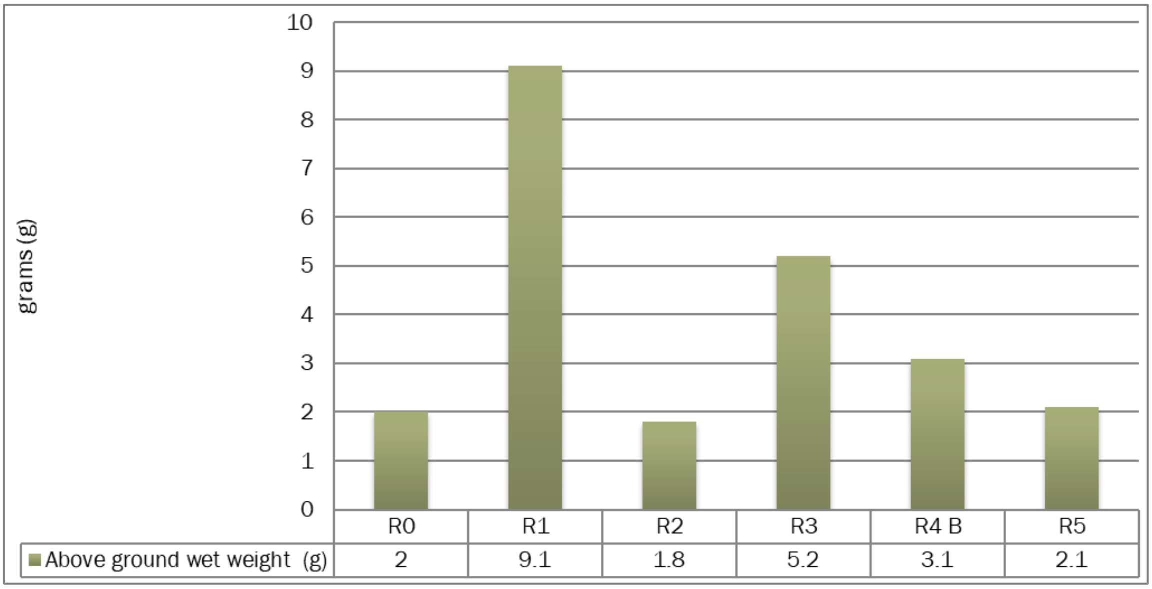


Figure 5-84 Above ground wet weight (g) of seagrasses collected in core samples per site within the Richmond Cay

Epiphyte weight refers to the weight of the epiphytes present on the collected seagrass blades retrieved in the corer. This varied between 0 grams at R0 and 2.8 grams at R1 as seen in (Figure 5-85).

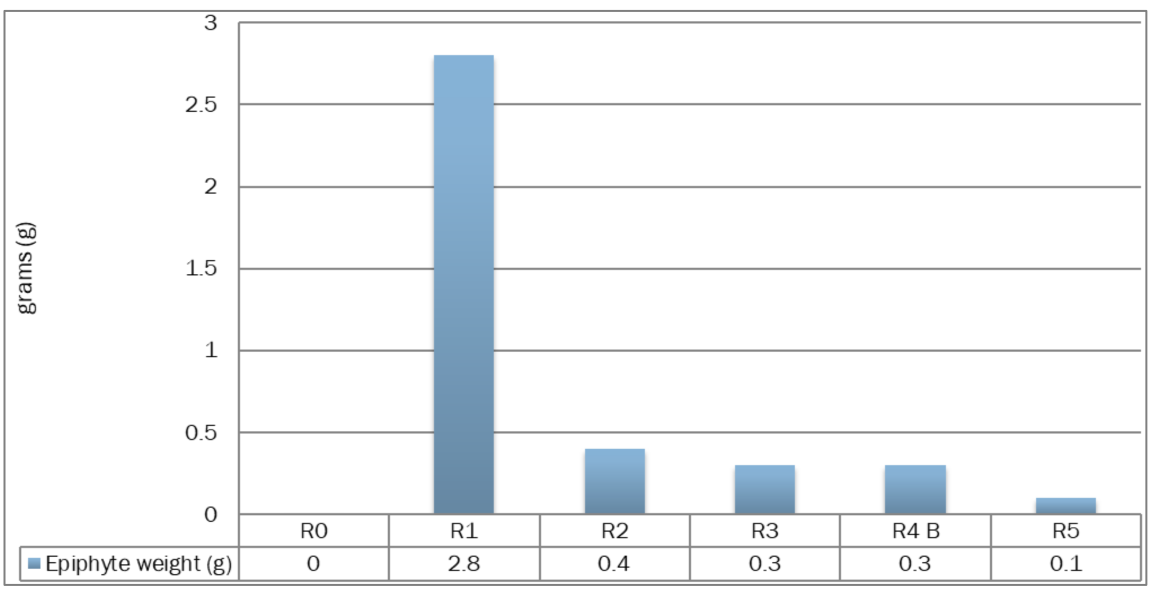


Figure 5-85 Epiphyte weight (g) of seagrasses collected in core samples per site within the Richmond Cay

Of the below ground dry weights seen, R1 was found to have the largest weight of 0.9 grams. This was followed by R3, R4B, R2, R0 and R5 respectfully (Figure 5-86).

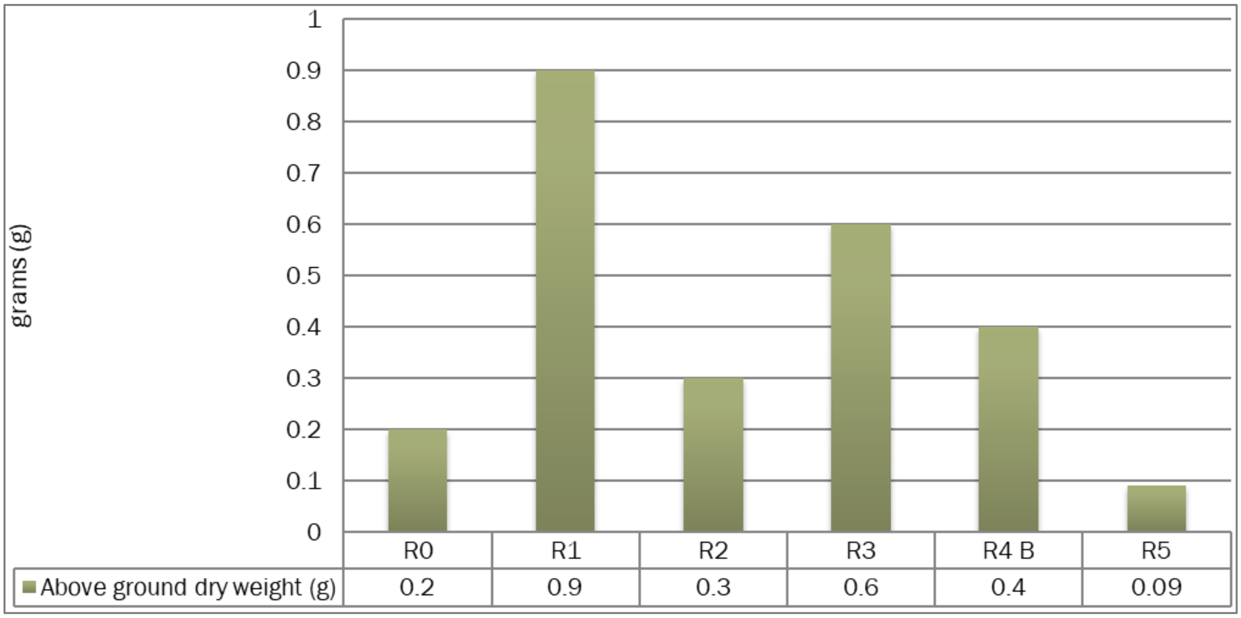


Figure 5-86 Above ground dry weight (g) collected in core samples per site within the Reading Pen peninsula.

Below ground wet weight refers to the weight of the root and rhizome layer collected within each core before the drying process. This was seen to vary between sites with the highest weight being present at R5 with a total weight of 333 grams. This was followed by R1, R3, R0, R2 and R4B (Figure 5-87).

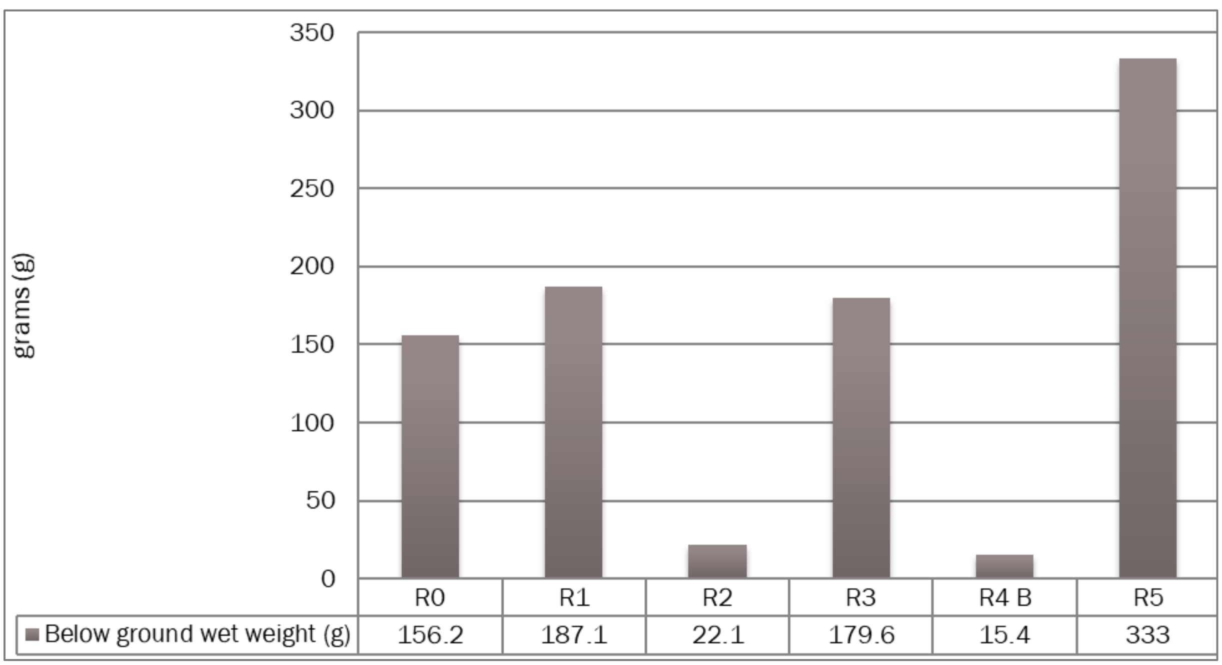


Figure 5-87 Below ground wet weight (g) collected in core samples per site within the Richmond Cay

According to the data below ground dry weight, much like below ground wet weight was highest at R5 and lowest at R4B (Figure 5-88).

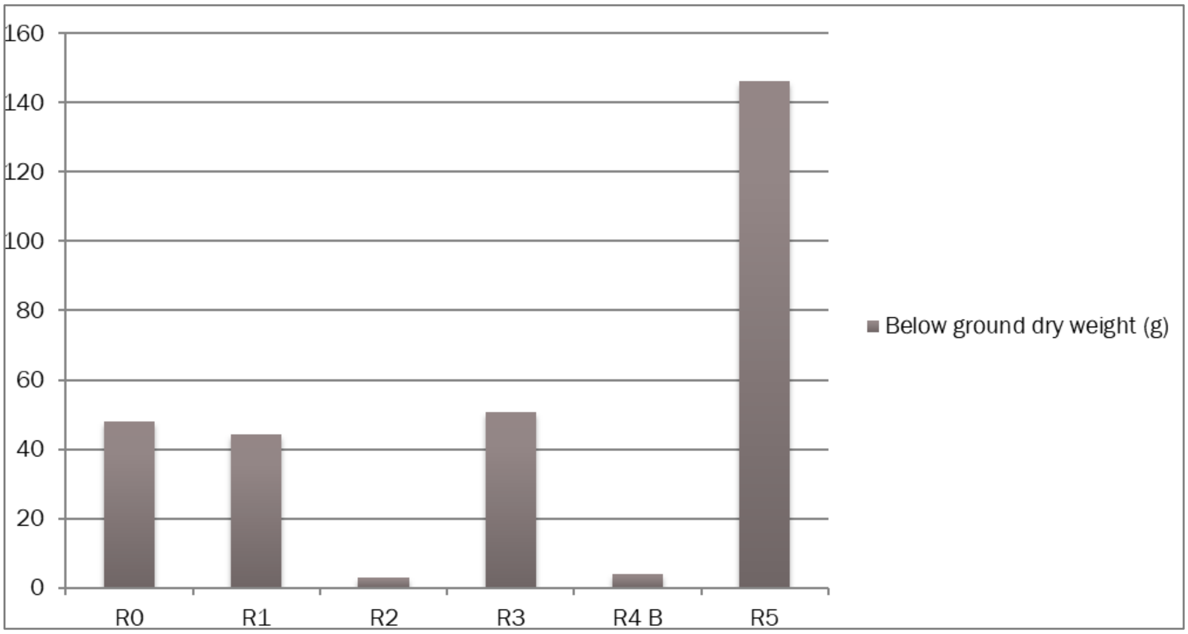


Figure 5-88 Below ground dry weight (g) collected in core samples per site within Richmond Cay

CARBON RESULTS

According to analysis conducted on the samples for each site, the highest carbon value within the shoot component of the seagrasses collected was seen at R2. This was followed by R4, R3, R0, R1 and R5 respectively (Figure 5-89).

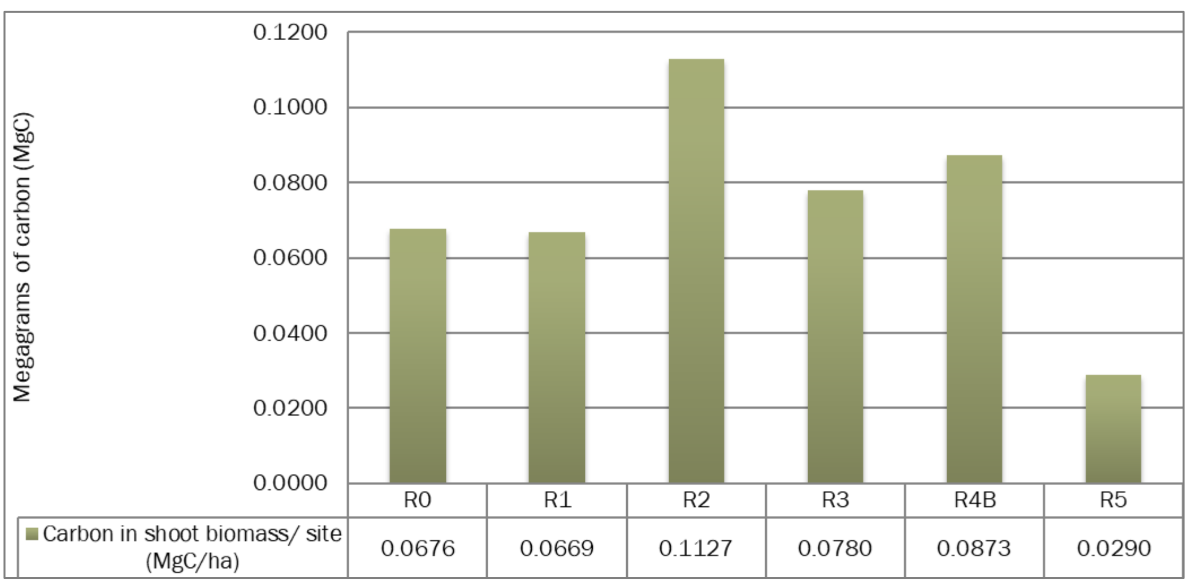


Figure 5-89 Carbon in shoot biomass (MgC/ha) per site within the Richmond Cay

Within the root and rhizome matrix, it was seen that carbon values are highest at R5, the site having the highest root biomass. This was followed by R0, R3, R4B, R1 and R2 (Figure 5-90).

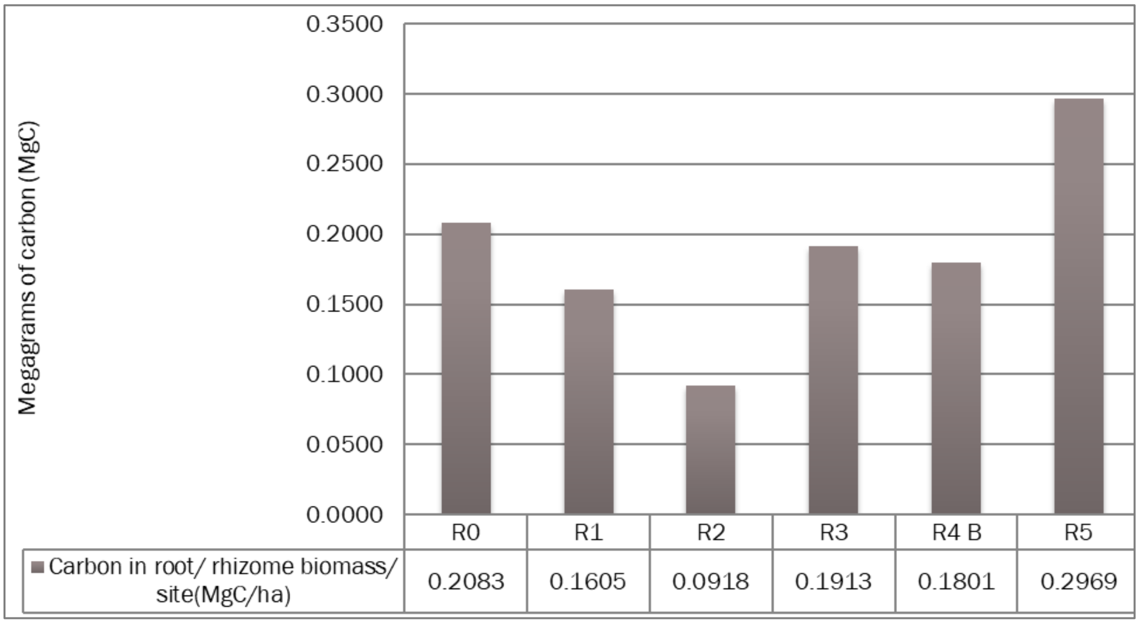


Figure 5-90 Carbon in root/rhizome biomass (MgC/ha) collected in core samples per site within the Richmond Cay

SOIL COMPONENT

Total values for soil carbon content indicated that the near shore sites R0 and R5 possessed the highest carbon values while the lowest values were seen at R2 and R1 respectively (Figure 5-91).

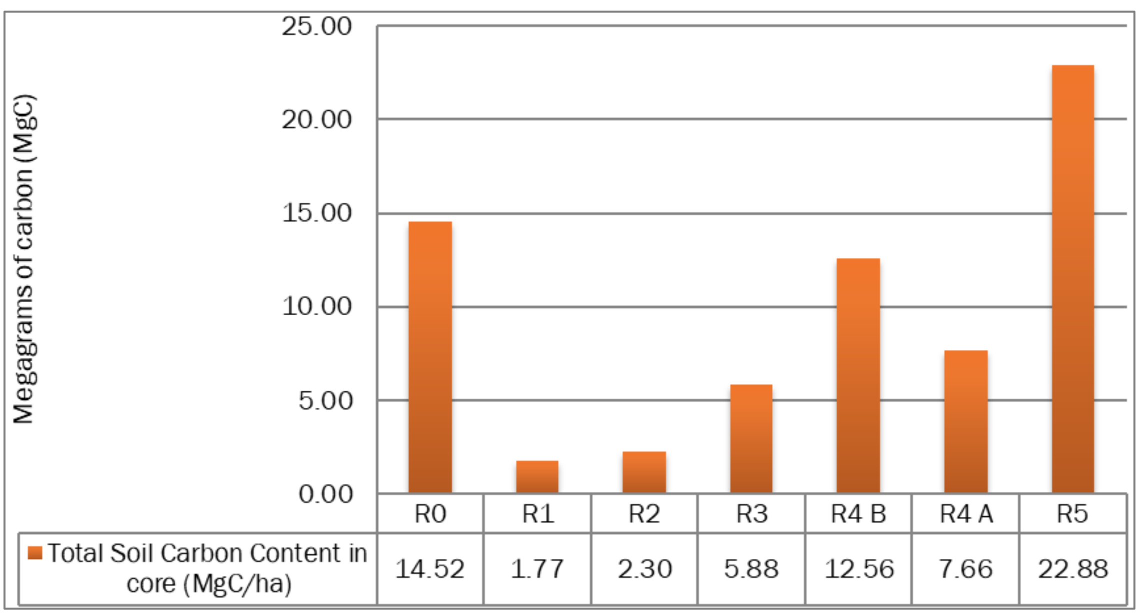


Figure 5-91 Soil carbon content per site (MgC/ha) collected in core samples within the Richmond Cay

Shoot Analysis

Blade density found within the west bay (R0) amounted to eight (8) blades, a relatively low number in comparison to the entire dataset. Though blade densities were seen as relatively low, average blade lengths within the western bay remained competitive at 14.28cm, second only to one site within the eastern bay (R4B). Low blade densities within this region may be as a result of physical conditions such as constant influences of run-off, predation and associated biota within this area as well as hydrodynamic influences. Characterized by shallow depths, the western bay and its associated seagrass may often suffer pressures from wave activities. This wave activity though reduced by the bays' eastern rocky shore may still result in losses of seagrass biomass as grasses here are vulnerable due to predatory pressures by herbivorous fauna as well as desiccation caused by high ultraviolet exposure.

A measure of seagrass abundance along depth gradients, seagrass biomass is the weight of seagrasses per square meter (measured as fresh weight, dry weight, or ash-free dry weight). This measure may either refer to the seagrasses overall biomass or their aboveground biomass (Borum, et al., 2004). The exposed or above ground seagrass blades are the plant's most delicate component. Due to high wave intensities, human activity, and grazing by a variety of marine species, these blades frequently break (Short , et al., 2016). As a result, the physical and biological aspects of their surroundings constantly influence the shoot biomass of seagrass ecosystems. This parameter is therefore very dynamic depending on prevalent physical and biological conditions.

Shoot biomass within the western bay was the third lowest of all samples collected for vegetative parameters and amounted to 0.00199g. Seagrass shoot biomass is constantly influenced by the physical and biological aspects of their surroundings. This parameter is therefore very dynamic depending on prevalent conditions. Though seagrasses within the western bay are more protected from wave activity, their patchy distribution, high numbers of grazing fauna, constant exposure to ultraviolet waves and coarse substrate may result in the biomass value seen. As mentioned earlier high light intensities increases the vulnerability of seagrasses to breakage as a result of desiccation. Decreased surface area of blades as a result of feeding pressures will also lead to breakages of seagrasses as persistent wave activity occurs. Lastly substrate has a major role to play in seagrass stability. Where coarse sand substrate is prominent, grasses may have a hard time remaining rooted and as a result may become dislodged from the substrate and carried elsewhere. This bed may therefore under persistent high wave activity continue to deteriorate due to these factors.

Core carbon values within the shoot component of seagrasses collected within the western bay amounted to 0.0676MgC, the third lowest of the samples taken at Richmond Cay. A direct relation to biomass, shoot carbon values will give an indicator of the efficiency at which a bed is operating under prevailing factors. However, this parameter cannot be used as a stand-alone value to describe a seagrass beds storage efficiency. Above ground components being constantly altered by grazing and breakage though important, only give a partial estimate of a bed's capability. Root as well as soil carbon analysis will provide the additional information needed to assess any seagrass area.

Using carbon values from samples collected within the western bay, a total shoot carbon storage of 0.0266 MgC/ha was estimated for the western bay seagrass area (Table 5-39). This was the highest of all total estimates within the project area. Values seen here reflect the vast area of seagrasses present within this sheltered bay and may be owing to the reduced hydrodynamic activity that this bed experiences.

Table 5-39 Total shoot carbon stored (MgC/ha) in the West Bay project area.

West Bay	
SITE	Total Carbon Stored in Shoot in Project Area (MgC/ha)
R0	0.0266

Root Analysis

Root analysis indicated a biomass of 0.0061g and a root carbon value of 0.2083MgC. Values here in comparison with the full dataset indicated that R0, located within the western bay has conditions which are suitable for greater carbon storage. Root biomass within the western bay was the second highest of all samples collected at Richmond Cay. The sheltered nature of this area despite its coarse substrate may allow for easier establishment of roots compared to the eastern bay which receives greater pressures from hydrodynamic activity and posses' larger benthic obstructions. In addition, under depth limitations within the western bay, seagrasses may allocate resources accordingly to below ground components rather than maintain vertical growth in order to survive. Much like the relationship between shoot biomass and carbon values, root components will follow the same trend. Where a loss in root biomass is seen a subsequent loss in carbon storage will be evident.

Estimated total root carbon values within the west bay indicated that a total of 0.082 MgC/ha is stored within the seagrass beds here (Table 5-40). This is reflective of core carbon values as this area is also seen to store the highest value of total root carbon of all sites within the project area.

Table 5-40 Total root carbon stored (MgC/ha) in the West Bay project area.

West Bay	
SITE	Total Carbon Stored in Root in Project Area (MgC/ha)
R0	0.082

Soil Analysis

Dry bulk density, which is determined by the mass of a fully dried sample and its original volume, often indicates prominent soil components, including differences between organic and inorganic components. Texture, colour, weight, and the contents of these dried samples are frequently used to determine this. Within the western bay, soil samples were darker in nature with a mixture of sand and silt along with a few uninhabited shells which may indicate higher organic input within this area. Within the western bay, dry bulk density reflected a value of 0.834g/cm^3. This was the second highest value of the samples collected at Richmond Cay.

Carbon storage in sediments is determined by several factors, including sediment stability, associated root components of seagrasses present in the area, proximity to rivers and manmade outflows and the nature and level of disturbances present. Soil carbon calculations from cores taken within the western bay indicated a value of 14.518 MgC and was the second highest soil carbon value. Being near shore, inputs associated with human activity as well as its sheltered nature result in the accumulation as well as decreased potential of the movement of organic matter further along the coastline by wave activity. This may be coupled with its observed diverse faunal community which may further support high carbon values found as a result of constant organic inputs. Removal of these meadows may therefore result in habitat fragmentation and species displacement, physical changes to the coastline as habitat functions become interrupted, coastal erosion features will become more prominent as well as the removal of existing and productive carbon sinks.

Within the west bay project area, estimated total soil carbon values indicated that approximately 5.71 MgC/ha is stored here (Table 5-41). Based on these results, the west bay possesses the highest total soil carbon of all sites within the project area. This may be due to the factors discussed earlier regarding its sheltered nature, reduced chances of flushing and proximity to outputs from nearby terrestrial habitat.

Table 5-41 Total soil carbon within the West Bay project area

West Bay	
SITE	Total Soil carbon in Project Area (MgC/ha)
R0	5.71

Plate 5-46 Seagrass in pavement

Plate 5-47 Patchy distribution of seagrass

West Bay Fish

Fish density within the Western Bay was low, of the eighteen species identified, the most common were Blue Tang (*Acanthurus coeruleus*), Doctorfish (*Acanthurus chirurgus*), Stripped Parrotfish (*Scarus iserti*), Bluehead Wrasse (*Thalassoma bifasciatum*) and Slippery Dick Wrasse (*Halichoeres bivittatus*).

Roving surveys were conducted both outside and within the Western Bay. All fish species encountered were recorded and relative abundance noted. Abundance was scored with the following parameters in mind: Single (1) Few (2-10) Many (11-100) and Abundant (>100). The survey area can be seen below in Figure 5-101.

A total of eighteen species (18) were identified within the western bay (Table 5-42), however of the eighteen identified species, they were most commonly identified as single individual, with no species being abundant. Fish density within the Western Bay, is in general was low. No top predator species such as Barracuda, or invasive lionfish were observed during the Western Bay roving survey.

Table 5-42 Species richness - Western Bay

Common Name	Scientific Name	Code
Blackbar Soldierfiesh	*Myripristis jacobus*	F
Blue Tang	*Acanthurus coeruleus*	M
Butterflyfish - Foureye	*Chaetodon capistratus*	F
Butterflyfish - Spotfin	*Chaetodon ocellatus*	S
Damselfish - Beaugregory	*Stegastes leucostictus*	F
Damselfish - Dusky	*Stegastes adustus*	F

Common Name	Scientific Name	Code
Damselfish - Threespot	*Stegastes planifrons*	S
Damselfish - Yellowtail	*Microspathodon chrysurus*	F
Doctorfish	*Acanthurus chirurgus*	M
Hamlet - Indigo	*Hypoplectrus indigo*	S
Jack - Bar	*Caranx ruber*	F
Parrotfish - Redband	*Sparisoma aurofrenatum*	S
Parrotfish - Striped	*Scarus iserti*	M
Sharpnose Puffer	*Canthigaster rostrata*	S
Spotted Goatfish	*Pseudupeneus maculatus*	S
Wrasse - Bluehead	*Thalassoma bifasciatum*	M
Wrasse - Rainbow	*Halichoeres pictus*	S
Wrasse - Slippery Dick	*Halichoeres bivittatus*	M

5.2.4.3 Eastern Bay

East Bay Habitats

The eastern bay is a large back reef lagoon with extensive seagrass beds and a fringing reef system, some rocky shore and a sandy beach. Similarly, to the west bay the fringing reef has dense areas of seafans and several *A. palmata* colonies. Unlike the west bay, the eastern bay has an extensive seagrass bed, in addition to the vegetative components, other similar habitats include reef crest/patch reef areas, the *Echinometra* zone, bare pavement and areas with rock and rubble. Areas of pavement within the bay consisted of encrusting species of *Millipora, Siderastrea, Pseudodiploria, Porites asteriodes.* The varying substrate type within this large area results in various sub habitats, such as patch reefs within the seagrass bed. While areas with silty substrate were seen to have lower species diversity. Hard corals can be found in within most habitat types of the bay in varying size classes and density. However, areas with high levels of soft and silty substrate had no hard corals present. Colonisation on most patch reefs seen in this area tends to be low, likely due to the heavy wave action in more exposed and shallow areas.

A total of 18 A. palmata colonies and an additional 61 large hard corals (>10cm) were mapped.

A total of 21761.1m^2 of seagrass was mapped.

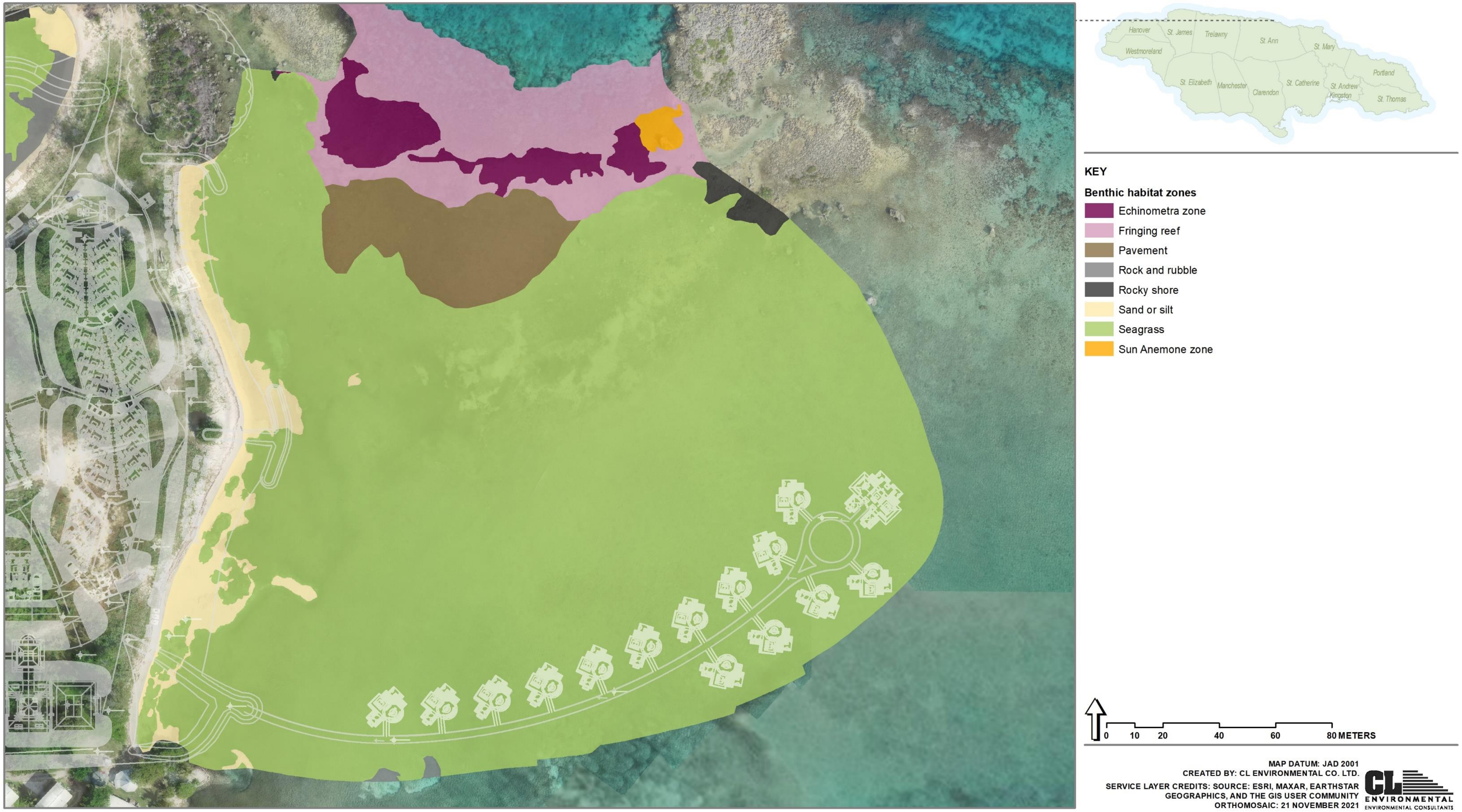


Figure 5-92 East Bay Habitat Map

EAST BAY SPECIES COMPOSITION

Habitat composition within the east bay is similar to the west, however over a much larger area, giving rise to sub habitats. The main estimated habitats are given in Table 5-43.

Table 5-43 Estimated East Bay Habitat Areas

Benthic zone	Eastern bay (m^2)
Echinometra zone	1618.8
Fringing reef	5145.3
Pavement	2701.6
Rock and rubble	77.7
Rocky shore	327.2
Sand or silt	2113.2
Seagrass	44510.7
Sun Anemone zone	201.7
Estimated surveyed/mapped area	**56696.2**

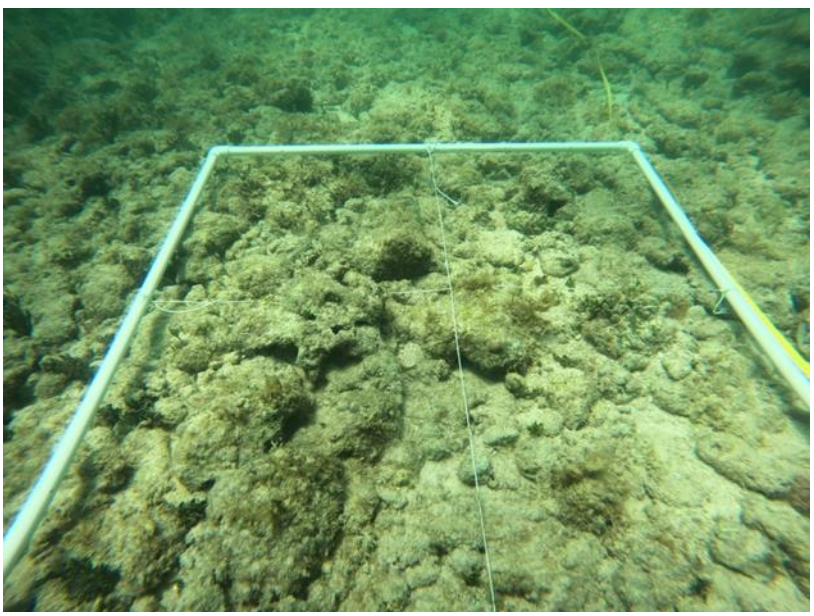


Plate 5-48 Quadrat in Rock and Rubble

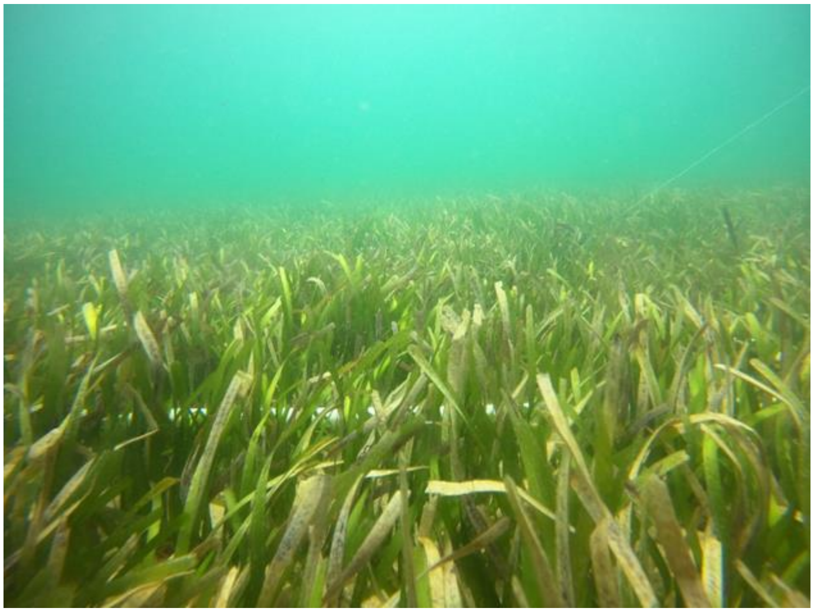


Plate 5-49 Dense seagrass in the east bay

Plate 5-50 Shallow section of the seagrass bed

Plate 5-51 Seagrass bordered by rock and rubble in the east bay

EAST BAY CORAL COMMUNITY

18 A. *palmata* colonies and an additional 61 >10cm hard corals were mapped in the west bay. All coral mapped were 10cm or larger. Many corals and fire corals could not be mapped due to wave action and their location in very shallow or hazardous areas of the fringing reef. Dense areas of seafans were seen along the submerged sections of the Ironshore and reef areas. Further away from the shore, 6, belt transects (Figure 5-93) were used to estimate species composition and density of larger coral colonies and patch reefs. Roving surveys were also used to record larger coral colonies All hard and Soft Coral mapped are shown in Figure 5-94.

Similar to the west bay, several random quadrats were tossed throughout the nearshore seagrass beds, in order to estimate species density and distribution. All corals recorded in quadrat data were less than 10cm. Plate 5-48 - Plate 5-51 are examples of substrate and habitat in the east bay.

Table 5-44 Estimated species per m^2 for each Habitat

Coral <10 cm per m^2				Urchins per m^2
Habitat	*Siderastrea sp.*	*Porites divaricata*	*Gorgonia ventalina*	*Echinometra*
Seagrass	3	13	4.3	0
Pavement	4.5			15

Belt transect data was used to estimate species composition and distribution of project areas further into the bay.

P. divaricata estimates were calculated based on percentage cover in each belt transect. From the transect data approximately **1.42%** of the 740m^2 of sample area contains *P.divaricata*. which is equivalent **10.5m^2 of coral cover.**

Table 5-45 Coral Colonies per m^2

Coral >10cm per m^2	
Siderastrea sp.	11.67
Porites astreoides	2.3
Millepora sp	5.5
Gorgonia ventalina	13.3
Agaricia sp	0.67
Pseudodiploria clivosa	2
Orbicella Annularis	0.17

Figure 5-93 Belt transects in the East Bay

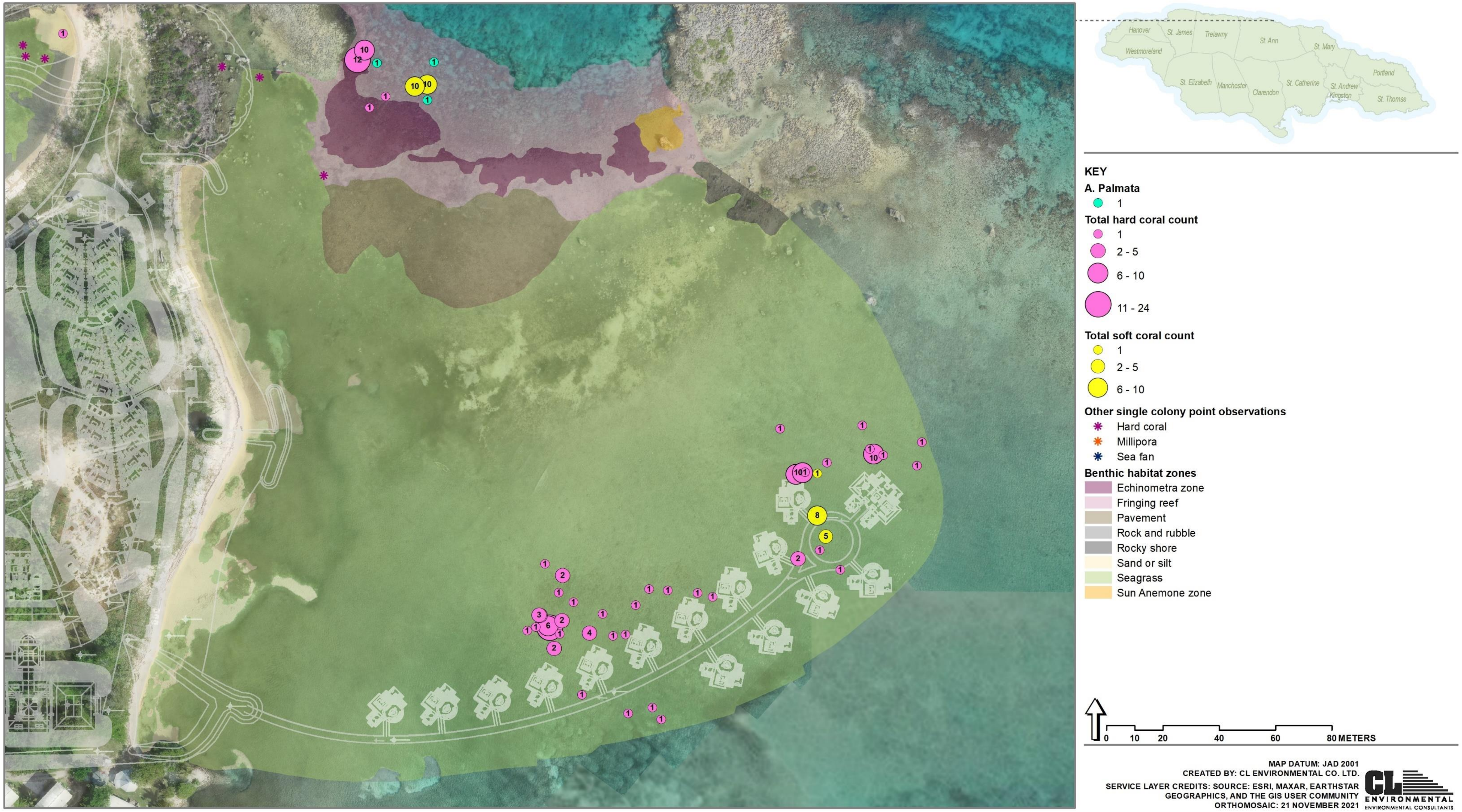


Figure 5-94 Hard and Soft Coral Community in the East Bay

Much of the backreef coral community is composed of small colonies in seagrass and pavement communities. Larger colonies are found on patch reefs or as standalone colonies. Notable feature of the east bay coral community includes dense consolidated colonies of *Porites divaricata*. These form dense clusters throughout sections of the seagrass bed. Plate 5-52 - Plate 5-55 give examples of the coral community in the east bay.

Plate 5-52 Collection of consolidated P. *divaricata*

Plate 5-53 Example of a small patch reef within the eastern bay

Plate 5-54 Species encrusting on coral rubble.

Plate 5-55 *Pseudodiploria* encrusting on rubble.

Table 5-46 gives species seen in the east bay.

Table 5-46 East Bay Species List

CORAL	
SOFT CORAL	
Common Name	**Scientific Name**
Common Sea Fan	*Gorgonia ventalina*
HARD CORAL	
Common Name	**Scientific Name**
	Agaricia spp.
Elkhorn Coral	*Acropora palmata*
Finger Coral	*Porites porites*
Golfball Coral	*Favia fragum*
Great Star Coral	*Montastraea cavernosa*
Knobby Brain Coral	*Pseudodiploria clivosa*
Lobed Star Coral	*Orbicella annularis*
Massive Starlet Coral	*Siderastrea siderea*
Mustard Hill Coral	*Porites astreoides*
Smooth Brain Coral	*Pseudodiploria strigosa*
Thin Finger Coral	*Porites divaricata*
HYDROCORAL	
Common Name	**Scientific Name**
Branching Fire Coral	*Millepora alcicornis*
Blade Fire Coral	*Millepora complanata*
ECHINODERM	
Common Name	**Scientific Name**
BRITTLE STAR	
Brittle Star	*Ophioderma sp*
SEA BISCUIT / SAND DOLLAR	
Inflated Sea Biscuit	*Clypeaster rosaceus*
SEA CUCUMBER	
Brown Sea Cucumber	
Three-Rowed Sea Cucumber	*Isostichopus badionotus*
SEA STAR	
Common Comet Star	*Linckia guildingii*
Conical Spined Sea Star	*Echinaster sentus*
Cushion Sea Star	*Oreaster reticulatus*
SEA URCHINS	
Long-Spined Urchin	*Diadema antillarum*
Reef Urchin	*Echinometra viridis*
Rock Boring Urchin	*Echinometra lucunter lucunter*
Slate-Pencil Urchin	*Eucidaris tribuloides*
Variegated Urchin	*Lytechinus variegatus*
West Indian Sea Egg	*Tripnuestes ventricosus*

EAST BAY SEAGRASS

Additional benthic parameters such as substrate type within the east bay include bare sand along the coastline with noticeable transitions into pavement, rock and rubble, coral (dense Porites divaricata) and sand dominated areas projecting further offshore. Benthos within the eastern bay may be categorized into four zones: rock and rubble, seagrass, sand and rubble, seagrass and sand and pavement.

Plate 5-56 Aerial image of the east bay and fringing reef

Plate 5-57 Aerial image of the east bay

The dominant vegetative type within the eastern bay is the seagrass *Thalassia testudinum* which occupies 21,218.4 square meters. Additional seagrasses found in the eastern bay include stands of *Halodule wrightii* (542.7 m^2). (Table 5-47). These seagrasses are present in various densities throughout the bay and may be associated with dominant substrate types and physical limitations within their environment. Along the westmost coastline of the east bay, seagrasses are present in dense mats within silt and sandy substrate, progressing further east along the coastline these Thalassia stands are joined by the sand and nearshore inhabiting seagrass *Halodule wrightii*. This species is present in isolated beds towards the boundary of the project area. Though the eastern bay possesses a greater depth profile in comparison to the west bay, an extensive shallow backreef which receives high hydrodynamic influences is present. Within this backreef area seagrass distribution is sparse and may be a result of prevailing conditions.

Table 5-47 Total mapped Seagrass in the East Bay

Seagrass specie	Eastern bay (sqm)
Thalassia	21,218.4
Halodule	542.7
Total surveyed/ mapped	**21,761.1**

Seagrasses within this shallow backreef portion of the eastern bay have a noticeable smaller blade length, width, shoot density and percentage cover in comparison to other areas. Further east, within deeper areas of the bay seagrasses blade lengths and densities are present in increasing numbers.

Figure 5-96 Illustrates the substrate composition of mapped seagrass areas in the east bay.

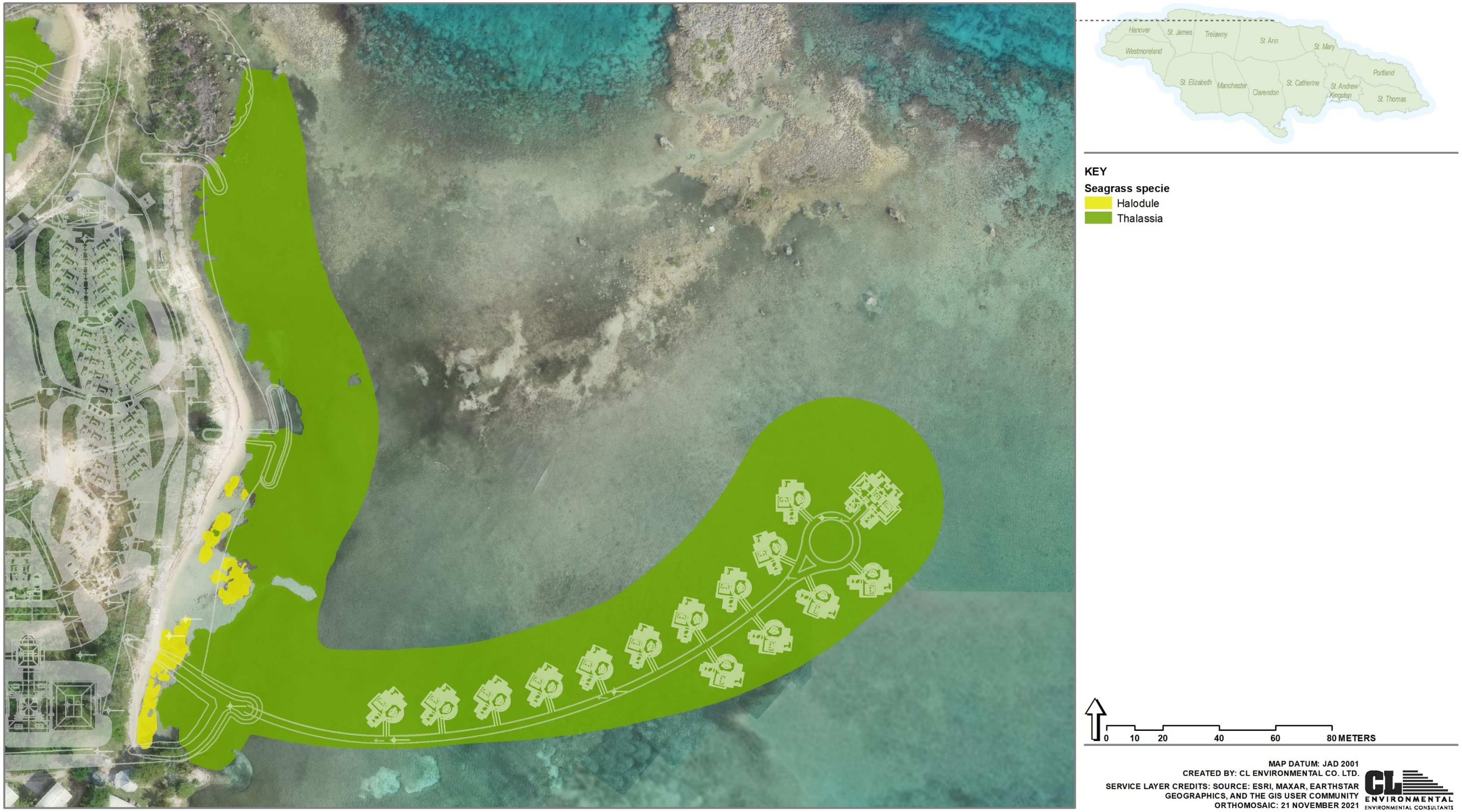


Figure 5-95 Mapped seagrass in the east bay

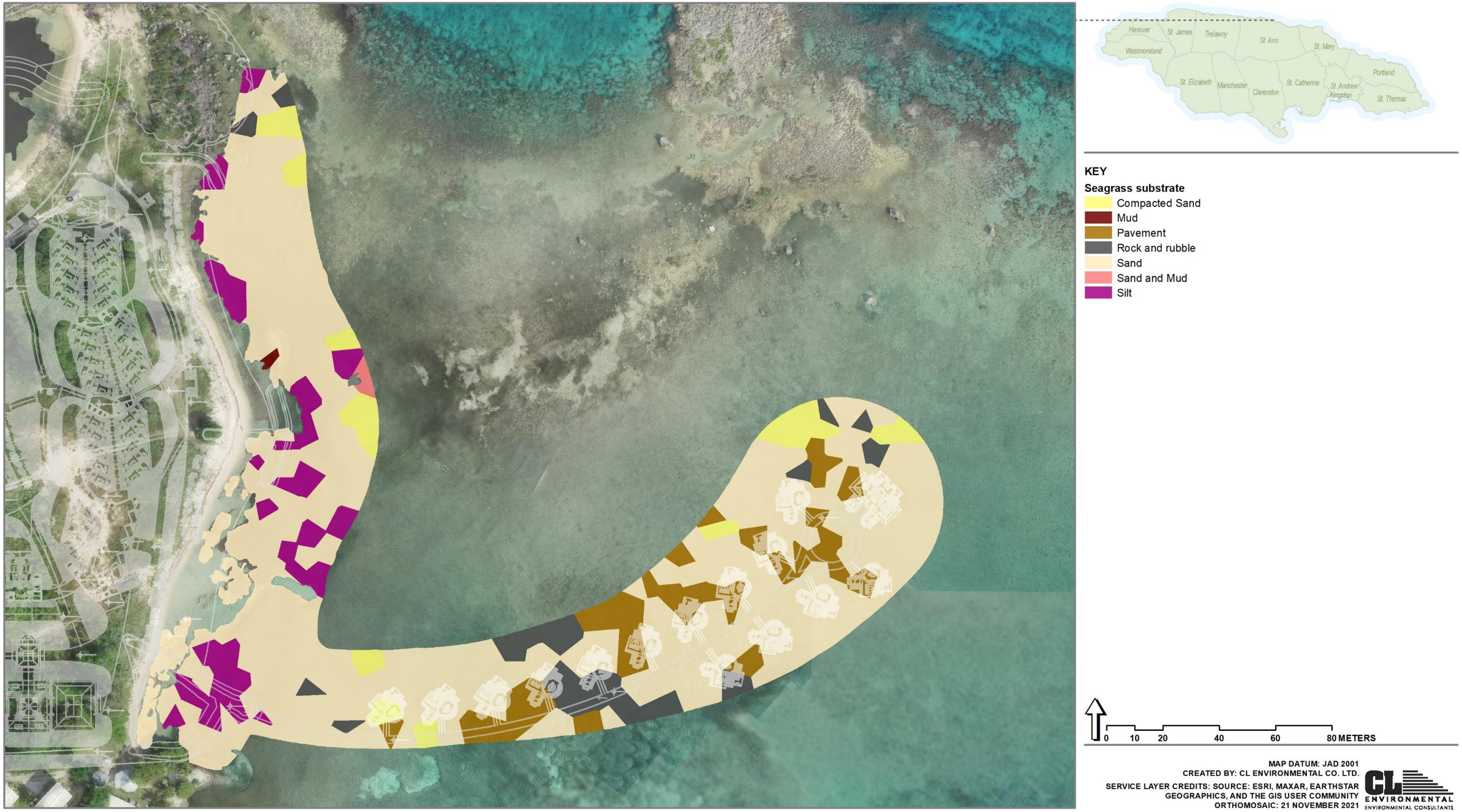


Figure 5-96 Substrate composition of mapped seagrass in the East Bay

Shoot Analysis

Blade density is a representation of the abundance and distribution of seagrasses within a given area. Within the dataset, the highest blade density was found at R1 with a total of seventeen (17) blades which was followed by R3, R4B, R0, R2 and R5 respectively. High blade densities at R1 and R3 may be a result of both beds being part of a continuous and respectively large seagrass meadow. Though this area receives a fair amount of wave activity due to its shallow nature, the characteristic dense nature of the meadow and its offshore extension provides an increasing amount of protection from hydrodynamic pressures as seagrasses along with rock and coral rubble continue to stagger wave energies.

Among the samples which were collected, sites with the lowest blade densities were R5 and R2 with a total of five (5) and seven (7) blades retrieved respectfully. This may be a result of the difference in substrate type. Within these areas, substrate consisted of rock, coral rubble and pavement which provide an obstruction in the lateral spread of seagrass beds and result in reduced colonization and thus percentage cover of seagrasses.

Shoot biomass was seen to be highest at R2 (0.00332g) while the lowest biomass was seen at R5 (0.00085g). High shoot biomass as seen at R2 may be due to a number of factors such as high amounts of photosynthetically active radiation (PAR), shallow depths, low colonization of epiphytes present on seagrass blades (0.4 g) as well as the substrate type present here. Along with these, resource allocation away from root biomass may be in action in order to continue bed survival.

Light is the dominant environmental factor in accounting for seagrass variability in biomass abundance, leaf productivity and species distribution (Cayabyab & Enriquez, 2007). Reductions in light availability related to sediment loading and resuspension have been suggested as the main factors responsible for biomass loss and subsequent environmental deterioration (Dawson & Dennison, 1996). Site R2 is located in a low-density seagrass bed characterized by good light penetration, shallow depths and fewer chances of competition through overcrowding. These aforementioned characteristics will account for the high shoot biomass present here.

The opposite is seen at R5 where shoot biomass was lowest. Reasons for the reduction in biomass may also be due to light penetration. According to (Aho & Beck, 2011), seagrass blades within shallow waters may often suffer from harmful UV B rays, often leading to shoot desiccation. In such communities it is often beneficial for these blades to have shoots with some amount of epiphytic colonization to protect blades from drying out due to prolonged ultraviolet exposure. This exposure to air and UV rays was seen as blades within this area were burnt, appearing brown in colouration and often become exposed during low tide.

In addition, Nephelometric Turbidity Unit (NTU) is the unit, which is used to measure the turbidity of fluid, that is, the presence of suspended particles in a water body (Peterson & Gunderson, 2008). Higher NTU values describe water which has more suspended particles while low values reflect the opposite. According to water quality data, R5 recorded an NTU of 0.00 indicating high water clarity. Paired with shallow depths, low epiphyte weight (0.1g) and reduced blade densities, seagrasses here are suspected to be suffering from high levels of ultraviolet damage.

Carbon stored within the shoot component of the seagrasses sampled from within Richmond Cay yielded a total core value of 0.4415 MgC. Of this, carbon values recorded within the east bay had a total of 0.2866 MgC. Among sites shoot carbon values varied between 0.1127 MgC found at R2 to 0.0290MgC at R5. Here, carbon values have a direct relationship to shoot biomass. As a result, the same trend will be present among both parameters.

Estimates of total shoot carbon within the east bay project area indicated that a total of 0.0326 MgC/ha is present (Table 5-48). Of the sites sampled, the bed with the highest estimated shoot carbon were those present at R2. This remains consisted with core carbon values determined.

Table 5-48 Total shoot carbon stored (MgC/ha) in the East Bay project area.

East Bay	
SITE	Total Carbon Stored in Shoot in Project Area (MgC/ha)
R1	0.0084
R2	0.0142
R3	0.0098
R5	0.0002
Total	0.0326

Root Analysis

One of the most important root metrics for studies of plant response to environmental change, soil carbon modelling, and estimating soil carbon sequestration is root biomass (Hirte, et al., 2017). At Richmond Cay, the site which had the highest root biomass was R5 (0.0087) while the site with the lowest root biomass was R2 (0.0027). R2 is located in a relatively shallow bed with high exposure to wave activity. As a result, it is expected that grasses here will find it difficult to remain stabilized to their associated substrate and allocate more resources to the growth of their root component. However, this is not evident and may be due to the bed’s substrate composition.

Substrate type has a significant role in the growth of root systems. Physical obstructions that reduce space for root growth can profoundly affect plant performance (Semchenko, et al., 2008). At R2, the site with the lowest root biomass, the substrate type was recorded and observed to be composed mainly of coral rubble, uninhabited shells and stone. These materials at high densities may prevent root systems from successful and efficient lateral spread. Roots may therefore be thin and heavily interlocked with the substrate as a means for stability. At R5, the substrate differs greatly. Here the sediment is composed of large amounts of silt along with sand which allows for continued vertical and lateral spread of root systems. Roots here are seen to thrive as they have a suitable medium for unimpeded growth.

Data collected at Richmond Cay from samples indicated a total root carbon value of 0.7406 MgC which was retrieved within the corer. Of this value the site with the lowest carbon storage was R2 (0.092 MgC) while the site with the highest carbon value was R5 (0.297 MgC). Data for this parameter was consistent with trends seen in root biomass as highest values were seen at R5 followed by R0, R3, R1 and R2 respectively.

Estimates for total area of carbon stored within the root component of the seagrasses within the east bay project area indicated a total value of 0.058 MgC/ha (Table 5-49). Of this value, beds associated with R3 were seen to have the highest carbon storage. Being situated in the vast expanse of rock and rubble of the east bay, this bed possesses a much larger area in comparison to the sand and mud present at R5 which was previously discussed as having highest values based on core samples. Though both sets of data accurately describe the status of the beds, having a larger area will result in higher capacities for carbon storage within seagrass beds.

Table 5-49 Total root carbon stored (MgC/ha) in the East Bay project area.

East Bay	
SITE	Total Carbon Stored in Root in Project Area (MgC/ha)
R1	0.020
R2	0.012
R3	0.024
R5	0.002
Total	0.058

Soil Analysis

Within the eastern bay, a total soil carbon value derived from core samples of 32.834 MgC was found. According to the results gathered, blue carbon storage within the substrate was greatest at R5 (22.884 MgC), this was followed by R0 (14.518 MgC) (located in the western bay). R5 as was discussed earlier possesses the highest root biomass of the sites which were sampled. Increasing complexities within the root/rhizome biomass of a seagrass bed will lead to a resultant increase in the ability of these root systems to stabilize the surrounding sediment within this area. Therefore, a reduction in sediment loss will be present. This information coupled with the nearshore, shallow and protected nature of this seagrass bed will account for soil carbon values as the movement of substrate remains limited.

Having the lowest shoot biomass and density as previously stated, the seagrasses at R5 will have a harder time trapping and filtering out sediment particles from the water column. This however does not negate the ability of the present root system to reduce the amount of sediment present due to high wave intensities. Supporting data behind this theory includes values relating to organic carbon present within this area. Loss on ignition (LOI %) is one of the most widely utilized methods used to determine the organic matter content in soils (Hoogsteen, et al., 2015). R5 was noted to have the highest percentage loss on ignition (4.354%) followed by R0 (3.379%). Relatively high levels of LOI would further confirm observed results for blue carbon storage within substrate samples found within these sites.

Within the east bay project area, estimated total soil carbon values indicated that approximately 1.39 MgC/ha is stored here (Table 5-50), a much lower value than that found within the western bay. Of the eastern bay sites, the area with the highest estimated soil carbon value were the beds associated with R3 (0.74 MgC/ha). As mentioned earlier, though core carbon values reflect elevated levels of carbon at R5, this area possesses a much smaller total area in comparison to other seagrass beds. As a result, R3 possess a high capacity to sequester and store carbon within its substrate.

Table 5-50 **Total soil carbon stored (MgC/ha) in the East Bay project area.**

East Bay	
SITE	Total Soil carbon in Project Area (MgC/ha)
R1	0.22
R2	0.29
R3	0.74
R5	0.14
Total	1.39

Additional Seagrass Survey Areas in the East Bay

Additional sites sampled within the eastern bay but outside of the immediate project area included R4B and R4A (Figure 5-76). Depths within this area ranged between 10 – 13 feet. The seagrass bed present within this area consisted of continuous and extensive stands of *Thalassia testudinum* projecting further offshore.

Table 5-51 **Results of core carbon analysis taken nearby potential relocation bed in the East Bay**

Additional Seagrass Areas					
Avg. Blade length (cm)	Avg. Blade width (cm)	Shoot biomass (g)	Carbon in shoot biomass (MgC)	Root biomass (g)	Carbon in root biomass (MgC)
14.660	0.750	0.003	0.087	0.005	0.180

This bed stores the second highest carbon within its vegetative components (shoot and root) while soil carbon values reflect average values for the entire dataset. The deepest site R4 B recorded a shoot biomass of 0.003g with a shoot carbon storage value of 0.87 MgC (Table 5-51). This site had the second highest shoot biomass and carbon value of the six (6) sites sampled for vegetative parameters. At a depth of thirteen (13) feet, this site also recorded the highest average blade length of 14.66cm. Blade lengths within this area may be due to the depth in which this bed is located as well as the lack of herbivorous fauna which were absent upon sampling. With increasing depths and reduced grazing, seagrasses are less likely to become cropped or predated upon.

Seagrass distribution here took the form of row-like bands with uniform undulating sandy substrate. This formation is known as “linear sand waves” or “sand ripples”. These are formed when a flat bed of loose sand is subjected to an oscillatory water flow, suggesting that the sand bed is linearly unstable and susceptible to further bed erosion (Bungaard, et al., 2004). Though ongoing influence from wave activity may be prevalent, high particle sizes of the substrate may result in greater water clarity as these particles do not remain in the water column for long periods. This will allow for vegetation here to be exposed to photosynthetically active radiation for longer periods throughout the day. Therefore, explaining the relatively higher biomass seen in relation to other sites which were sampled. Within the 0.0053g root biomass at R4B, a carbon value of 0.1801 MgC was stored.

Soil carbon among these outer sites were valued at 12.564MgC at R4B and 7.657MgC at R4A from sampled core totals (Table 5-52). Though sediment type and descriptions remain similar for both sites, R4B has a higher density of seagrasses. As a result, carbon sequestration processes will transfer a greater portion of carbon to substrate components here in comparison to those at R4A. It is therefore suitable to conclude that though both sites may continue to erode due to high wave activity, R4A is likely to experience erosion at a greater degree over time.

Table 5-52 Total soil carbon stored (MgC) in the additional East Bay seagrass

SITE	Total Soil carbon in core (MgC)
R4 A	7.66
R4 B	12.56

Limitations:

- Due to the substrate composition in sections of the east bay, core depth was restricted by areas of rock, rubble and pavement, reducing the volume of soil collected.
- During the coring process some seagrass blades will be cropped reducing the number of blades suitable for further analysis.
- Manual removal of cores is time consuming in coarse substrates.
- The high wave climate within the eastern bay makes sampling of benthic habitats difficult.

East Bay Fish

Fish density within the Eastern Bay was moderate twenty-three species were identified between the transect lines and roving surveys. Most fish were juveniles, carnivores and falling within the 0-5cm size class. The Eastern Bay fish community at Richmond Cay was dominated by Bluehead Wrasse (*Thalassoma bifasciatum*), Doctorfish (*Acanthurus chirurgus*), and Slippery Dick Wrasse (*Halichoeres bivittatus*).

Surveys were conducted within the Eastern Bay for fish, with surveys along transect lines and a roving survey within the bay, The four transect lines and roving survey areas can be seen below in Figure 5-101. No top predator species such as Barracuda, or invasive lionfish were observed during the Eastern Bay surveys.

Roving Surveys were conducted within the Eastern Bay. During these surveys these areas were swam through and any fish species recorded, and relative abundance noted. Abundance was scored with the following parameters in mind: Single (1) Few (2-10) Many (11-100) and Abundant (>100).

A total of thirteen species (13) were identified within the eastern bay during the roving survey (Table 5-53), of the thirteen identified species, they were most commonly identified as single and many, with no species being abundant. Fish density within the Western Bay, in general was medium.

Table 5-53 Species richness Inside Eastern Bay

Common Name	Scientific Name	Code
Butterflyfish - Banded	*Chaetodon striatus*	S
Damselfish - Beaugregory	*Stegastes leucostictus*	F
Damselfish - Biocolor	*Stegastes partitus*	S
Damselfish - Dusky	*Stegastes adustus*	F

Common Name	Scientific Name	Code
Damselfish - Threespot	*Stegastes planifrons*	S
Doctorfish	*Acanthurus chirurgus*	M
Grunt - French	*Haemulon flavolineatum*	M
Jack - Bar	*Caranx ruber*	S
Parrotfish - Striped	*Scarus iserti*	F
Silver Jenny	*Eucinostomus gula*	F
Squirrelfish	*Holocentrus adscensionis*	S
Wrasse - Bluehead	*Thalassoma bifasciatum*	M
Wrasse - Slippery Dick	*Halichoeres bivittatus*	M

FISH TRANSECTS

Surveys were conducted along four transect lines within the Eastern Bay. Swimming along the lines, fish within a 2m belt were counted and their size estimated using a graduated T-bar. Size classes ranged from 0-5cm, 5-10cm, 10-20cm and >20cm. Fish species observed along the four transect lines can be seen below in Table 5-54.

Table 5-54 Fish species list within the Eastern Bay

Common Name	Scientific Name
Damselfish - Beaugregory	*Stegastes leucostictus*
Damselfish - Sergeant Major	*Abudefduf saxatilis*
Damselfish - Cocoa	*Stegastes variabilis*
Doctorfish	*Acanthurus chirurgus*
Parrotfish - Bucktooth	*Sparisoma radians*
Parrotfish - Stoplight	*Sparisoma viride*
Parrotfish - Yellowtail	*Sparisoma rubripinne*
Parrotfish - Striped	*Scarus iserti*
Wrasse - Bluehead	*Thalassoma bifasciatum*
Wrasse - Slippery Dick	*Halichoeres bivittatus*
Wrasse - Blackear	*Halichoeres poeyi*
Wrasse - Clown	*Halichoeres maculipinna*
Blue Tang	*Acanthurus coeruleus*
Butterflyfish - Banded	*Chaetodon striatus*
Jack - Bar	*Caranx ruber*
Balloonfish	*Diodon holocanthus*
Goldspotted Eel	*Myrichthys ocellatus*
Grunt - French	*Haemulon flavolineatum*
Highhat	*Pareques acuminatus*
Blenny - Goldline	*Malacoctenus aurolineatus*

FISH DIVERSITY AND ABUNDANCE

A total of 20 species were identified across the four transect lines (Table 5-55) with T2 and T3 having the greatest species richness both having 14 species observed. The most frequent species observed across all four transects were Wrasse - Slippery Dick (*Halichoeres bivittatus*) and Doctorfish (*Acanthurus chirurgus*).

Table 5-55 Species Richness per transect line

Species	T1	T2	T3	T4
Stegastes leucostictus	x	x	x	
Abudefduf saxatilis	x	x	x	
Stegastes variabilis		x		
Acanthurus chirurgus	x	x	x	x
Sparisoma radians	x	x		x
Sparisoma viride		x		
Sparisoma rubripinne		x		
Scarus iserti			x	x
Thalassoma bifasciatum	x	x	x	
Halichoeres bivittatus	x	x	x	x
Halichoeres poeyi		x	x	x
Halichoeres maculipinna		x	x	
Acanthurus coeruleus		x	x	
Chaetodon striatus		x		
Caranx ruber		x	x	
Diodon holocanthus			x	
Myrichthys ocellatus			x	
Haemulon flavolineatum			x	
Pareques acuminatus			x	
Malacoctenus aurolineatus				x
Species Richness	6	14	14	6

T2 had the highest number of fish recorded, while T1 and T4 closer to shore had the lowest (Figure 5-97). Along the lines laid, T3 had most of its fish associated with two blowouts along the transect line.

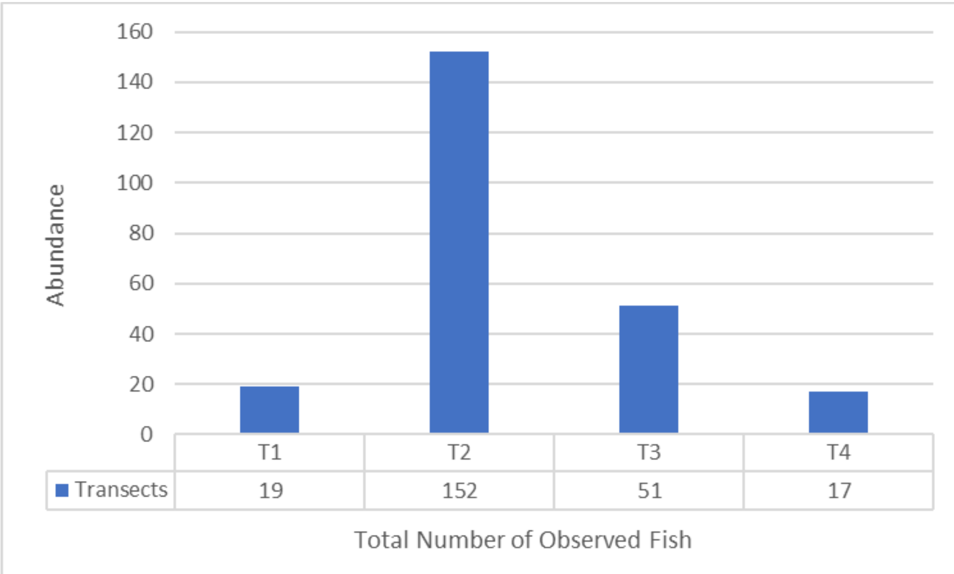


Figure 5-97 Fish Abundance within Eastern Bay

FEEDING GROUPS

Most of the fishes observed during the surveys were carnivores, with herbivores being the feeding group with the second highest number of individuals (Figure 5-98). The most abundant carnivores were Bluehead Wrasse (*Thalassoma bifasciatum*), with most other carnivores also belonging to the Wrasse family. Herbivores observed belonged to the Parrotfish and Doctorfish Family, with the most abundant herbivore fish being the Bucktooth Parrotfish (*Sparisoma radians*). Of the omnivores observed, the Beaugregory Damselfish (*Stegastes leucostictus*) was the most abundant.

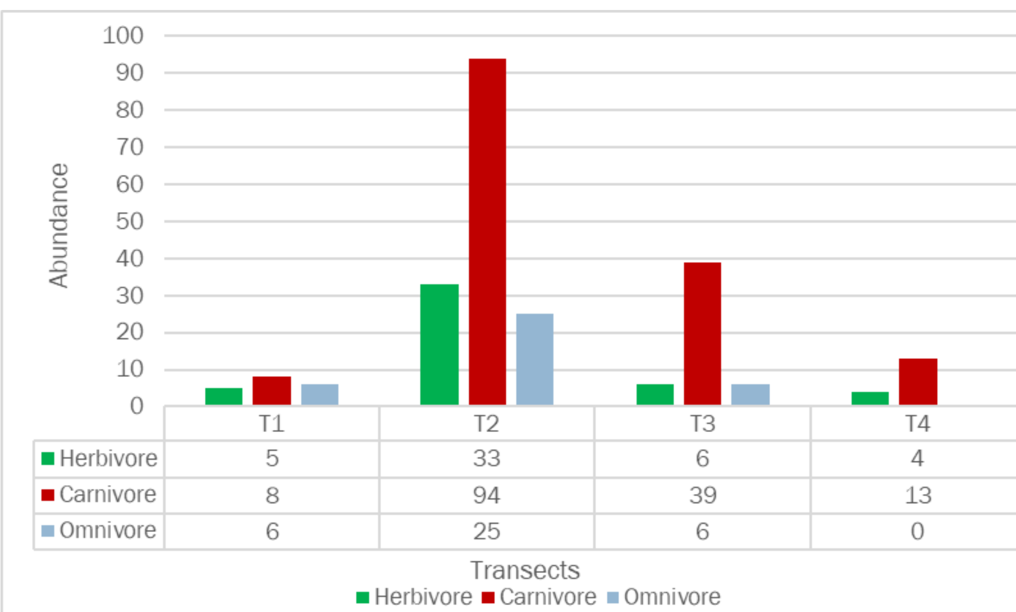
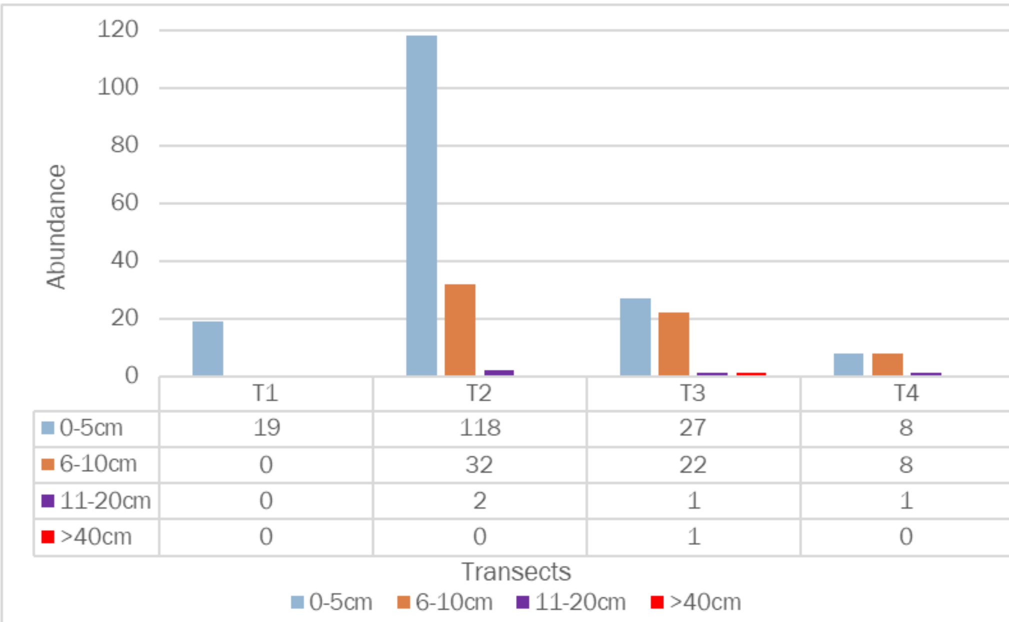


Figure 5-98 Abundance of fish per Transect based on feeding group

FISH SIZE

All fish were 20 cm and less in total length except for one Goldspotted Eel (*Myrichthys ocellatus*) which was >40cm, most fish were in the 0-5cm size class (Figure 5-99). Based on the families observed, most of these fishes would be within the juvenile stage of their life cycle. The largest individuals, besides the Goldspotted Eel, were the Yellowtail Parrotfish (*Sparisoma rubripinne*), Balloonfish (*Diodon holocanthus*), and Striped Parrotfish (*Scarus iserti*).



	T1	T2	T3	T4
0-5cm	19	118	27	8
6-10cm	0	32	22	8
11-20cm	0	2	1	1
>40cm	0	0	1	0

Figure 5-99 Abundance of fish size per Transect.

5.2.4.4 Reef Systems and Community

Fringing Reef System

An extensive fringing reef system can be found across both bays of the project area. Roving surveys were conducted for general health, a species list and photo inventory for benthic features and fish.

The fringing reef had 49 A. *Palmata* (including those mapped in east and west bay areas).

Figure 5-100 shows the fringing reef survey area and mapped coral colonies.

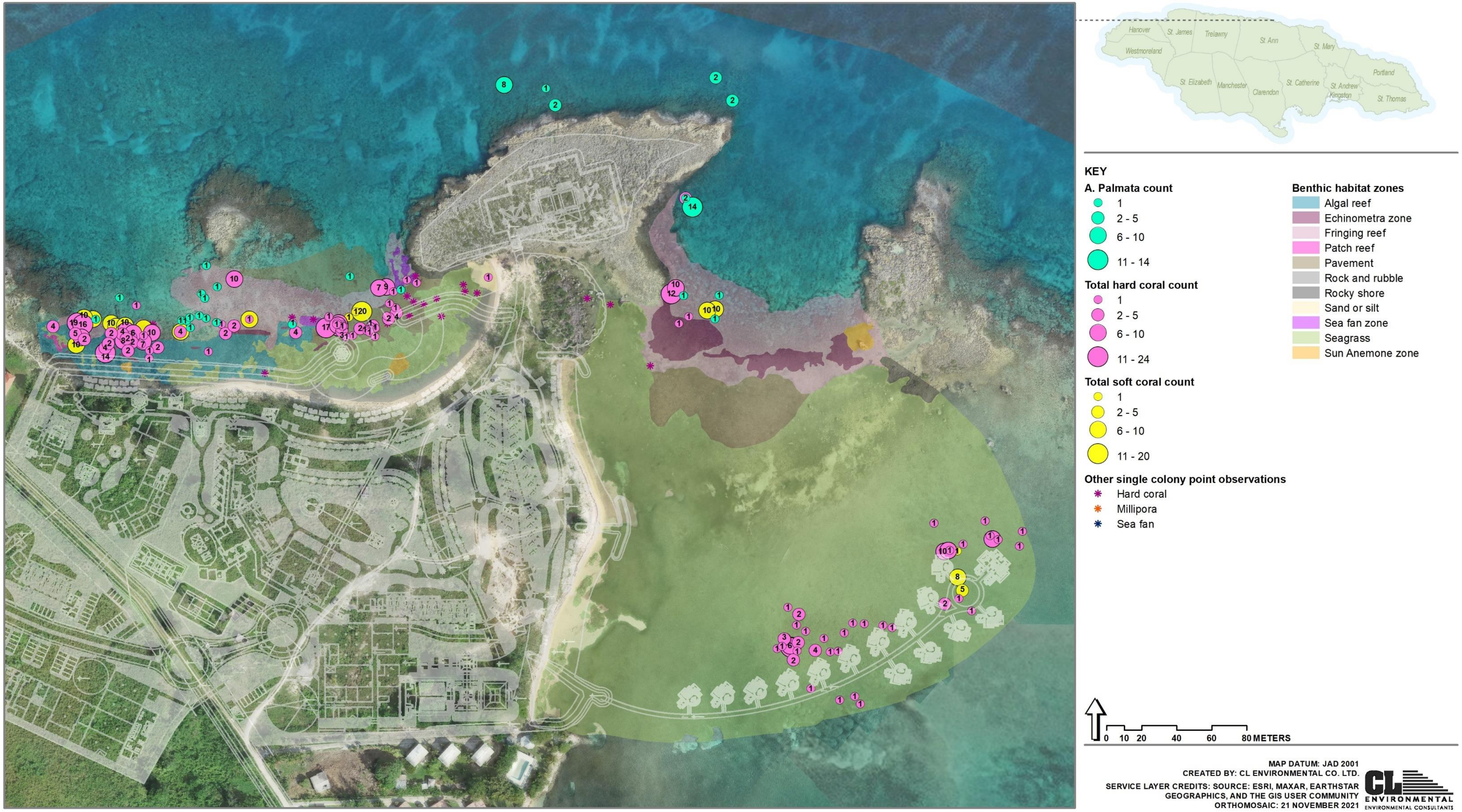


Figure 5-100 Fringing reef

Significant populations of *A. palmata* were seen along the fringing reef. The colonies appeared to be in good health but are highly vulnerable to environmental changes. Both bays had extensive collections of seafans, in particular associated with rocky shore outcroppings. Some disease and signs of stress were seen on a few colonies. The very shallow reef crest areas were dominated by *Millipora* and macroalgae. Several large coral colonies are present on the downward face of the fringing reef, the reef crest and various backreef areas. Diadema continue to be notable absent from the reef. Macroalgae dominates large sections of the fringing reef and associated patch reef areas. Seward of the reef is a large deeper pavement area no relief. Coral colonies in very shallow, high wave energy areas such as the reef crest and along the rocky shore/ intertidal areas could not be mapped, counted or measured. Corals and seafans in between features and down the reef slope were also difficult to map. A general species list for the fringing reef is given in Table 5-56

Table 5-56 Coral Species list for the Fringing Reef

CORAL	
SOFT CORAL	
Common Name	**Scientific Name**
Common Sea Fan	Gorgonia ventalina
HARD CORAL	
Common Name	**Scientific Name**
	Agaricia spp.
Elkhorn Coral	Acropora palmata
Finger Coral	Porites porites
Golfball Coral	Favia fragum
Great Star Coral	Montastraea cavernosa
Knobby Brain Coral	Pseudo diploria clivosa
Lobed Star Coral	Orbicella annularis
Massive Starlet Coral	Siderastrea siderea
Mustard Hill Coral	Porites astreoides
Smooth Brain Coral	Pseudo diploria strigosa
Thin Finger Coral	Porites divaricata
HYDROCORAL	
Common Name	**Scientific Name**
Branching Fire Coral	Millepora alcicornis
Blade Fire Coral	Millepora complanata

Plate 5-58 - Plate 5-66 are some examples of sections of the fringing reef.

Plate 5-58 *Acropora palmata* colonies

Plate 5-59 *Acropora palmata* colonies

Plate 5-60 *Acropora palmata* colonies

Plate 5-61 *Acropora palmata* colonies and numerous sea fans

Plate 5-62 Large *Millepora* colony on the reef crest

Plate 5-63 Large encrusting *Pseudodiploria* colonies

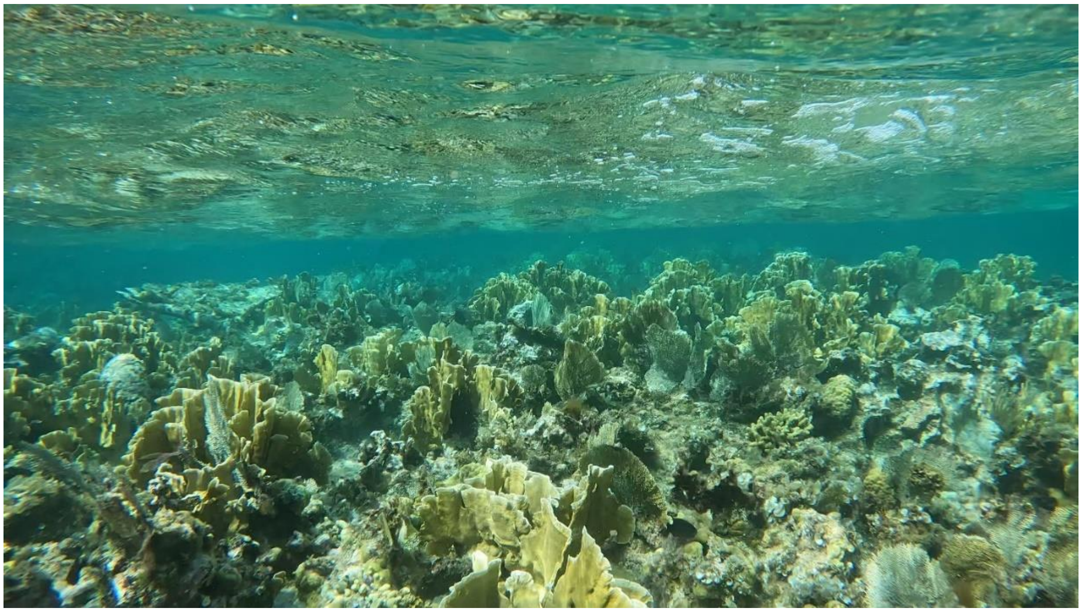


Plate 5-64 Dense Sea fan zone

Plate 5-65 Dense Sea fan zone

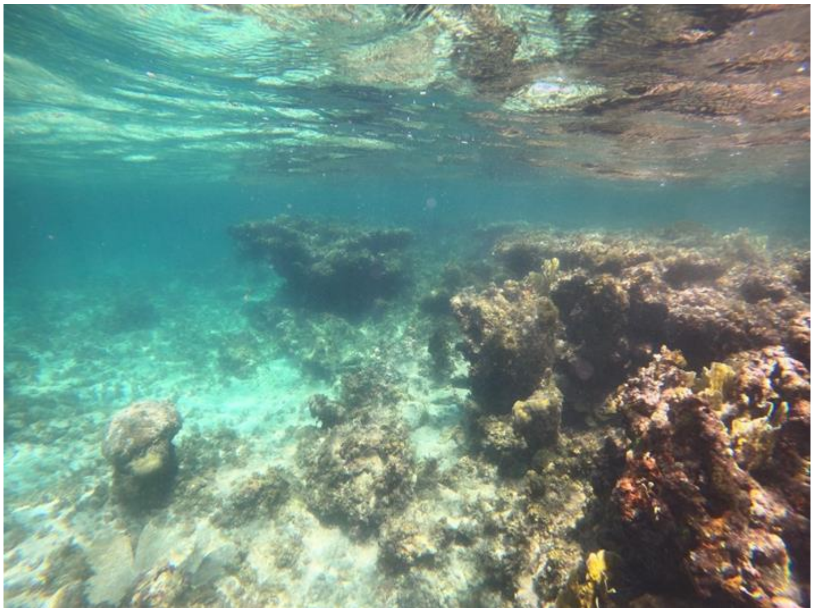


Plate 5-66 Section algal reef and pavement border

Fringing Reef Fish

Fish density within the Fringing Reef was high, of the seventeen species identified within the fringing reef community. The dominant species included; Blue Tang (*Acanthurus coeruleus*), Doctorfish (*Acanthurus chirurgus*), Bluehead Wrasse (*Thalassoma bifasciatum*) and Yellowtail Damselfish (*Microspathodon chrysurus*).

Roving Surveys were conducted within the Fringing reef system to the North of the Eastern Bay.

During these surveys these areas were swam through and any fish species recorded, and relative abundance noted. Abundance was scored with the following parameters in mind: Single (1) Few (2-10) Many (11-100) and Abundant (>100).

A total of seventeen species (17) were identified outside the Eastern Bay (Table 5-57) Of the identified species inside and outside the Eastern Bay, the fish were most commonly identified as many. Fish density within the fringing reef system, in general was high. No top predator species such as Barracuda, or invasive lionfish were observed during the Fringing Reef roving survey.

Table 5-57 Species richness Outside Eastern Bay

Common Name	Scientific Name	Code
Angelfish - French	*Pomacanthus paru*	S
Blenny - Redlip	*Ophioblennius macclurei*	S
Blue Tang	*Acanthurus coeruleus*	M
Butterflyfish - Foureye	*Chaetodon capistratus*	F
Butterflyfish - Reef	*Chaetodon sedentarius*	F

Common Name	Scientific Name	Code
Chromis - Blue	*Chromis cyanea*	F
Damselfish - Dusky	*Stegastes adustus*	F
Damselfish - Threespot	*Stegastes planifrons*	F
Damselfish - Yellowtail	*Microspathodon chrysurus*	M
Doctorfish	*Acanthurus chirurgus*	M
Jack - Bar	*Caranx ruber*	F
Parrotfish - Redband	*Sparisoma aurofrenatum*	F
Parrotfish - Stoplight	*Sparisoma viride*	F
Parrotfish - Striped	*Scarus iserti*	F
Sharpnose Puffer	*Canthigaster rostrata*	F
Spotted Goatfish	*Pseudupeneus maculatus*	S
Wrasse - Bluehead	*Thalassoma bifasciatum*	M

Figure 5-101 Roving and Fish Transect Survey Areas within the Eastern and Western Bays

Barrier Reef

Coral cover and diversity was generally low with high macroalgae at all three survey locations. Incidents of disease observed around transect areas was low. *Diadema* numbers were very low, and no living pillar corals were seen in or around the survey areas. These observations are a likely result of the major disease epidemics that have impacted Caribbean coral reefs. Some evidence of damage form recent storms was also seen but not extensive.

METHODS

Photo Transects and Roving Survey

Three (3) reef survey sites were chosen, RT1 (eastern), RT-2 (central), and RT-3 (western) shown in Figure 5-102 Each of the sample sites had three, 30 metre transect lines, each run along sections of the reef to avoid large sand patches and high-low relief variations. Along each 30m transect line, photos were taken every 3 meters using a 1 m^2 quadrat, totalling 10 photos per transect, giving a total of 30 photos per site.

The photos were analysed using the Coral Point Count with Excel extensions (CPCe) program. This program involves overlaying spatially random points on each image. The benthic features under each of these points are user-identified (e.g. coral species, bleaching/disease incidents, algae, sand, recently killed coral and other features). Coverage statistics are then calculated, and these results displayed in an excel spreadsheet.

Data collected will include:

- Percentage Coral Cover;
- Live coral
- Recently killed coral
- Dead coral
- Diseased or bleached coral
- Percentage Algae Cover

General Substrate Composition: The substrate type will also be identified (sand, pavement rock etc.)

Other Data

Any rare, endangered, commercially important (lobster and conch) and invasive organisms observed, as well as the presence/absence of seagrasses was noted. Any obvious sedimentation, anchor damage, marine debris and other direct impacts was also recorded.

Additional information collected at each sample site included; identification of endangered Acroporid species; very large/old colonies. Manual invertebrate counts were done along each line, 1 metre on either side of the transect line. A roving survey of the general area was also conducted to identify disease, bleaching and other features.

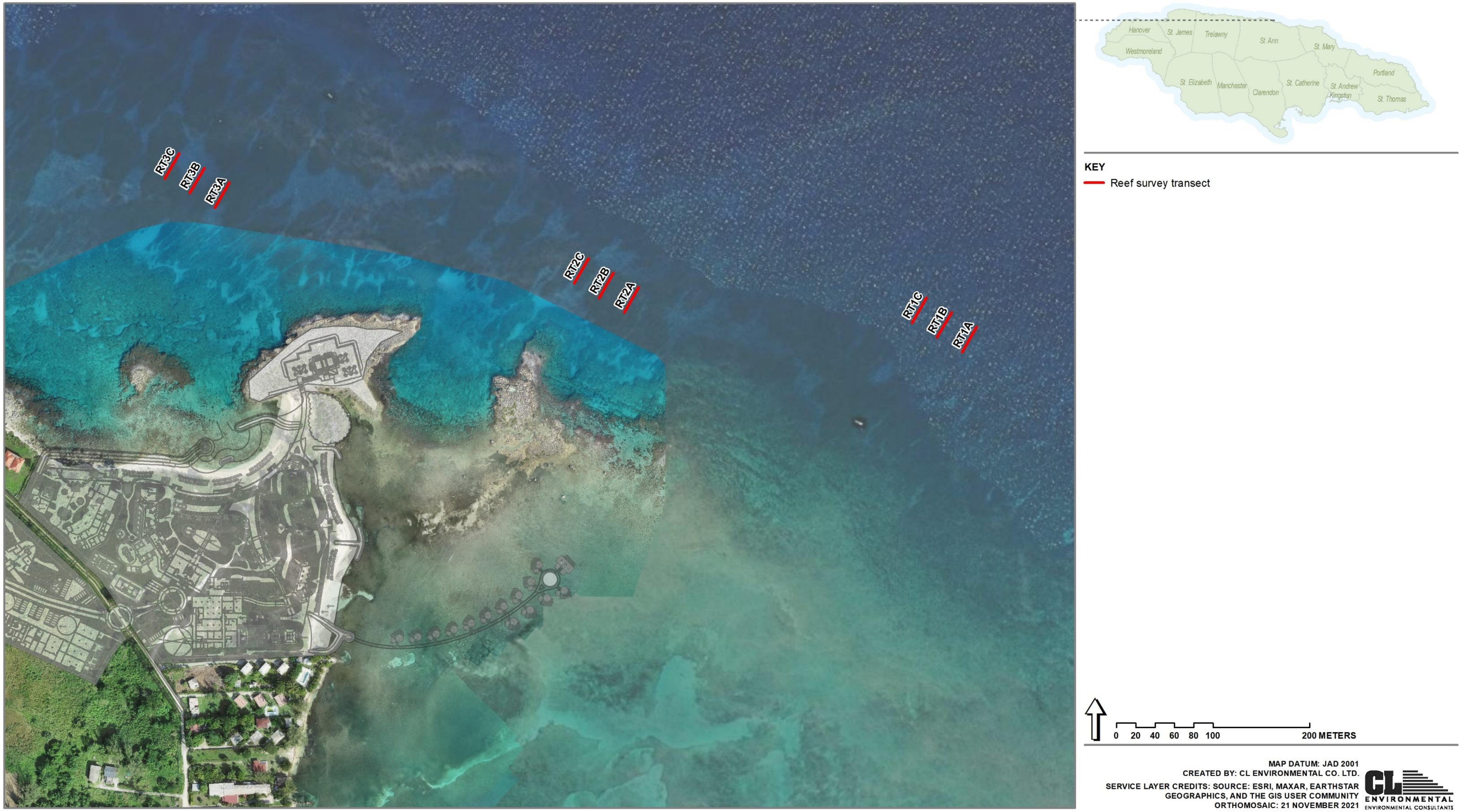


Figure 5-102 Reef Survey Locations

Invertebrates

Manual counts of invertebrates (mainly urchins and commercially important species) were done along each transect line, 1m on either side of the line (2m belt transect) with special care taken to inspect any crevices or overhangs within the transect area. Data was recorded for species and total numbers.

Fish

Fish counts were conducted at each transect line. The numbers and feeding habits of fish species observed were obtained using roving fish count modified methods defined for the Reef Check/AGRRA protocols.

A 30 m long and 2m x 2m transect (cube) was used at each site. The belt transect included the overlying water column. The numbers and feeding habits of fish species observed along the transect was recorded and divided into size classes with the aid of a graduated T-bar. General site observations such as the presence of fish pots, nets, spear-fishermen, invasive and rare species were also recorded.

TRANSECT SUMMARY DATA

The results of the reef survey show that each survey area is dominated by macroalgae, with low coral cover, low diversity and very high macroalgae. Dead coral with algae was relatively low as other encrusting species. The low other live, sponges and zoanthids is likely due to high levels of macroalgae shaping the reef. Nuisance species such as *Chondrilla nucula*, *Cliona* sp. had a low occurrence in all transect areas. Macroalgae appears to be outcompeting all other benthic species in all transects. The transect summary data is given in Table 5-58.

Table 5-58 Transect summary data

MAJOR CATEGORY (% of transect)	RT1	RT2	RT3
CORAL	6.66	6.79	7.71
GORGONIANS	0.52	0.27	3.75
SPONGES	2.09	2.10	4.83
ZOANTHIDS	0.00	0.25	0.00
MACROALGAE	85.65	68.69	63.77
OTHER LIVE	0.65	0.13	0.14
DEAD CORAL WITH ALGAE	2.87	18.35	15.83
CORALLINE ALGAE	0.00	0.40	1.11
DISEASED CORALS	0.00	0.00	0.00
SAND, PAVEMENT, RUBBLE	1.56	3.01	2.87
UNKNOWNS	0.00	0.00	0.00
TAPE, WAND, SHADOW	7.03	8.83	11.88

Percentage coral cover was low at all three survey locations while macroalgae was high at all three. RT1 had significantly higher macroalgae than RT@ and RT3, as shown in Figure 5-103. Species diversity was also low and similar between sites.

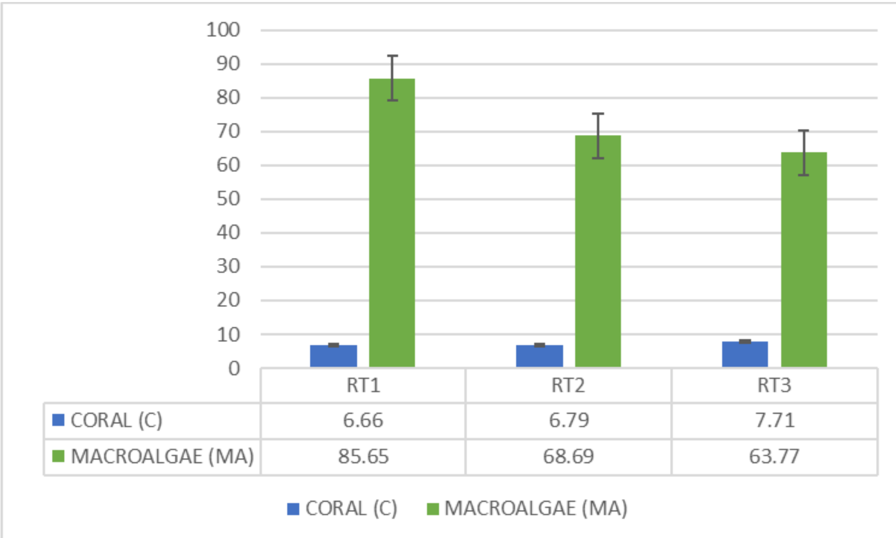


Figure 5-103 Coral Macroalgae comparison between sites

Table 5-59 RT1 Hard Species and Mean Percentage Coral Cover

Species	Mean %Cover
Agaricia sp.	2.74
Madracis decactis	0.13
Madracis mirabilis	0.13
Millipora alcicornis	0.13
Orbicella annularis	0.66
Orbicella faveolata	1.56
Porites furcata	0.39
Porites porites	0.13
Siderastrea siderea	0.66

Table 5-60 RT2 Hard Species and Mean Percentage Coral Cover

Species	Mean % Cover
Agaricia sp.	2.74
Madracis decactis	0.26
Millipora alcicornis	0.12
Orbicella annularis	0.75
Montastraea cavernosa	0.62
Porites astreoides	0.38
Siderastrea siderea	1.68

Table 5-61 RT3 Hard Species and Mean Percentage Coral Cover

Species	Mean % Cover
Agaricia sp.	2.06
Madracis decactis	0.14
Orbicella faveolata	2.06
Porites astreoides	1.66

Species	Mean % Cover
Porites furcata	0.28
Porites porites	0.55
Siderastrea radians	0.14
Siderastrea siderea	0.41

Table 5-62 Roving Survey additional species

CORAL	
SOFT CORAL	
Common Name	**Scientific Name**
Common Sea Fan	*Gorgonia ventalina*
Encrusting Gorgonian	*Erythropodium caribaeorum*
HARD CORAL	
Common Name	**Scientific Name**
Elkhorn Coral	*Acropora cervicornis*
Finger Coral	*Porites porites*
Knobby Brain Coral	*Pseudo diploria clivosa*
Lobed Star Coral	*Orbicella annularis*
Smooth Brain Coral	*Pseudo diploria strigosa*
Thin Finger Coral	*Porites divaricata*
HYDROCORAL	
Common Name	**Scientific Name**
Branching Fire Coral	*Millepora alcicornis*
Blade Fire Coral	*Millepora complanata*

Plate 5-67 Large bouquet of Madracis

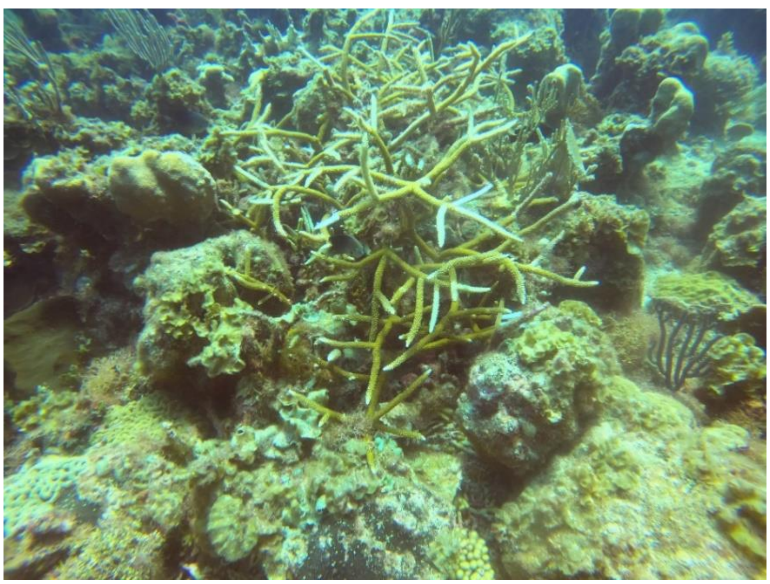


Plate 5-68 Thicket of A. cervicornis

Plate 5-69 Diseased colony outside the transect area

DIVERSITY INDICES

Simpson's Diversity Indices

Simpson's Diversity Index is a measure of diversity. It measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species). In ecology, it is often used to quantify the biodiversity of a habitat. It takes into account the number of species present, as well as the abundance of each species. Simpson's Index of Diversity 0-1; The value of this index ranges between 0 and 1, the greater the value, the greater the sample diversity. In this case, the index represents the probability that two individuals randomly selected from a sample will belong to different species.

The Shannon-Weaver Index

The Shannon-Weaver or Shannon-Wiener Index indicates species diversity of a community or area. The higher the value, the higher the diversity. If there is more diversity, this indicates less competition between species. If the value is lower, this indicates that competition has narrowed down the number of species able to make a living in that community or area. The Shannon-Weiner index cannot really determine the richness of the species or the evenness as separate calculations for those exist. However, richness of the species and the evenness of the community is used to calculate the diversity.

Diversity indices were similarly high between RT2 and RT3. RT1 had the lowest diversity.

- Simpson's Diversity Indices; RT1- 0.57, RT2 – 0.97and RT3- 1.17
- Shannon-Weaver Index; RT1 – 0.25 RT2- 0.49 and RT3- 0.55

Invertebrates

Manual counts of invertebrates, which focused on urchins and commercially important species such as conch and lobster were done along each transect line, 1m on either side of the line (2m belt transect) and shown in Table 5-63.

Table 5-63 Invertebrate counts and Observations

Species	RT1	RT2	RT3
Diadema antillarium		3	
Echinometra	12	11	17
Lytechinus			4
Tripneustes	4	2	8
Eucidaris tribuloides		1	1

Barrier Reef Fish

Twenty-nine species of fish were identified between the three transect sites within the Barrier Reef at Richmond Cay. Site 2 had the highest species richness and Site 3 had the greatest abundance and density of fish. The largest group of fish were identified as carnivores which fell within the 0-5cm size class. The dominated species include; Blue Chromis (*Chromis cyanea*), Bluehead (*Thalassoma bifasciatum*), Longfin Damselfish (*Stegastes diencaeus*) and Striped Parrotfish (*Scarus iseri*). No top predator species such as Barracuda, or invasive lionfish were observed during the Barrier reef surveys.

To assess the fish communities at RT-1, RT-2, and RT-3, a modified AGRRA Fish Protocol was used, laying three 30m transects at each site. Swimming along the transect, all fish within a 2m wide belt and overlying water column were recorded. For each individual, the total length was estimated using a graduated T-bar and assigned to one of the following size classes: 0 - <5cm; - 10 cm; 11 - 20 cm; 21 - 30 cm; 31 - 40 cm; increments of 10cm for individuals above 40cm. Lines were run parallel to each other within similar depth ranges and separated by at least 5m. FishBase (http://www.fishbase.org) was used to determine the diet of each species before assigning them to one of three broad categories – Herbivore, Carnivore, and Omnivore.

FISH DIVERSITY

A total of 29 species were identified across the three sites (Table 5-64). RT-2 had the highest species richness, with 24/29 species observed along the transects laid there. The most frequent species across the three sites were Blue Chromis (*Chromis cyanea*), Bluehead (Thalassoma bifasciatum), Longfin Damselfish (*Stegastes diencaeus*) and Striped Parrotfish (*Scarus iseri*).

Table 5-64 Species Richness per site

Species	RT-1	RT-2	RT-3
Acanthurus bahianus		X	
Acanthurus coeruleus		X	X
Bodianus rufus	X		X
Bothus lunatus		X	

Species	RT-1	RT-2	RT-3
Canthigaster rostrata	X	X	X
Caranx ruber		X	
Cephalopholis cruentata	X	X	X
Cephalopholis fulva		X	
Chromis cyanea	X	X	X
Chromis multilineata			X
Clepticus parrae		X	X
Halichoeres garnoti	X	X	X
Holocentrus adscensionis	X	X	X
Holocentrus rufus		X	X
Hypoplectrus guttavarius			X
Microspathodon chrysurus		X	X
Myripristis jacobus		X	X
Scarus iseri	X	X	X
Scarus taeniopterus		X	
Serranus tigrinus	X	X	X
Sparisoma atomarium	X		X
Sparisoma aurofrenatum	X	X	X
Sparisoma viride		X	X
Stegastes adustus	X		X
Stegastes diencaeus	X	X	X
Stegastes partitus	X	X	X
Stegastes planifrons	X	X	X
Stegastes variabilis		X	
Thalassoma bifasciatum	X	X	X
Species Richness	**15**	**24**	**23**

Table 5-65 Species richness per transect line

	RT-1	RT-2	RT-3
A	15	16	15
B	11	12	11
C	10	14	16
Avg. #/Site	**12**	**14**	**14**

FISH ABUNDANCE

RT-3 had the highest number of fish recorded, while RT-1 on the site's eastern end had the lowest (Figure 1). Along the lines laid, RT-3 was also the most rugose with live stony coral (pers. obvs.), providing more reef area for fish to occupy.

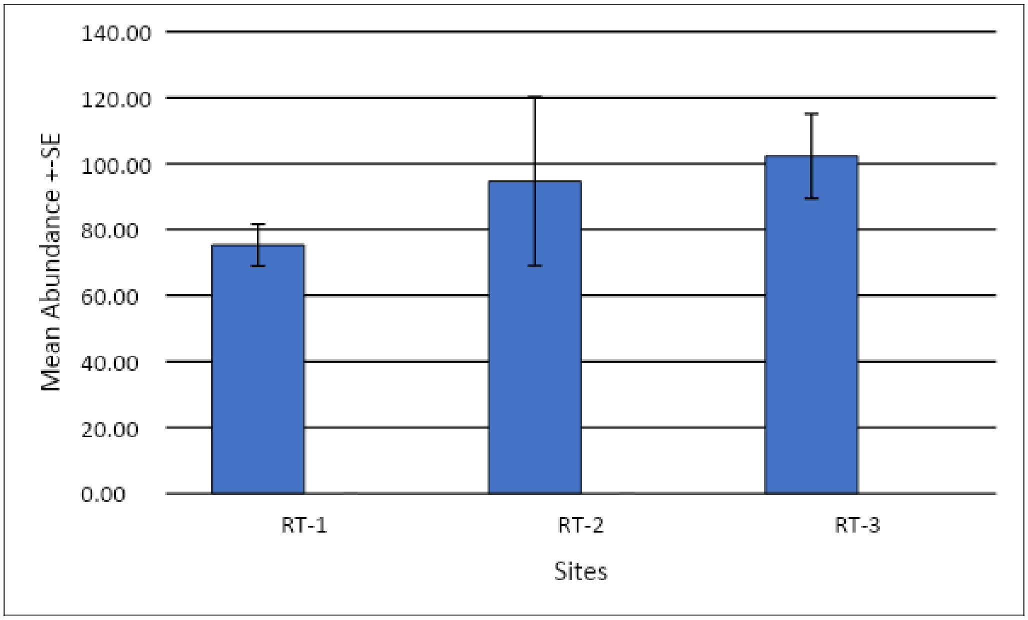


Figure 5-104 Mean abundance of fish per site

FEEDING GROUPS

Most of the fishes observed during the surveys were carnivores, with herbivores being the feeding group with the smallest number of individuals (Figure 5-105). The most abundant carnivores were Blue Chromis (*Chromis cyanea*), and Bluehead (*Thalassoma bifasciatum*). Herbivores observed belonged to the Surgeonfish and Parrotfish Family, with the most abundant fish being the Striped Parrotfish (*Scarus iseri*). Of the omnivores observed, the Longfin Damselfish (*Stegastes diencaeus*) was the most abundant.

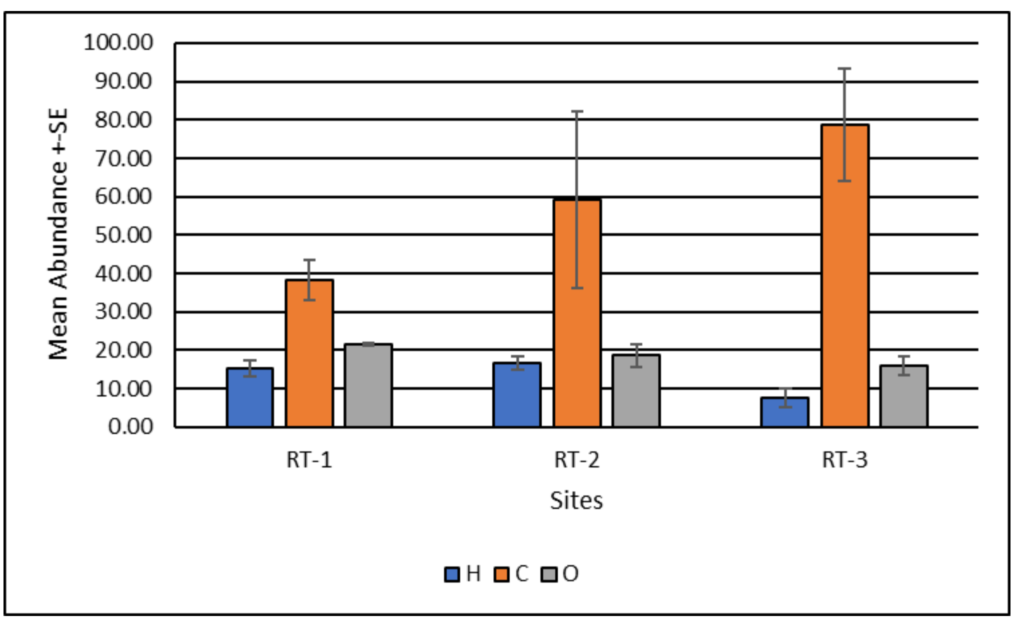


Figure 5-105 Mean abundance of fish per site based on feeding group

FISH DENSITY

The average density across the three sites ranged from 126 to 170 individuals /100m², with RT-3 being the most dense.

Table 5-66 Fish density per transect line

	RT-1	RT-2	RT-3
A	146.67	130.00	150.00
B	116.67	101.67	148.33
C	113.33	241.67	213.33
Avg. Density (#/100m²)/ Site	**125.56**	**157.78**	**170.56**

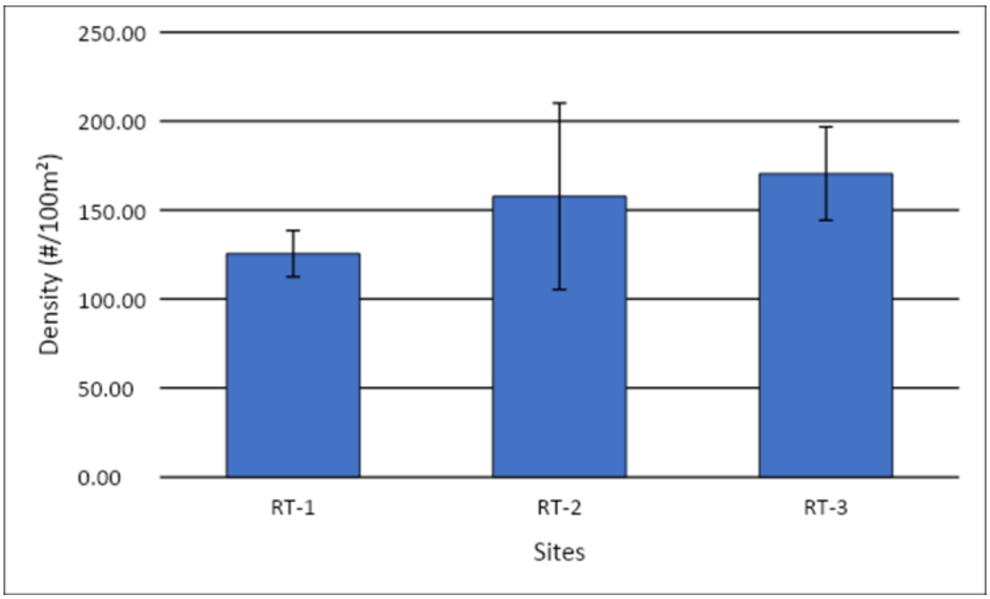


Figure 5-106 Average density of individuals (#/100m²) per site

FISH SIZE

All fish were 20 cm and less in total length, with most being in the 0-5 and 6-10cm size classes (Figure 5-107) Based on the families observed, most of these fishes would be within the juvenile stage of their life cycle. The largest individuals were the Creole Wrasse (*Clepticus parrae)*, Spanish Hogfish (*Bodianus rufus*), and Peacock Flounder (*Bothus lunatus*).

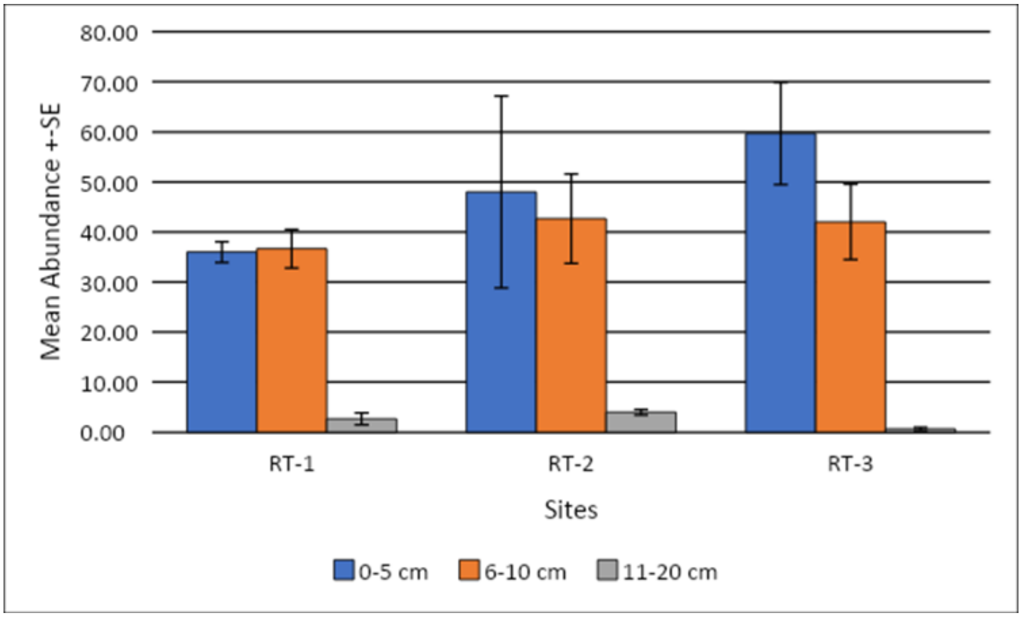


Figure 5-107 Mean abundance of fish size per site

Hard Coral, Macroalgae, Grazers and Herbivores

Hard coral cover was low at all three survey areas, while macroalgae was high for all three. RT1 had the highest percent cover of macroalgae, however it had similar densities of herbivorous fish and urchins to RT2. RT3 had the lowest densities of herbivorous fish and the highest density of urchins.

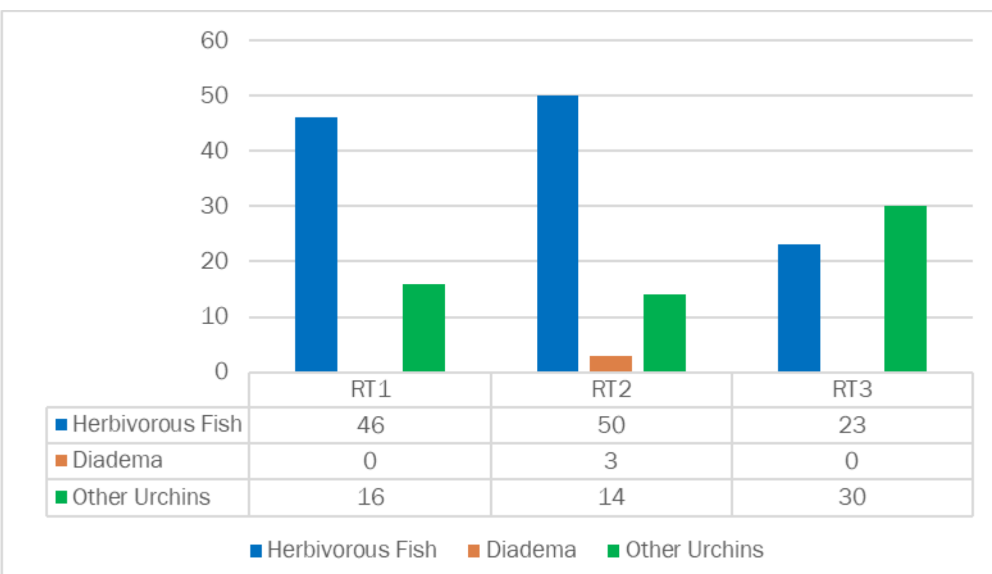
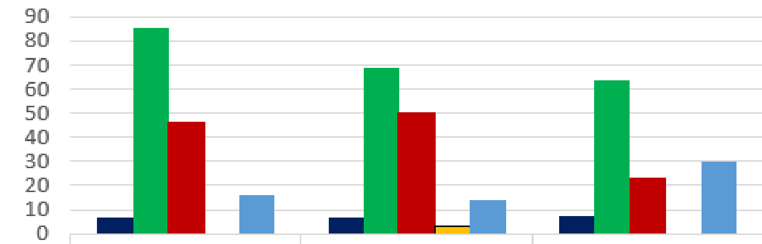


Figure 5-108 Comparison of Herbivorous Fish, Diadema and other urchins between transect locations.



	RT1	RT2	RT3
Coral (C)	6.66	6.79	7.71
Macroalgae (MA)	85.65	68.69	63.77
Herbivorous Fish	46	50	23
Diadema	0	3	0
Other Urchins	16	14	30

Figure 5-109 Hard Coral, Macroalgae and Grazing comparison between sites

Overall RT3 had the was the most diverse, had the highest percent coral and lowest macroalgal cover while RT1 had the highest macroalgal cover, lowest diversity and lowest percent cover of coral. This suggest that reef health improves in a westerly direction from the proposed project area. The impact of the mass Diadema mortality event, frequent storms, coral disease and fishing pressure are likely major factors influencing the current state of the reef.

5.3 NATURAL HAZARD VULNERABILITY

5.3.1 Earthquake and Seismicity

5.3.1.1 Historical Seismic Events

Seismic events have the capacity to be some of the most devastating and costly natural hazards. The level of damage or loss typically varies depending on the magnitude of an event, wherein effects can range from only being noticed via seismograph to significant loss of life and infrastructural damages. Despite having the tools for monitoring and recording these occurrences, earthquakes are unpredictable in nature.

Jamaica straddles the boundary between Caribbean tectonic plate and Gonave micro-plate. The Walton and the Enriquillo Fault Zones, extending respectively to the west and the east of Jamaica, form the boundary between these two plates. The movement across these two fault zones are transmitted through the Jamaican Fault system and are the source of significant earthquake activity in the island. The closest active faults near the project site are the Duanvale Fault zone and the Montpelier-New-Market Fault zone which intersects near Montego Bay and has respectively an E-W and NNW- SSE orientation (C. DeMets, 2007).

Jamaica has had a notable earthquake history with significant events such as the 1692 Port Royal earthquake, the 1907 Kingston earthquake, the 1957 March 1st earthquake, which impacted the western end of the island and the 1993 January 13th earthquake. These events were the cause of significant losses for Jamaican citizens but only represent a small portion of the seismic activity occurring on the island; more recently, between 2011 and 2020 there were over 1000 recorded earthquakes with local epicentres, of which approximately 94 were actually felt. Although none were catastrophic, it highlights the significant levels of seismic activity across Jamaica.

Observance of these historical events along with the other smaller recorded occurrences sets the precedence of the importance of seismic consideration in the codes and practices used to develop infrastructure and ensuring they are operationally safe.

No earthquake epicentres were located within 1 km of the proposed project site. The closest epicentre is approximately 3.3 km south of the site (Figure 5-110).

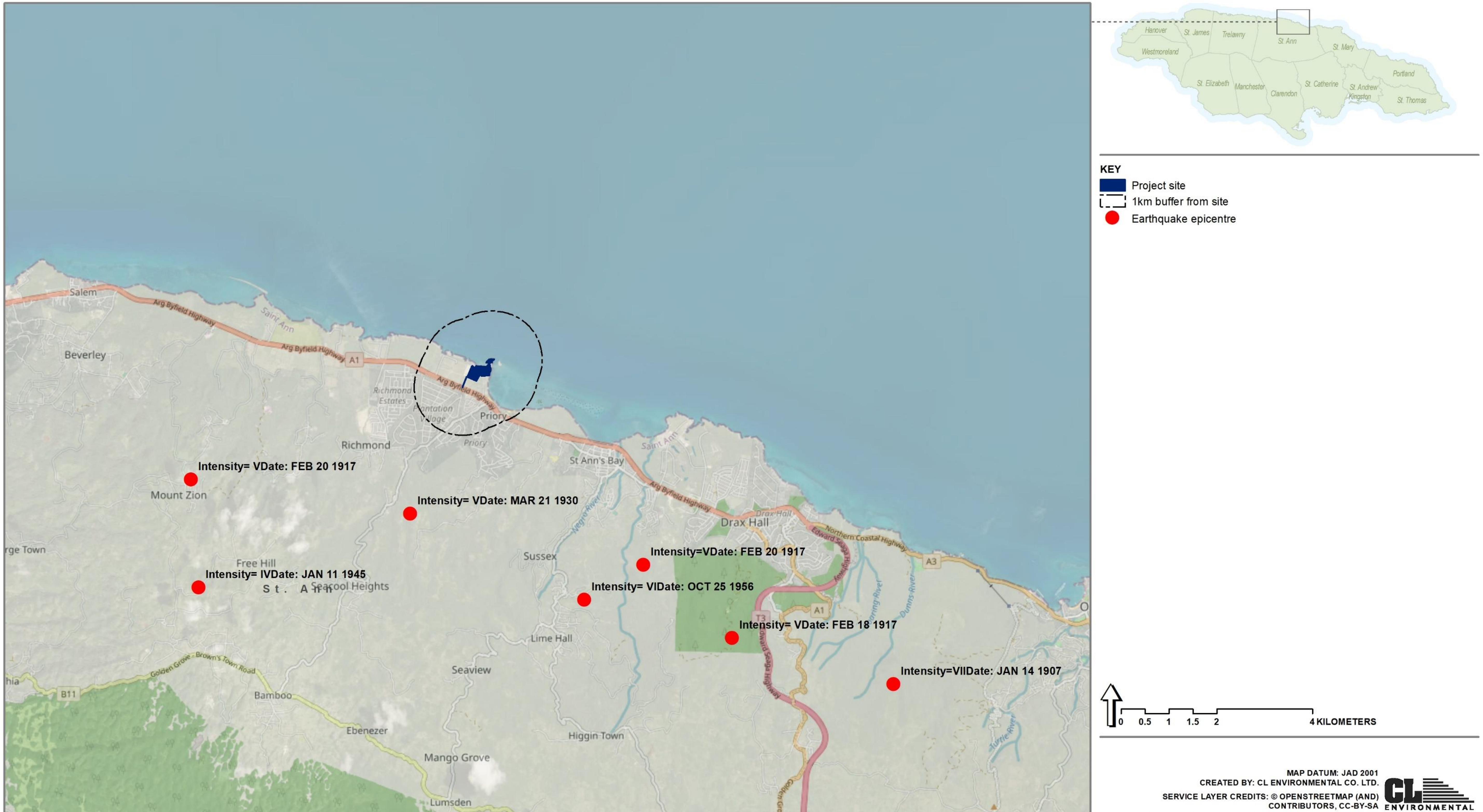


Figure 5-110 Earthquake epicentres in proximity to the project site

5.3.1.2 Project-Specific Seismicity

The soil profile encountered in the area consists of degraded fragments of coral and calcareous deposits, with high potential for liquefaction. The Seismic Site Class was determined using the Standard Penetration Test blow count (SPT-N) for all the boreholes drilled. For the calculation of the Site Class following this method, the value of SPT-N was limited to 100 blows/foot. Based on the calculations and local geology, the site has been classified as Site Class E: Soft/loose Soils.

Horizontal Ground Acceleration

Table 5-67 and Table 5-68 summarizes the seismic parameters for a probability of exceedance of 10% in 50 years according to the Kingston Metropolitan Area Seismic Hazard Assessment Report, by the Caribbean Disaster Mitigation Project (Organization of America States (OAS), 1998). and the Jamaican Standard JS 306.2009_IBC. The Peak Ground Acceleration for the project area were extrapolated for the project area from the seismic hazard maps for Jamaica (Figure 5-111).

Table 5-67 Seismic parameters and Site Class values

Probability of Exceedance	S_1 [g]	S_S [g]	Site Class	Fa	Fv
10% in 50 years	0.22	0.50	E	1.7	3.2

Table 5-68 Response spectrum seismic values

Site Class	S_{DS} [g]	S_{D1} [g]	T_O [sec]	T_S [sec]	Near Field (0/1)
E	0.85	0.70	0.17	0.83	1

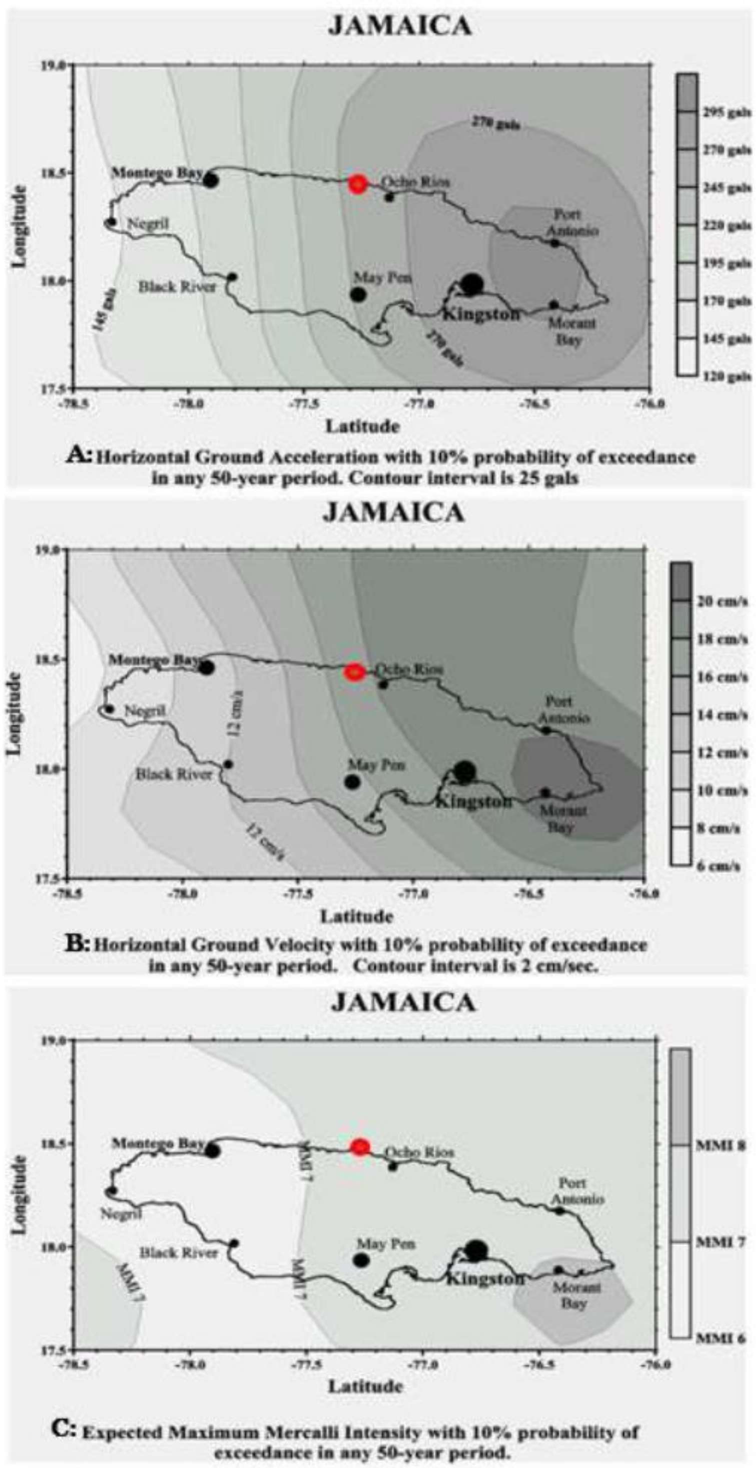


Figure 5-111 Seismic Hazard Maps for Jamaica (Source: CDMP, 1998): (a) Horizontal Ground Acceleration; (b) Horizontal Ground Velocity; (c) Modified Maximum Mercalli Intensity

Spectral Acceleration

The Spectral Acceleration (SA) is the preferred Seismic Hazard intensity parameter used in most modern building codes. This is a measure of maximum acceleration observed from a specific oscillatory period (similar to that of natural building oscillation) caused by a sustained shaking during an Earthquake. This acceleration varies based on location and as result means that the level of ground shaking also varies based on location.

Determining the short and long period spectral accelerations associated with varying regions can be a useful indicator of the level of seismicity and consequently the possibility of more pronounced ground motions in one area versus the other. The spectral acceleration periods observed were 0.2 seconds which is representative of short buildings (a few floors tall) and 1.0 second which is geared towards representing the oscillations of taller structures (greater than 7 floors). The Spectral Accelerations for the project area were extrapolated for the project area from the seismic hazard maps recommended in the IBC Code adopted for Jamaica (Figure 5-112).

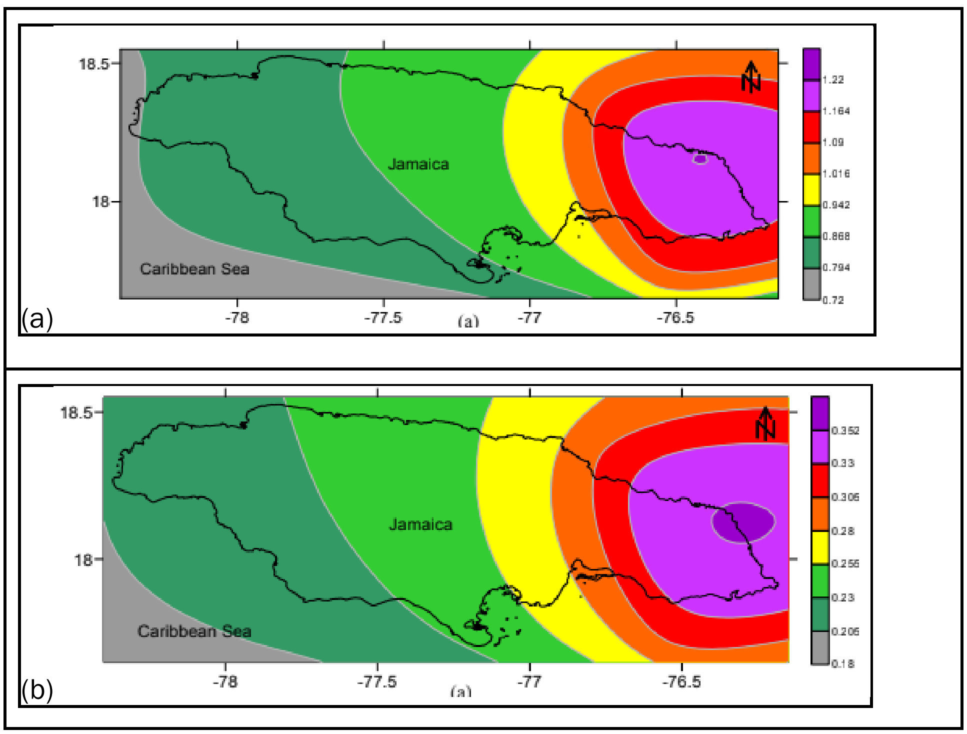


Figure 5-112 Site Spectral Response map for 0.2s short period (a) and 1.0s long period (b) (Source: Probabilistic Seismic Hazard Assessment for Jamaica Sep. 2013)

Figure 5-113 presents a map of the location of the active inland fault zones. This confirms that the project is located in the near field of an active fault Duanvale.

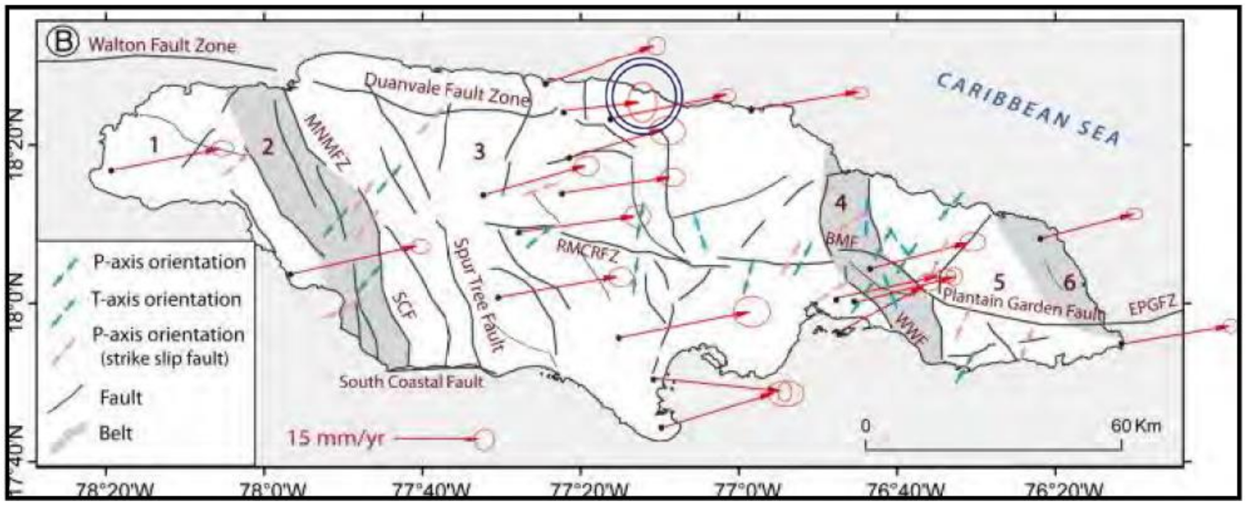


Figure 5-113 Location of active inland fault zones and rate of slip

5.3.1.3 Liquefaction Potential

During liquefaction, the soils lose their shear strength therefore losing the bearing capacity to support structures. In order for the potential effects of liquefaction to be manifested at the ground surface, the soils generally have to be clean sands; silty sands (SM), non-plastic silts (ML), with loose to medium relative density, saturated relatively near the ground surface, and must be subjected to sufficient magnitude duration of shaking.

Lateral spreading, differential settlement, loss of bearing capacity, ground tension cracks are results of this phenomenon. With the results of our borings, the potential for liquefaction was evaluated following the simplified SEED and IDRISS procedure, a method that is applicable for low-slope terrain.

Liquefaction potential of the subsurface soils was estimated using the N values of the soil samples obtained in the borings and the measured content of fines. Based on the calculations, layers of silty sand and silty gravel were found, with the potential of liquefaction in all borings at depths between 5 and 50 ft.

5.3.2 Hurricanes and Storm Surge

From June to November, the Caribbean region is vulnerable to tropical storms and hurricanes. These storms can cause dramatic and abrupt changes to the coastline. In general, coastal protection structures are designed to withstand wave attack from these extreme storm events, such as choosing an armour stone size for a coastal structure or determining design wave forces that may occur as a result of extreme waves. Extreme waves occur infrequently, and it takes decades or centuries of data to adequately describe the statistics.

The US National Oceanic and Atmospheric Administration (NOAA), specifically the National Hurricane Centre (NHC), has compiled detailed information on tropical cyclones, including all hurricanes, for the

Atlantic Ocean. The main source of information describing the individual storms was this database of storm tracks and other parameters.

Jamaica is located directly in 'Hurricane Alley,' an area of water in the Atlantic Ocean where hurricanes typically form due to warmer sea surface temperatures. Figure 5-114 shows the historical paths of hurricanes in the North Atlantic basin, which form between latitudes 5°N and 25°N off Africa's west coast and then track across the Atlantic Ocean. The north-east Trade Winds typically push those formed at lower latitudes on a westerly track, whereas those formed at higher latitudes track more to the north and north-west.

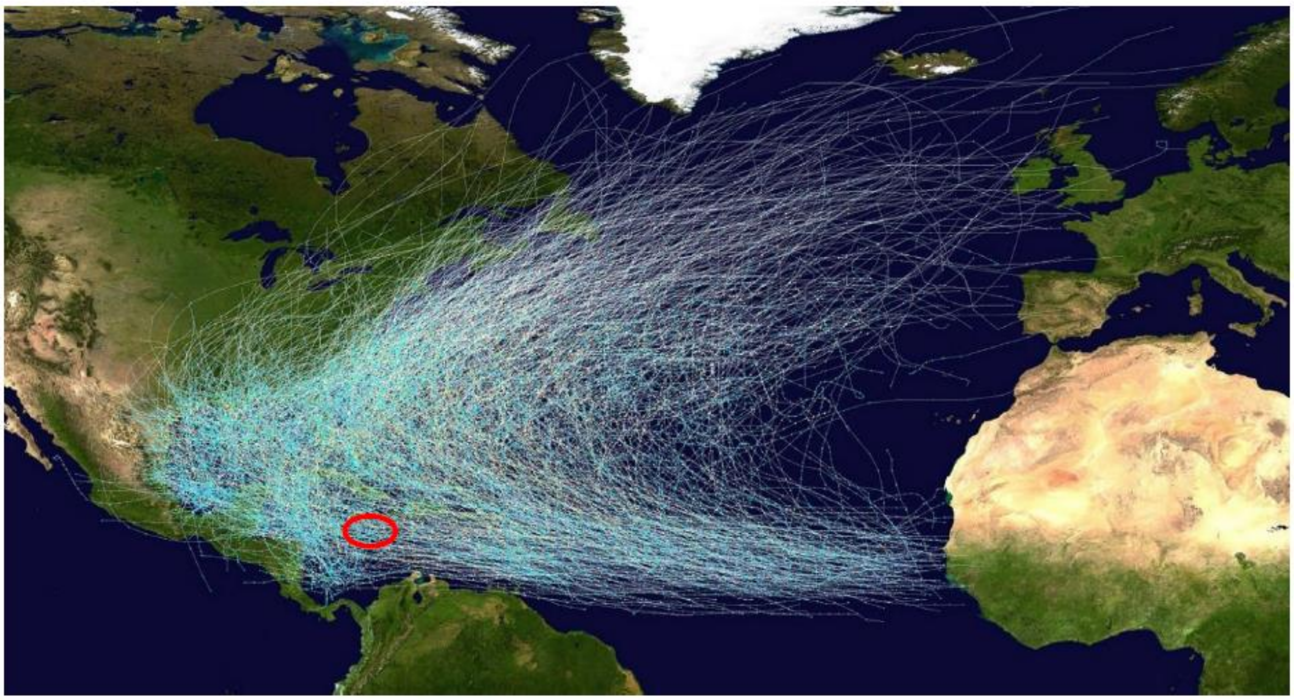


Figure 5-114 Atlantic hurricane tracks since 1851, the sweeping shape of which is commonly called 'Hurricane Alley'. The approximate location of Jamaica is highlighted by an orange circle.

Hurricanes produce heavy rainfall, high winds, and storm surge, all of which have the potential to cause damage and dislocation. Extreme rainfalls and sea levels are typically associated with hurricanes and tropical storms and depressions. Hurricanes can form almost anywhere in the Tropical Atlantic Basin from the West Coast of Africa near the Cape Verde Islands, to the Gulf of Mexico and the Caribbean Sea which are the main development areas. Jamaica lies in the Atlantic hurricane belt west of one of the Main Development Area, Cape Verde Islands. Over the past twenty years, at least five major hurricanes have impacted the Caribbean region (Figure 5-115).

Recent global and regional climate change models have been predicting changes in the climate conditions that may increase the impacts of the coastal hazards. Jamaica's Second National

Communication (SNC) on Climate Change (Government of Jamaica, 2011) lists the main climate change hazards as follows:

- Sea level rise
- Increase in extreme events – precipitation and drought
- More intense storms and increased storm surge levels
- Increased temperature

The Intergovernmental panel on Climate Change (IPCC) have made projections based on numerical models which indicate tropical storms are far more intense storms than in previous years. The (2007) IPCC report (Solomon, 2007) stated the following:

> *"There is evidence from modelling studies that future tropical cyclones could become more severe, with greater wind speeds and more intense precipitation. Studies suggest that such changes may already be underway; there are indications that the average number of Category 4 and 5 hurricanes per year has increased over the past 30 years."*

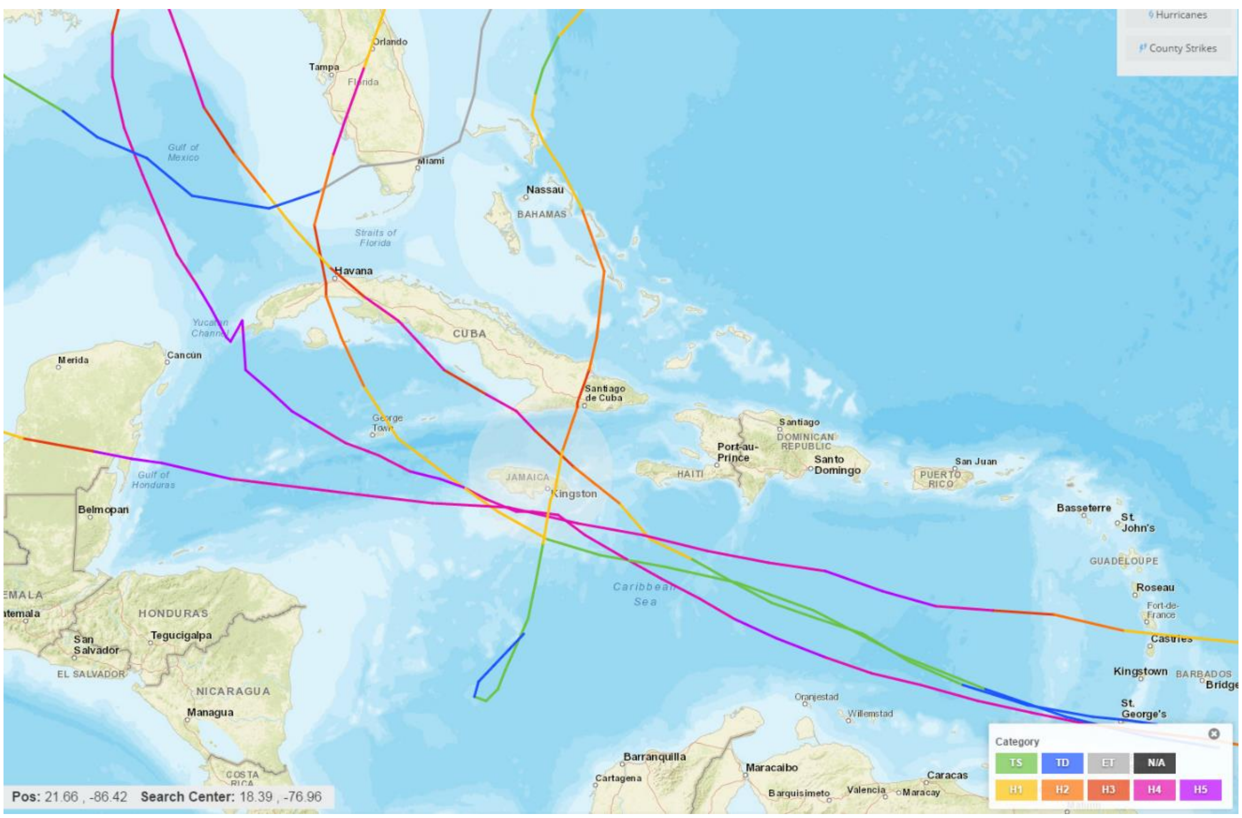


Figure 5-115 Tropical storms/Hurricanes passing through the Caribbean over the past fifteen (15) years.

Others have isolated the influence of increasing temperatures on the frequency of hurricanes and have suggested that a 0.5C increase will result in a 40% increase in hurricane activities (Saunders & Lea, 2008). The predictions of the IPCC are consistent with the number of category 4 and 5 storms that have tracked within 400 kilometres Jamaica in the past 130 years (Figure 5-116); the number of category 4 and 5 storms has increased from 10 to 15 storms per twenty-year intervals up to 1950 to 30 to 35 storms per twenty years after 1950. This doubling of storm occurrences coupled with increased sea level rise can result in shoreline retreat as beach profiles adjust to a more intense wave climate.

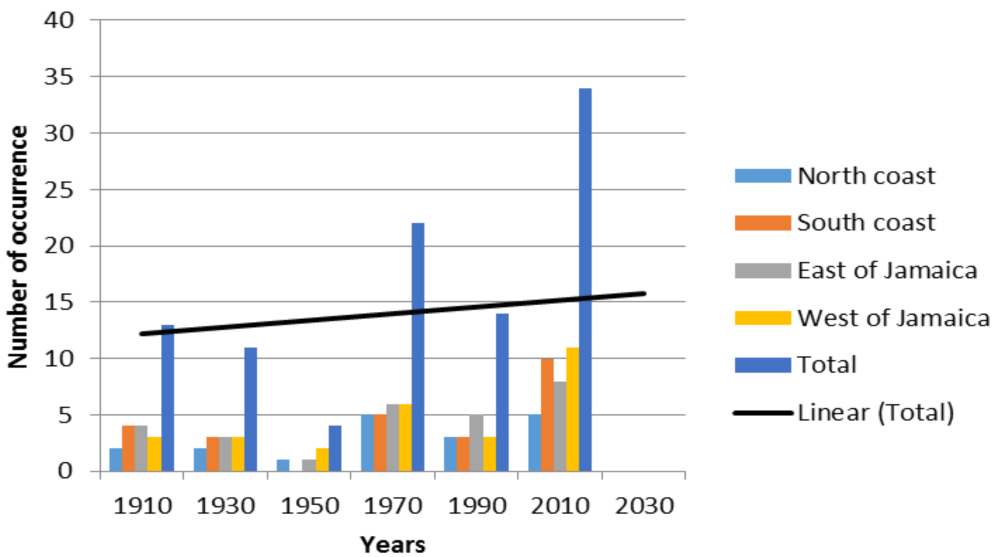


Figure 5-116 Occurrences of Category 4 and 5 hurricanes that have passed within 300 kilometres of Jamaica's shoreline since 1890 to 2014, in twenty years intervals

5.3.2.1 Historical Hurricane Activity

Historical hurricane information from the NHC database was reviewed (for storms occurring between 1851 and 2020). All hurricanes passing within a 300km radius of the project site were extracted from the database.

The results show that since the year 1851, 117 tropical storms and hurricanes have passed within this radius from the Richmond Bay area of Jamaica. The total number of storms can be broken down according to the categories described by the Saffir Simpson scale (Figure 5-117). The graph shows that the study area was more frequently hit by tropical storms (63) and was only affected by strong hurricanes (category 3 and higher) infrequently (20). Figure 5-118 shows the temporal distribution of storms. The graph shows that several years can pass without a hurricane, but it also indicates that more than one storm can pass close to the island in any given year. The figure also shows that the period between 2000 and 2010 was very active, with many years featuring more than one storm passing near the site and with one year recording four storms that passed within a 300km radius. Anecdotal accounts of the behaviour of the site during this decade should be considered as valuable in this analysis.

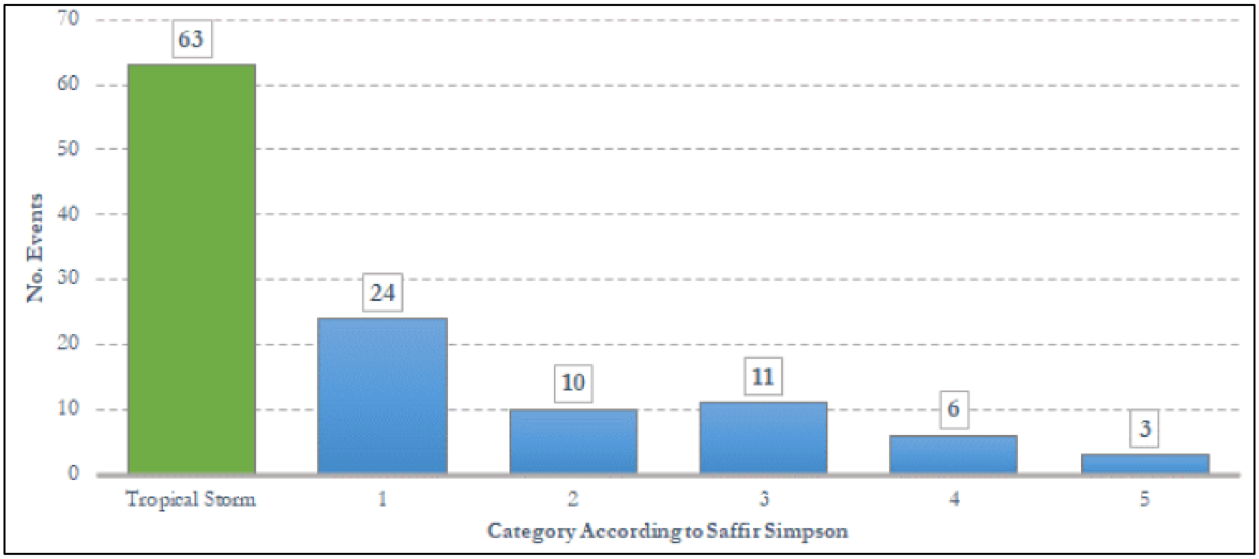


Figure 5-117 Storm distribution, according to Saffir Simpson classification, since 1850 showing storms that have passed within a 300km radius of the project site

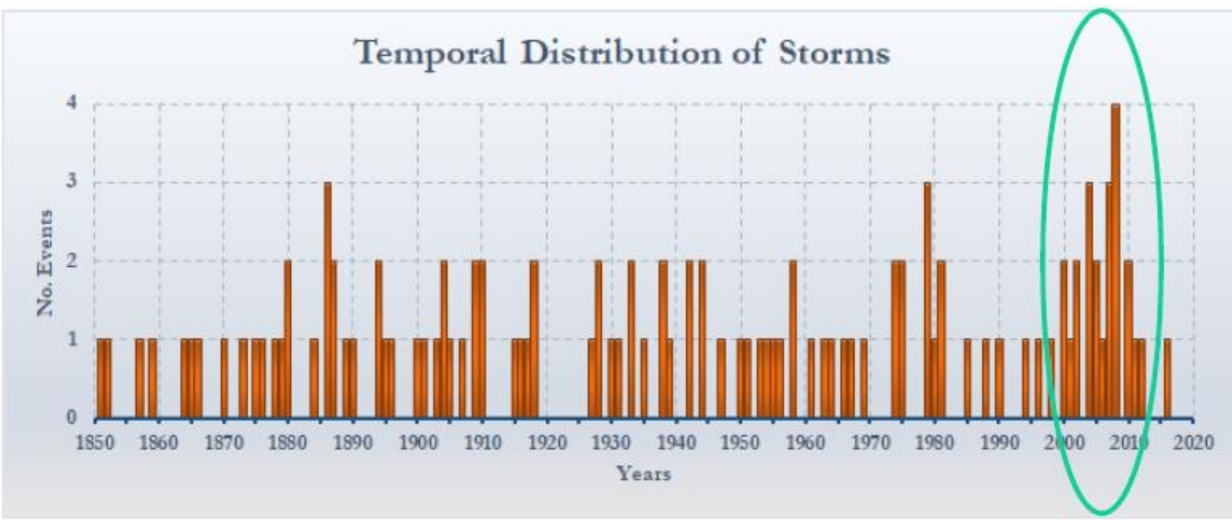


Figure 5-118 Storm distribution since 1851 showing storms that have passed within a 300km radius of the project site

5.3.2.2 Hurricane Simulations

Offshore Hurricane Waves

Deep-water wave parameters were calculated for each selected tropical cyclone using parametric models (Cooper, 1988; Young and Burchell, 1996). The resulting wave conditions were segmented into directional sectors and fit to a statistical function describing their exceedance probability. The wave parameter values for 50-year return periods were determined from the best-fit statistical distribution. The deep-water wave parameters corresponding to the 50-year return periods were computed for all directional sectors. Table 5-69 shows the wave heights, wind speeds, and periods for the directional sectors investigated.

The highest waves, as shown in the table, come from the east, with deep water wave heights of 11.51m for the 50-year storm. However, due to the breaking of waves caused by offshore features, the highest deep-water conditions do not always translate to the highest nearshore conditions. MIKE 21 SW and HD models were used to simulate the interaction of deep waters with bathymetry to determine the highest wave conditions near the project site.

Table 5-69 Boundary wave and uniform wind conditions used for 50-year return period simulations

Direction	Windspeed (m/s)	Wave height (m)	Wave period (s)
North	30.53	6.72	10.96
Northeast	37.68	10.91	14.87
East	35.40	11.51	15.38
Southeast	33.86	10.41	14.44
South	30.13	7.65	11.89
Southwest	25.11	6.47	10.70
West	28.06	6.51	10.74
Northwest	27.05	7.10	11.35

Surge Levels

Water levels rise during a hurricane's passage due to inverse barometric pressure rise (IBR), which is caused by the low atmospheric pressure in the hurricane's centre. Water levels were computed from each historical storm, as with wave heights, and the data was fitted to various statistical distributions. The analysis was not conducted on a directional basis due to the non-directionality of the water level increase phenomenon.

Based on correlation and goodness-of-fit to the most extreme values, the best-fit distribution was chosen. In addition to the extreme scenarios, it is critical to consider the long-term trends caused by global sea level rise. Scientists have predicted global sea level rise (GSLR) based on current rates of sea level rise and forecasting of the effects of climate change on thermal expansion of the seas and melting of glaciers and polar ice caps. The sea level rise component was calculated using an adapted version of the IPCC Summary for policymakers' sea level rise projections for the RCP4.5 and RCP8.5 scenarios. RCP8.5 is recommended because it is a more conservative estimate.

Tidal variations were considered and, based on the Admiralty Total Tide6 program, highest astronomical tide above MSL was determined to be 0.39m. It should be noted that this tidal level is higher than the DTU 10 tidal model prediction. The reason for this is that the DTU 10 global ocean tide model only uses the 12 major tidal constituents, whereas Admiralty Total Tide information is sourced directly from national hydrographic offices around the world, which collect real-time data that can capture other tidal constituents that the DTU 10 global ocean tide model does not. These effects were added to the IBR and the GSLR to produce final deep-water levels for the 50-year storm, which is shown in Table 5-70.

Table 5-70 IBR and design deep water surface level (m) for a return period of 50 years

Parameter	Value
IBR - Determined through statistical hind-casting analysis	0.35 m
Highest Astronomical Tide - Determined through historical analysis	0.39 m
Sea Level Rise Component	0.37 m
Rate of Sea Level Rise - RCP8.5 Scenario value from IPCC research	*7.4 mm/yr.*
Design Life - How long structure is to last (not related to design storm)	*50 yr.*
Total design deep water surface level (m)	**1.11 m**

5.3.2.3 Nearshore Wave Transformation of Hurricane Waves

The deep-water conditions were transformed to the nearshore regions and up to the project site using MIKE 21. Conditions for the extreme wave climate as listed in Table 5-69 and the deep-water surface levels were applied to the boundary of the model and transformed to the nearshore from the four main directional sectors – north-west, north, north-east, and east. The wind fields (magnitude and direction) shown in the table were applied as a constant over the entire model domain. Wind directions in a hurricane change rapidly, therefore, the worst-case scenario for wind direction was used, with winds approaching from the same dominant direction as the waves.

The coupling of hydrodynamics and waves in the numerical model is an important aspect of storm surge computations, particularly in areas where wave set-up is a significant component of total storm surge, such as the Caribbean. Large waves that approach shallow water or a reef and break, raise the water level causing localized currents. Currents and changing water levels influence waves by allowing them to travel further inland. MIKE 21's coupling of waves and currents allows these factors to be properly simulated.

The model was run with the conditions for the extreme wave climate listed above, and the maximum conditions near the shoreline were extracted. It should be noted that the simulation uses a 50-year time horizon to represent design water level conditions that include high tide and GSLR projections.

The maximum wave heights and storm surge resulting from the numerical model simulations are plotted in Figure 5-119 for the 50-year return period event and Figure 5-120 for the 25-year return period event. As shown, the simulations indicate that in the 50-year return period hurricane the entire shoreline is vulnerable to large wave attack (>1m) as far back as 50m from the shoreline and is entirely flooded up to 2.5m (excluding wave run-up) based on the existing topography. The simulations also indicate that in the 25-year return period hurricane the entire shoreline is also vulnerable to large wave attack (>1m) as far back as 50m from the shoreline and is entirely flooded up to 1.9m (excluding wave run-up) based on the existing topography.

Because the foreshore of the project site is low-lying and relatively flat (ground elevations less than 1.8m), it is important to understand that although the structures implemented to create/ protect the beach will be designed to sustain only minimal structural damage in the event of a hurricane, the stability of the beach itself may be severely impacted (flooded) and a portion of the nourished sand could be lost during these extreme events.

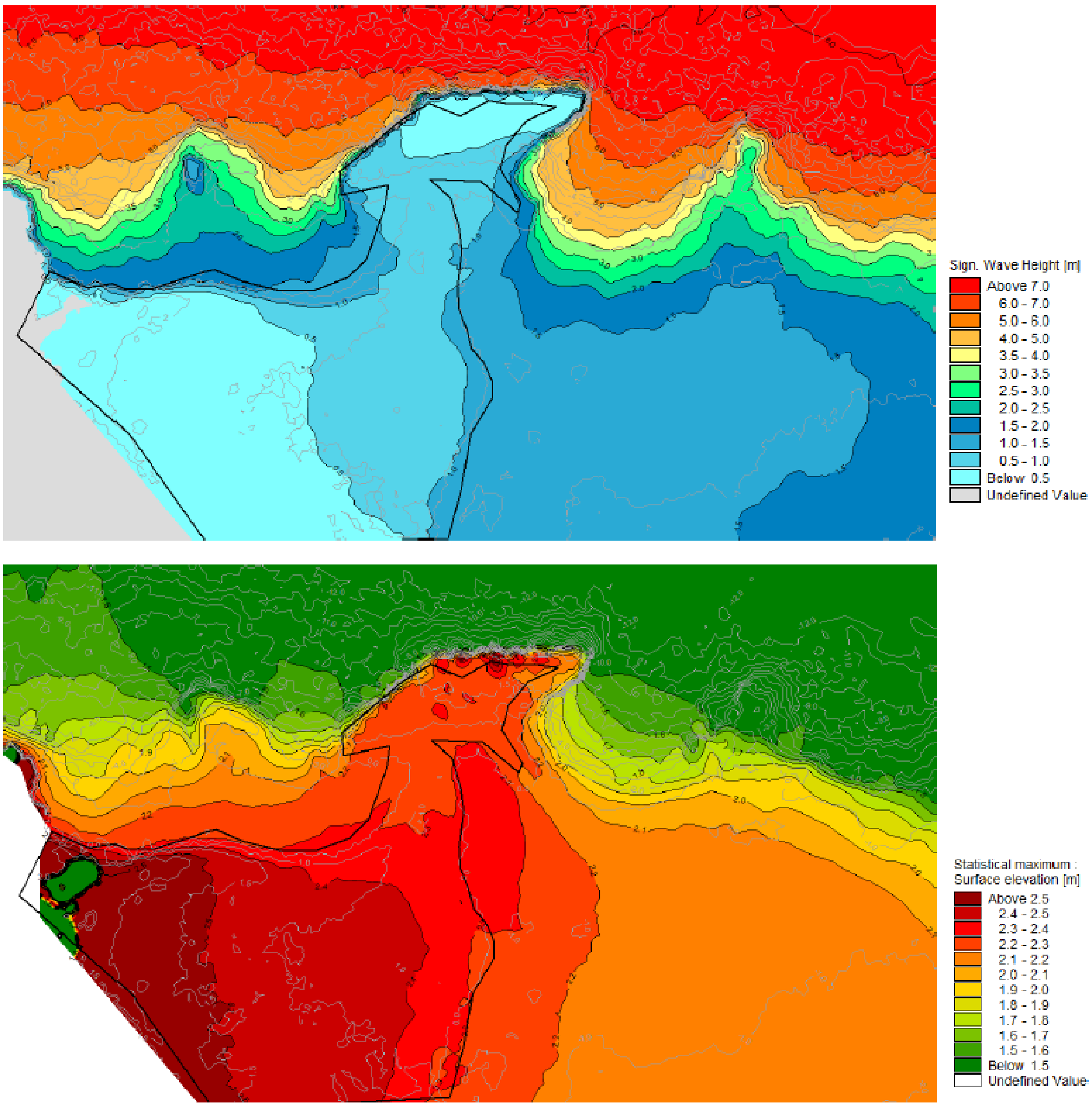


Figure 5-119 Simulation results of the 50-year return period event showing maximum wave heights (top) and storm surge (bottom)

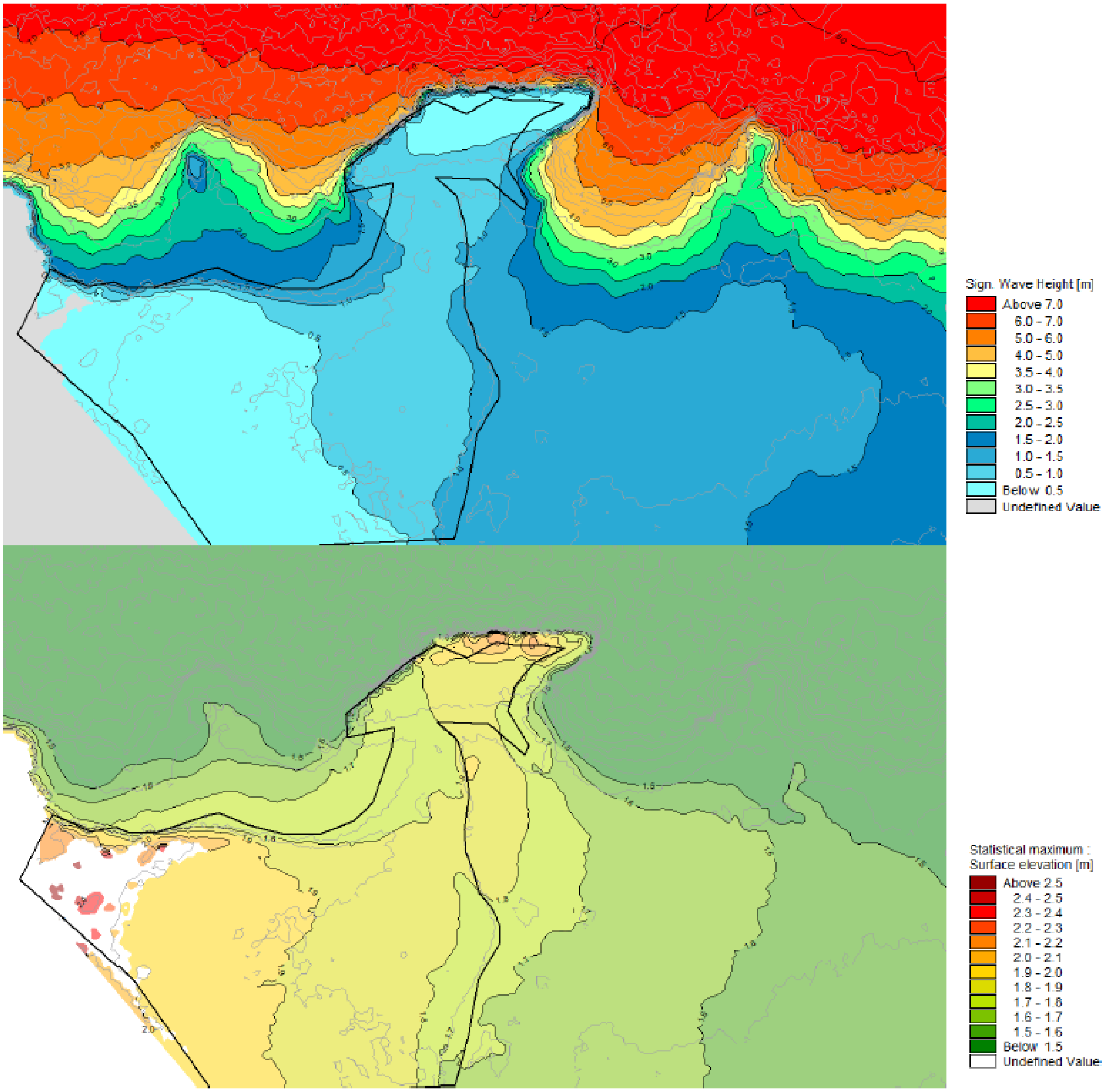


Figure 5-120 The simulation results of the 25-year return period event showing maximum wave heights (top) and storm surge (bottom)

5.3.2.4 Implication from Hurricane Waves

- The sudden change from deep water to the shallow shelf breaks the incoming hurricane waves. This causes significant rise to the water level leading to high levels of storm surge.
- The shoreline from all sides is vulnerable to storm surge. The site is completely inundated in the 25 and 50-year events, with inclusion of climate change impacts. There would be 1 to 1.5m of water above existing ground level for the 50-year event.

- The property and the buildings must be elevated above these storm surge levels of +2.5 above MSL, to avoid flooding.
- The overwater villas must also be elevated to minimize flooding and to withstand any waves to which they will be exposed. These villas are also best located away from the edge of the shelf where the waves break violently.
- Any structures on the peninsula will be exposed to extreme levels of splash from the high waves breaking at the shoreline. If not raised and appropriately setback from the shoreline there would be tremendous damage to any buildings. Properly designed reinforced concrete wall and rock revetment will also be needed to protect any structures and infrastructure.

5.3.3 Flooding

Anecdotal data collected indicates that the area is not prone to flooding during heavy rainfall, and areas where water would settle after rain events would infiltrate within one or two days. However, the site is susceptible to flooding during extreme storm events from overland generated flows (stormwater) and storm surge. The existing site is low-lying and relatively flat, which makes it susceptible to inundation during an extreme storm event.

5.3.4 Beach Stability

Satellite images of the shoreline that were available from Google Earth were extracted and geo-referenced into the project database (Figure 5-121). The geo-referenced satellite images were inputted to ArcGIS software where they were overlaid onto each other. For each available image of the area, the shoreline (which in this instance would refer to the high-water mark (HWM) or the ‘wetted’ area on the image) was traced over the base map and the location of the shoreline through the years was observed and compared.

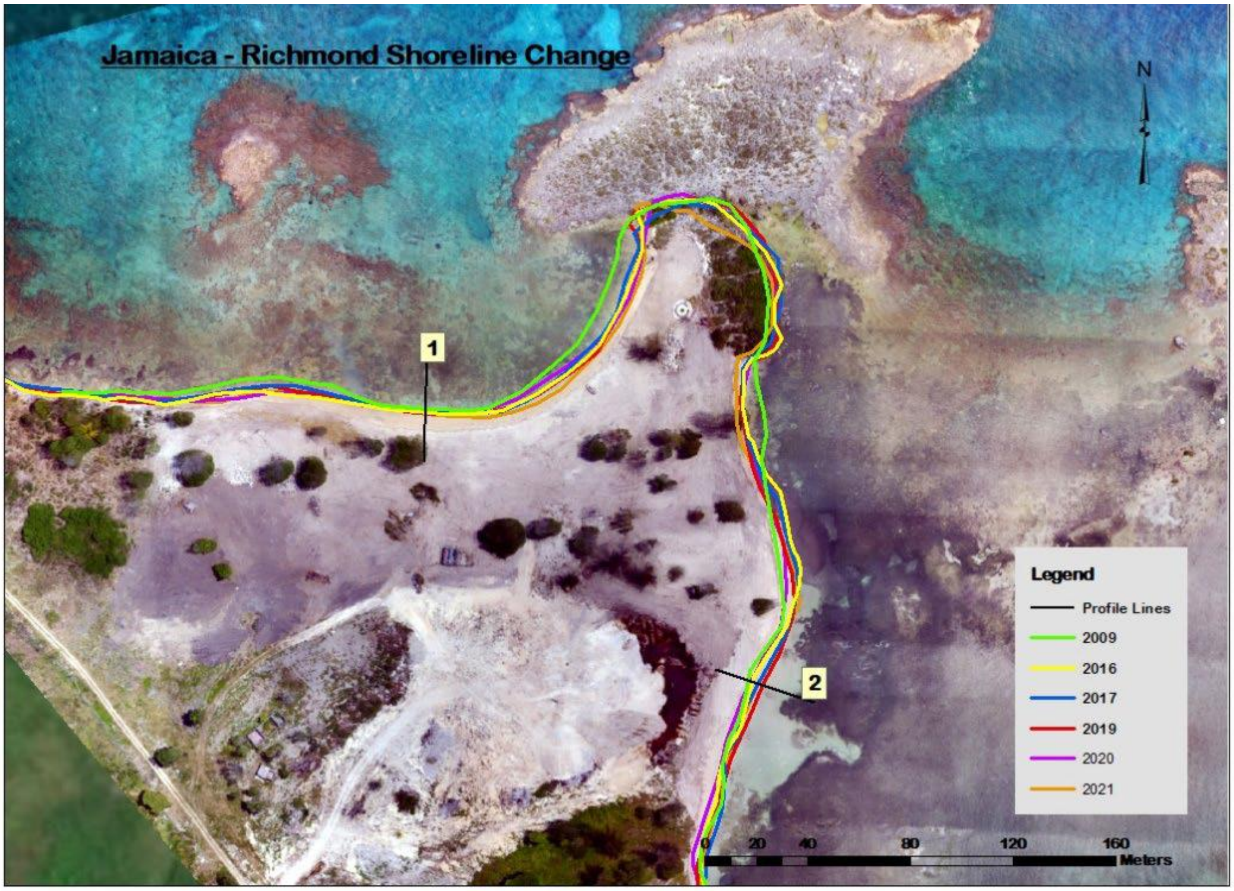


Figure 5-121 Historical shoreline changes between 2009 and 2021

There are some limitations to this methodology, uncertainties that mostly centre on the nature of the shoreline position at the time a satellite image is captured. Possible errors that could limit the analyses are:

- Seasonal error - Many beaches have seasonal cycles of erosion and accretion. Because high resolution satellite images are limited for the Caribbean islands, images cannot be selected on seasonal time frames.
- Tidal fluctuation error - The satellite images were obtained without regard to tidal cycles, which can result in inaccuracies on the digitized shoreline.
- Digitizing error - The error associated with digitizing the shoreline.
- Pixel error - The pixel size in orthorectified images is 0.5m, which means anything within 0.5m cannot be resolved.
- Rectification error – Satellite images are corrected, or rectified, to reduce displacements caused by lens distortions, earth curvature, refraction, camera tilt, and terrain relief using remote sensing software.

Even considering the range of possible errors, the comparison of the variations between images is regarded as helpful in quantifying the coastal changes (in a general sense), and an analysis was therefore still conducted. Five satellite images of the shoreline were available for comparison. These images were captured between 2009 and 2020 from the Google Earth© archives. One drone image captured in 2021 was also used in the analysis. Along the western beach, the images show erosion from 2009 to 2016. From 2016 to 2021, the shoreline does not change much and seem to be stable over those five years. Along the eastern beach, there seems to be erosion between 2009 to 2016 at the northern end of the eastern beach, while in the middle there is evidence of accretion during the same period. Along the eastern shoreline, between 2016 to 2021, the shoreline remained stable.

Figure 5-122 shows hurricanes passing within 300km of Jamaica between 2009 to 2016. Hurricane Sandy passed over Jamaica in 2012 as a category 1 hurricane. What this points to is:

- The entire project shoreline eroded sometime between 2009 and 2016. Since then, the shoreline has remained relatively stable and in fact has experienced some growth along the eastern shoreline.
- Hurricane events between this period seem to have contributed to this erosion. Therefore, this shoreline is vulnerable to erosion from storm events.

Figure 5-122 Hurricanes passing near project site between 2009 to 2016

5.4 CULTURAL/HERITAGE

The Archaeology Division of Jamaica National Heritage Trust (JNHT) conducted an Archaeological Desktop Assessment of the proposed project area, and the following sections present the main findings from the associated report. The detailed document "Archaeological Desktop Assessment – Secrets Richmond Hotel, St. Ann" (JNHT, 2023) is submitted as a standalone report document.

5.4.1 Methodology

This is a thorough review of all the available written and graphic information relating to the area in order to identify the likely character, extent and relative quality of the actual or potential archaeological and architectural resources. It includes relevant historical documents, journals and books, aerial photographs and/or satellite imagery, maps and other contemporary data found in the nation's repositories such as the Island Record Office, National Archives, National Library of Jamaica, University of Technology (UTECH), University of the West Indies (UWI) and private collections. Web sites were also consulted for the following:

- Historical documentation including, maps, plans, estate accounts, correspondence, titles, deeds, just to list a few.
- Published and unpublished results of any previous archaeological work on the site or in its vicinity.
- Satellite images and aerial photographs.

5.4.2 Results

5.4.2.1 Historical Background

Richmond Estate

The Richmond Estate was born out of an amalgamation of several estates/ properties. John Shelton had received a land grant in 1678 from the King of England, Scotland and Ireland, Charles II. This land grant was Richmond where he started growing indigo. Around 1730 his grandson John Shelton III purchased the neighbouring lands belonging to small holders namely Browne, Grey, Banks, Heming, Whitehorne and Thomas Williams. All these properties combined were renamed Richmond Estate and formed a large sugar estate. The accounts produce also indicates that Richmond not only produced sugar but rum, pimento and corn in varying years. In the late 1730s, Shelton mortgaged the plantation to Gershom Ely, a Jewish Merchant from Kingston however by 1747 the property became heavily indebted as Gershom owed the amount of £68,198. The property was then sold to the Hon. Philip Pinnock, Speaker of the Jamaica House of Assembly who built the Richmond Great House in the 1760s.

In 1775 Mr. Pinnock became greatly indebted to Honourable William Gray who was Provost Marshall General of Jamaica from 1768 to 1776. This was in the amount of £120,000. He mortgaged and then signed over the house along with the estate for the £120,000 pounds to the Hon. William Gray. By 1778 William Gray constructed a New Sugar works alongside the Old Sugar works forming two separate sugar plantations namely Richmond Old Works Estate and Richmond New Works Estate. The continued debt resulted in William Gray selling both plantations to his principal creditor Emanuel Baruch Lousada, a Jewish merchant from Kingston who resold it to another Jewish Merchant Jacob Israel Bernal in 1788.Ownership passed on to I. Jacob Bernal in 1792 with 123 slaves and 63 stock and a new water wheel was installed. It was 36 ft in diameter, with shaft, and a cogwheel 16 ft in diameter. The 1763 Craskell and Simpson map also shows a windmill and two waterwheels on the estate while James Robertson's 1804 map show Richmond estate having a waterwheel and house on the Old Work sand a waterwheel and a house on the New Works. By 1810 the estate was in the hands of Jacob Israel Bernal with 328 slaves and 185 stock along with Edinburgh Castle and in 1817 owned by Jacob J. Bernal with 298 slaves and 137 stock along with the New Works. In 1824 it was owned by his son Ralph Bernal MP with 270 slaves and 116 stock which by 1831 decreased to 251 slaves with no stock. In 1844 when this property was 1,416-acre Ralph Bernal left his entire estate in England and Jamaica to his son Ralph Bernal-Osborne, from Ireland who eventually gave Richmond Estate to his younger daughter, Grace Bernal-Osborne as part of her dowry on the occasion of her marriage in 1874 to His Grace William Amelius Aubrey DeVere Beauclerk, the 10th Duke of St. Albans.

Richmond was owned for much of the 19thC by the Dukes of St. Albans, a branch of the family of DeVere which held the hereditary office of Lord Great Chamberlain of England for 8 Centuries.

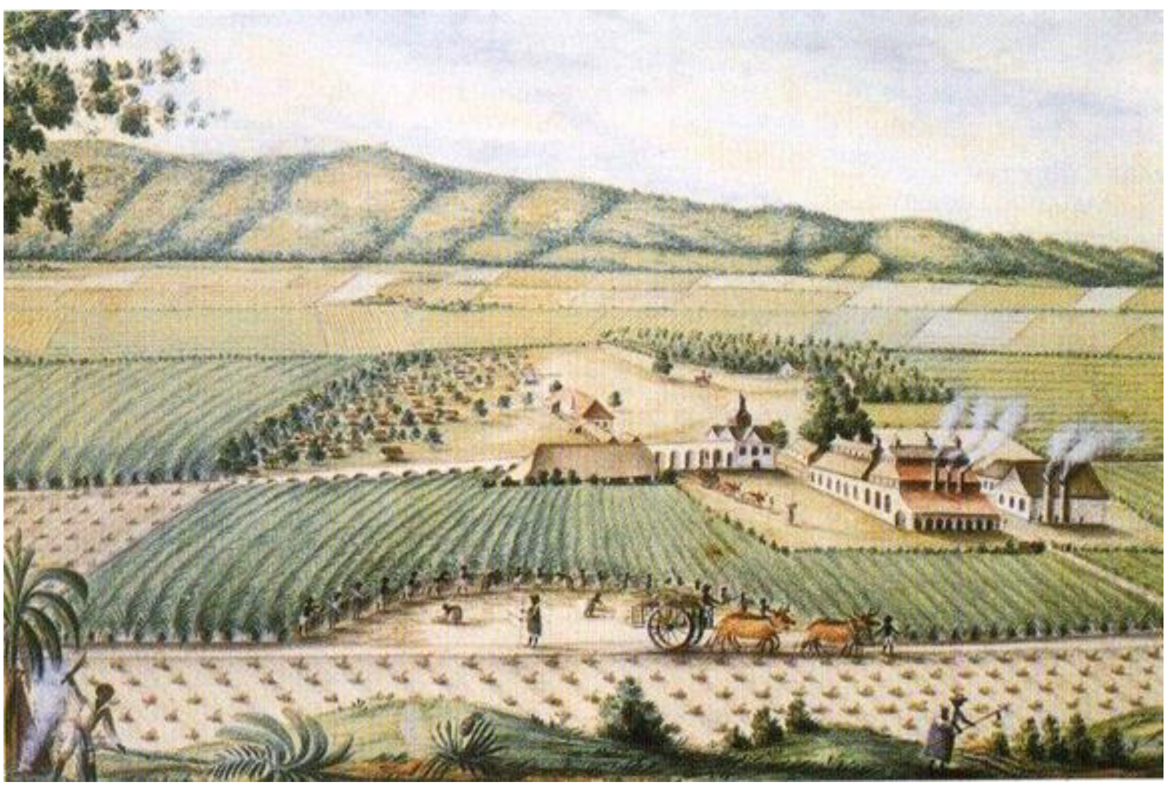


Plate 5-70 Richmond Estate, a watercolour by John Henry Schroeter, c. 1800

In 1879 this 1,800-acre property was owned by Richmond-Llandovery Estates. The 1855 plan of the estate shows the proposed development area as being in ruinate and is also observed to be in ruinate to date. The original 18thC Richmond Great House was destroyed by a hurricane during the 1880s.

In 1910 James Anthony Dougall bought Richmond from the trustees of the estate of the Duchess of St. Alban's. At this time only the 18th Century Overseer's House was on the Plantation. In 1912 Dougall decided to build a new Great House. The house was built on a hilltop amongst a ridge of wooded hills overlooking the sugar factory and had a long, curving driveway, flanked by royal palms. It was however built in the Jamaican Colonial Gingerbread style typical of the Edwardian era. The house stood in the middle of a beautiful tropical garden surrounded by manicured lawns, and the wide wrap around verandah providing a panoramic view of the wide coastal plain and the Caribbean Sea. The List of Properties outlines Richmond in 1912 as having 1795 acres and valued at £6300 and owned by A.J. Webb while producing sugar. By 1920 however the Estate was in the ownership of James A. Dougall with acreage of 1461 valuing £15000 and still being operated as a sugar estate. By 1930 the Richmond Estate had increased acreage to 2524 ½ valuing £15500 and still being run as a sugar estate.

At some stage the Banks Estate merged into Richmond, but Blenheim, Coolshade and Deveronside fell under the same management regime even though they had separate titles. These estates can be seen adjoining or in close proximity to the Richmond Estate on the James Robertson 1804 map and Estate plans (See maps 2, 3 and 4 and plan 2). Richmond was merged with Llandovery Estate in 1952 and operated as Richmond-Llandovery Estates by the Dougalls. It produced the famous TTL Rum until 1969, when the last sugar was produced, and the sugar factory was shut down. In 1970 the Dougalls sold Richmond-Llandovery Estates to the Jamaican Government, who in 1972 sold Richmond Estate to Leslie Adolph Brooks. The Brooks family operated it as a sugar, citrus and cattle estate and eventually sold the property in 2005.

Plate 5-71 The new Richmond Great House in 1927; photo by George A. Dougall

Plate 5-72 Image of Chimney from the Richmond Estate Works

Hartland Estate

The area now labelled Hartland Estate was once part of the Banks Estate as observed on the 1839 plan of the Estate. This property is south of the proposed development area across the highway that divides the Richmond Estate. The Banks Estate was observed to be adjoining the Richmond Estate to its east also (Plate 5-73).

Plate 5-73 Showing the Hartland Estate sign

The Banks Estate was owned in 1792 by Baruch Emanuel Lousada with 117 slaves and 49 stock, later owned in 1810 by Isaac Baruch Lousada et al. with 99 slaves and 16 stock and by 1817 owned solely by Isaac Baruch Lousada with 124 slaves and 51 stock. It was then under the proprietorship of Messrs. Lousada by 1824 with 114 slaves and 40 stock and by 1831 with 112 slaves and 15 stock. In 1844 this 759-acre property was owned by E. Lousada. The Lousada family was Jewish and had been in Jamaica before the English conquest. The motto of the Lousada family is “Honour is my Guide”. In 1879 this 875-acre property was owned by the heirs of Bernal who owned Richmond. As observed on the maps and the plan there was a works yard. The plan of the Banks Estate clearly outlines the works yard and overseers house in the area labelled as “k” and the Negro houses labelled as “l” (Plate 5-75). A windmill and an animal mill were illustrated on the Craskell and Simpson 1763 map while on James Robertson’s 1804 map a waterwheel was observed. Besides the largescale cultivation of sugar, the Banks Estate was also observed as engaging in the production of rum, logwood, mill cases, old iron and the hireage of livestock according to the Accounts produce.

It is uncertain when the name changed to Hartlands Estate however it is a possibility that Hartlands Estate got its name from Daniel Hart who owned the Coolshade Estate that can be seen on the 1844 and 1804 maps and the 1850 plan of the Coolshade Estate as an adjoining estate to Richmond (Plate 5-76).

Banks Estate in 1912 was 900 acres valued at £500 owned by Watkis and Williams and utilized as a pimento property. In 1920 New Bank and Tanglewood were seen as combined and having 98 acres valued at £309 and usage as common and pimento.

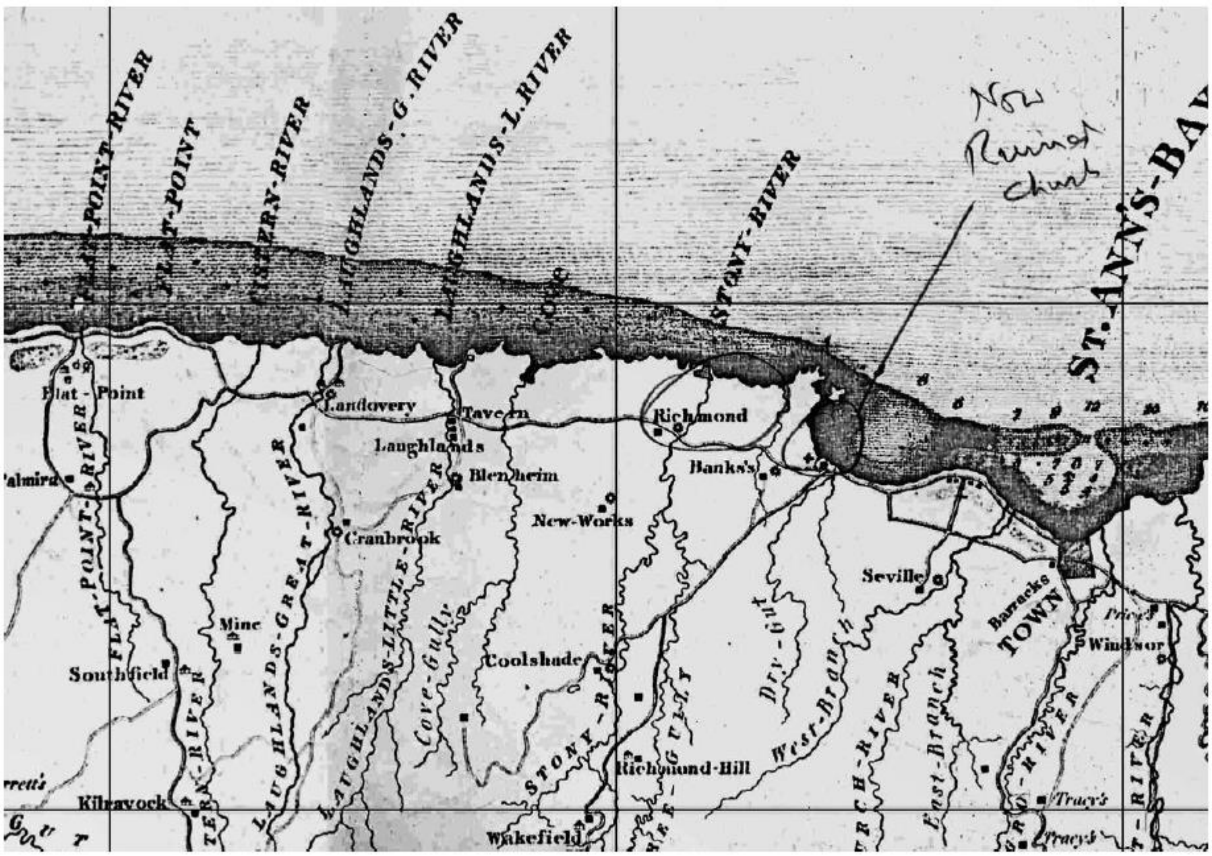


Plate 5-74 James Robertson's 1804 map Showing Richmond, Banks and Coolshade Estates

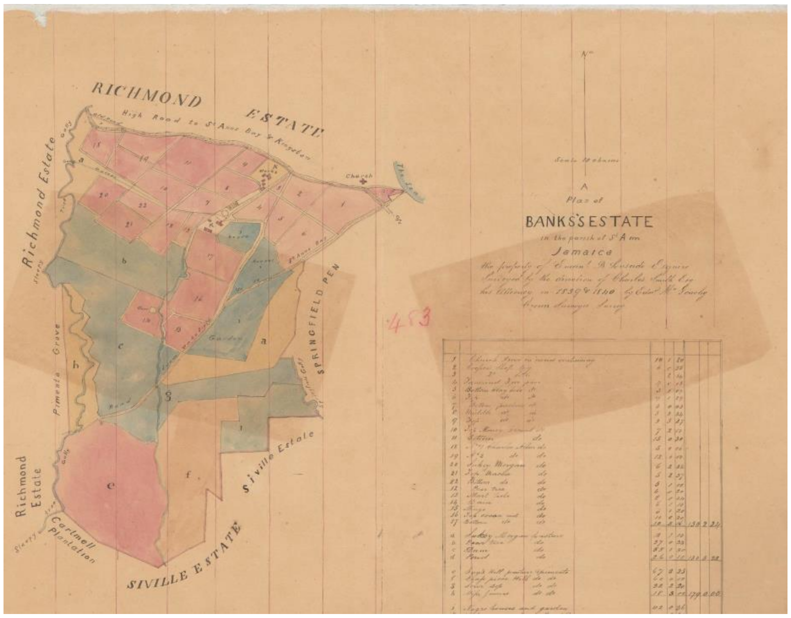


Plate 5-75 Plan of Banks Estate 1839 -1840

Plate 5-76 Plan of Coolshade Estate in 1850. (Property of Daniel Hart

The Priory

The Priory once formed part of the Seville Estate and was bought in 1810 by James Syms of Arabia Felix. The Priory was built on the site of an old Spanish monastery at the western end of the then Sevilla Nueva. The name Priory means a small monastery or nunnery governed by a prior or prioress. It was owned in 1824 by Mrs. Jane Syms née Casey, widow of James Syms, with 11 slaves and 3 stock. In 1879 this property was subdivided with one plot measuring 72 acres and another 38 acres which was cut up into lots and owned by the Central Housing Authority. Priory is an immediate adjoining community to Richmond heading in an easterly direction. The Priory settlement took the name of the originating property. There was also a small settlement here in the late 17thCentry. The first Anglican Church in St. Ann was built here in 1690 by Colonel Gershom Ely, in the shape of a Greek cross (Plate 5-78). There were also graves on the property, the oldest of which dated back to 1750. These were moved to the churchyard of the St. Agnes Anglican Church also in Priory (Plate 5-79). The historical maps indicate the location of the church where the ruins of the brick, stone and coral structure are still standing. The Hofstra University Marine Laboratory was also located in this area and American students visited to get practical courses in Marine Biology. A large metal anchor marks the entrance to several hotels and the site of the proposed development (Plate 5-80). It is uncertain where this anchor originated from.

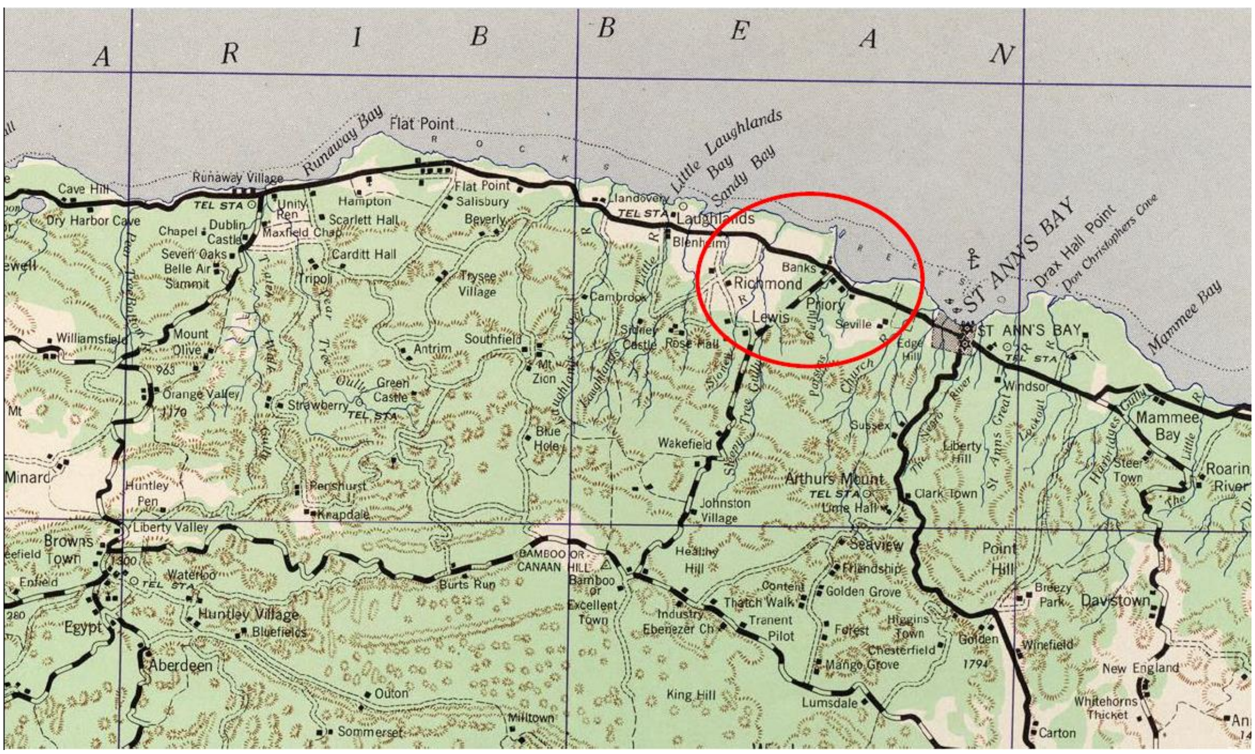


Plate 5-77 1944 Map displaying Priory, Richmond, Banks the Old Priory Church and the site of the proposed development

Plate 5-78 Ruins of the old Priory Church

Plate 5-79 The St. Agnes Anglican Church

Plate 5-80 Large iron anchor at the entrance that leads to the proposed development

Two vernacular houses were also identified in Priory (Plate 5-81). These houses form an important part of Jamaica's architectural heritage. They are made with hip roofs, wooden flooring fretwork for decoration, sash and French windows. This kind of housing is not being constructed anymore and must be preserved.

Plate 5-81 Showing two vernacular houses with hip roofing, verandah, wooden rails, sash windows and wooden doors

5.4.3 Discussion and Conclusion

The proposed development is slated to take place on the northern side of the Richmond Estate within the vicinity of the beach. Although the Richmond Estate was a large sugar estate the historical plan shows that this section of Richmond was in ruinate and therefore means that it was not utilized. As observed to date the property is still in ruinate and very few historical remnants are within the 1-kilometre radius of this site. The possibility exists however that there could be foundations of historical structures or features. The ruins of the Old Priory church, the St. Agnes Anglican Church and the vernacular houses are of high priority as they are examples of both the religious and architectural heritage of the island. It should be noted that the Jamaica National Heritage Trust Sites and Monument Record has shown several prehistoric sites in the vicinity, namely at Llandovery, Cranbrook, Richmond Hill, Southfield, Seville, Drax Hall and Little River. The possibility of a Taíno site on the Richmond Estate cannot be ruled out.

However, based on the findings of the desk-based assessment the Jamaica National Heritage Trust Archaeology Division does not have an issue with the development.

5.5 TRAFFIC IMPACT ASSESSMENT

The following section contains excerpts from the detailed Traffic Impact Assessment Report (CEAC Solutions Co. Ltd., 2022) conducted for the proposed project.

5.5.1 Introduction

The proposed service access to project site would be via an existing 12m reserved road (~6.5m carriage way) approximately 650m from the intersection of the ARG Byfield leg of the A1 highway. The main entrance is a proposed road also intersecting the highway. This highway links the residential communities in Plantation Village and Priory and the commercial town of St. Ann's Bay. Heading North-West along the main road would take you to Runaway Bay and continuing further would place you in Discovery Bay, driving in a South-Easterly direction takes you to St. Ann's Bay and beyond this to Steer Town. Presently, the site has tourist attractions and hotels in its close surrounds as well as residential communities and some local shops and stores. As such this segment of the transportation network is an extremely important and highly traversed area.

An investigation was necessary to understand the effects to the surrounding traffic conditions. The Traffic Impact Assessment (TIA) includes an assessment of transportation network performance based on varying traffic volume conditions:

1. Pre-Development conditions.
2. During Construction conditions.
3. Future Conditions with/without the Proposed Development.
4. Future Conditions with improvements to road corridor.
5. Provision of recommendations for mitigation of possible impacts.

Key objectives of this exercise are summarized as follows:

1. Define the general environment in which the development will be constructed by conducting or acquiring traffic counts in the vicinity of the ARG Byfield A1 Highway and the adjacent intersections at Bamboo Main Road.
2. The determination of Average Daily Traffic (ADT) and Peak Hourly Traffic (PHT) along the ARG Byfield A1 Highway and the intersection at Bamboo Main Road.
3. Determine the expected ADT and PHT at the proposed entrance of the property during construction and post-construction phases.
4. Determine the impact on roadway level of service (LOS) that the development will have.
5. Provide mitigative measures based on the impacts discovered.

5.5.2 Approach and Methodology

The approach involved dialogue with the National Works Agency (NWA) and other relevant stakeholders to guide the assessment scope and methods. The methodology included the following:

1. Project inception meetings
   a. Collect and collate project information and details required from the client.
   b. Converse with the NWA to discuss project parameters and assumptions that will be made to refine the scope of works required for approvals.
2. Desktop Data Collections
   a. NWA Road Network
3. Field Data Collection
   a. Collect existing information traffic count information from the NWA, and where there is absent information;
   b. Field parameters to include:
      i. Signage and road markings
      ii. Lane and shoulder widths
      iii. Sight distance
      iv. Grade (slope of the road)
4. Impact Analysis by using:
   a. The capacity analysis methodology published in the Highway Capacity Manual (HCM) 2000 edition. Sidra Intersection 8.0 traffic analysis software to analyse the intersections performance pre-development, during construction and post-construction.

The analysis was undertaken using the capacity analysis methodology published in the Highway Capacity Manual. Capacity analysis is a set of procedures employed in estimating the traffic carrying ability of roadways based on operational conditions. The level of service analysis for the signalized intersections and arterial segments was performed using Sidra Intersection 8.0 Traffic analysis software.

The efficiency of traffic operations was measured with the Level of Service (LOS) grading system. Evaluation of the roadway and associated intersections involved the assignment of grades from “A” to

"F" with "A" representing the highest level of operating conditions and "F" representing extremely congested and restricted operations (Table 5-71).

Table 5-71 Category of Level of Service at signalized intersections. From Chap 10 Traffic and Highway Engineering, Garber, L. Hoel.

Level of Service (LOS) Category	Category Characteristics
A	Describes the level of operation at which the average delay per vehicle is 10.0 seconds or less. At LOS A, vehicles arrive mainly during the green phase, resulting in only a few vehicles stopping at the intersection. Short cycle lengths may help in obtaining low delays.
B	Describes the level of operation at which delay per vehicle is greater than 10 seconds but not greater than 20 seconds. At LOS B, the number of vehicles stopped at the intersection is greater than that for LOS A, but the progression is still good, and cycle length also may be short.
C	Describes the level of operation at which delay per vehicle is greater than 20 seconds but not greater than 35 seconds. At LOS C, many vehicles go through the intersection without stopping, but a significant number of vehicles are stopped. In addition, some vehicles at an approach will not clear the intersection during the first cycle (cycle failure). The higher delay may be due to the significant number of vehicles arriving during the red phase (fair progression) and/or relatively long cycle lengths.
D	Describes the level of operation at which the delay per vehicle is greater than 35 seconds but not greater than 55 seconds. At LOS D, more vehicles are stopped at the intersection, resulting in a longer delay. The number of individual cycles failing is now noticeable. The longer delay at this level of service is due to a combination of two or more of several factors that include long cycle lengths, high (v/c) ratios, and unfavourable progression.
E	Describes the level of operation at which the delay per vehicle is greater than 55 seconds but not greater than 80 seconds. At LOS E, individual cycles frequently fail. This long delay, which is usually taken as the limit of acceptable delay by many agencies, generally includes high (v/c) ratios, long cycle lengths, and poor progression
F	Describes the level of operation at which the delay per vehicle is greater than 80 seconds. This long delay is usually unacceptable to most motorists. At LOS F, oversaturation usually occurs—that is, arrival flow rates are greater than the capacity at the intersection. Long delay can also occur as a result of poor progression and long cycle lengths. Note that this level of service can occur when approaches have high (v/c) ratios which are less than 1.00 but also have many individual cycles failing.

The scenarios investigated included are summarized as follows:

I. Pre-construction scenario (Existing Conditions) at Bamboo/North Coast A1 main road intersection
II. During Construction: with proposed main intersection, and the existing intersection.
III. Operational (Post-construction) scenario at year 1: with proposed main intersection, and the existing intersection.
IV. Operational (Post-construction) scenario at year 1: with proposed main intersection, the existing intersection and improvements to corridor.
V. Operational (Post construction) scenario at year 10 with 3% growth per annum with Actuated Signalized Intersection.: with proposed main intersection, and the existing intersection.

VI. Operational (Post construction) scenario at year 10 with 3% growth per annum with Actuated Signalized Intersection.: with proposed main intersection, the existing intersection, and improvements to corridor.

It must be noted that the improvement of the corridor was included as there are currently recommendations being made to improve the road corridor along the ARG Byfield section of the highway to alleviate traffic at the Bamboo Intersection.

5.5.3 Delay Assessment

5.5.3.1 Intersection, Capacity and Sight Distance Data

Roads and Intersection to be Impacted

The proposed development is to be located on a currently vacant, naturally vegetated land with coastal frontage. As a result, there is no current impact on traffic volumes influenced by site conditions. The site's service entrance is located on a reserved access road off the intersection of the ARG Byfield A1 Main Road and the Bamboo Main Road. A proposed intersection would be created as the main entrance for the project and would be placed about 640 m from the existing intersection at the Bamboo Main Road. The development will have a direct impact on the performance of the existing intersection and as such this provides the basis that the analysis of this segment will provide substantial insight into the overall traffic impact in the area.

Both intersections are key components of the project's road network as they provide a link to the Priory community, local guesthouses, churches, shops and other services.

Road Classification and Capacity

The A1 roadway would be categorized as a Class A road network spanning from of the Mandela Highway in Kingston to Negril, Westmoreland. The ARG Byfield segment is located in St. Ann and is approximately 6.7km long, spanning Drax Hall to Salem (Figure 5-123).

Figure 5-123 Road Classification type of the ARG Byfield A1 Highway

Speed Limits and Sight Distance

The observed speed limit on the modelled segment of the A1 main road was noted to be 50km/h. Based on the posted speeds; the minimum required stopping sight distance was determined to be 130m[3]. By traversing the area, the sight distance was deemed to be satisfactory within the majority of the roadway areas adjacent and accessible by the site.

5.5.3.2 Existing Conditions

Traffic Volumes

Traffic count data was retrieved from the NWA for the Laughlands/Bamboo Main Road Intersection of the highway for the date, July 30th, 2019 (8 am - 7 pm). The counts were collected at 5 minutes intervals. This data, along with a suggested annual increase in traffic volumes was used to predict the hourly traffic flow volumes for the intersections during 2022.

The traffic counts revealed that the AM peak was between the hours of 8:00 AM – 9:00 AM period. The midday peak was recorded at 1:00 PM – 2:00 PM. While the PM peak volume was recorded

[3] AASHTO: A Policy on Geometric Design of Highways and Streets, 2018

between 5:30 PM and 6:30 PM. The modified 2019 traffic volumes were then used to determine the 2022 traffic volumes also by using the 3% annual volume increase.

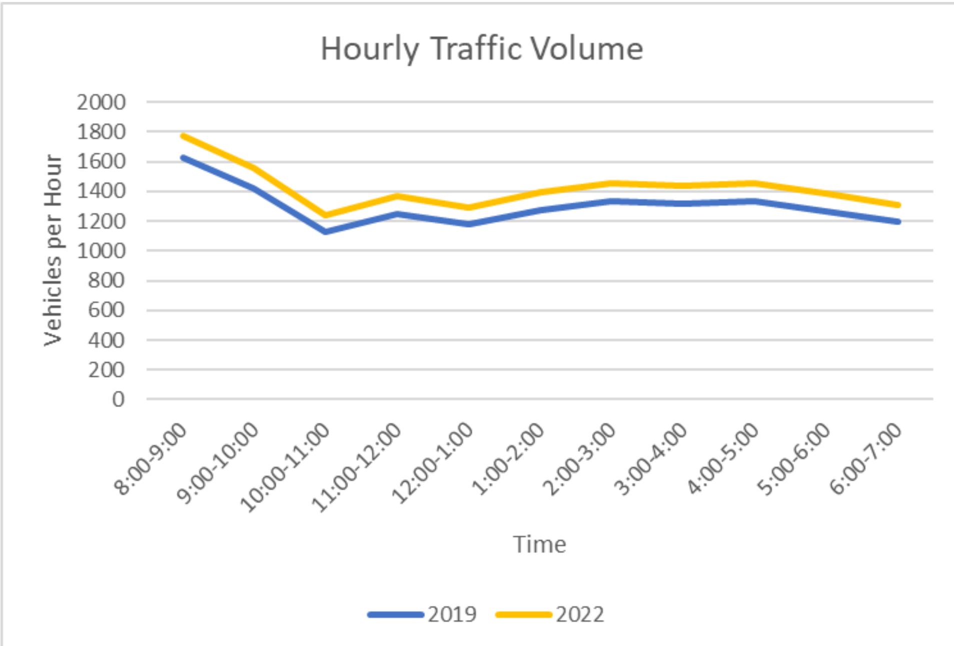


Figure 5-124 Comparative hourly traffic flow volume trends at the Bamboo/Laughlands Intersection (2019 and 2022)

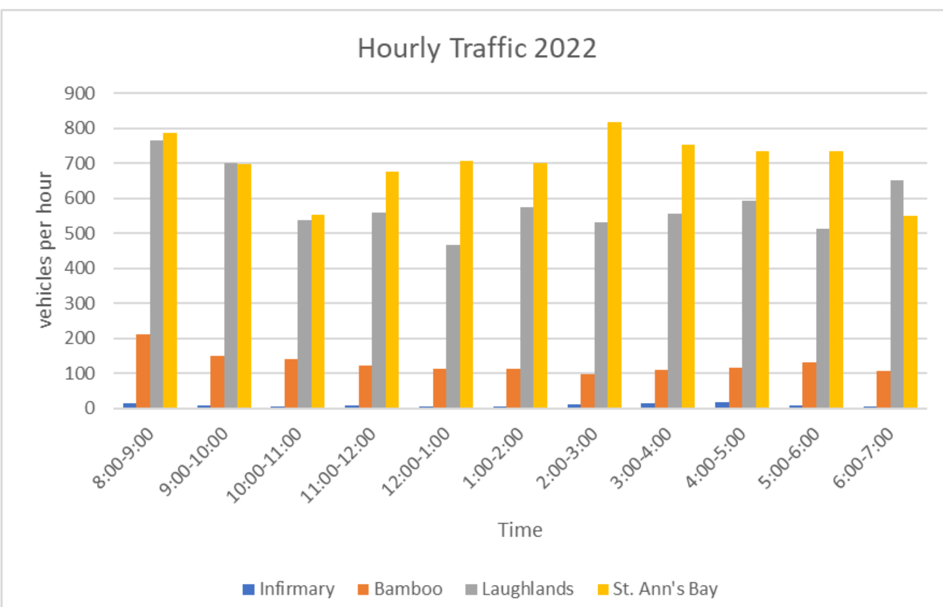


Figure 5-125 Showing breakdown of traffic volumes at Bamboo/Laughlands intersection by direction,2022.

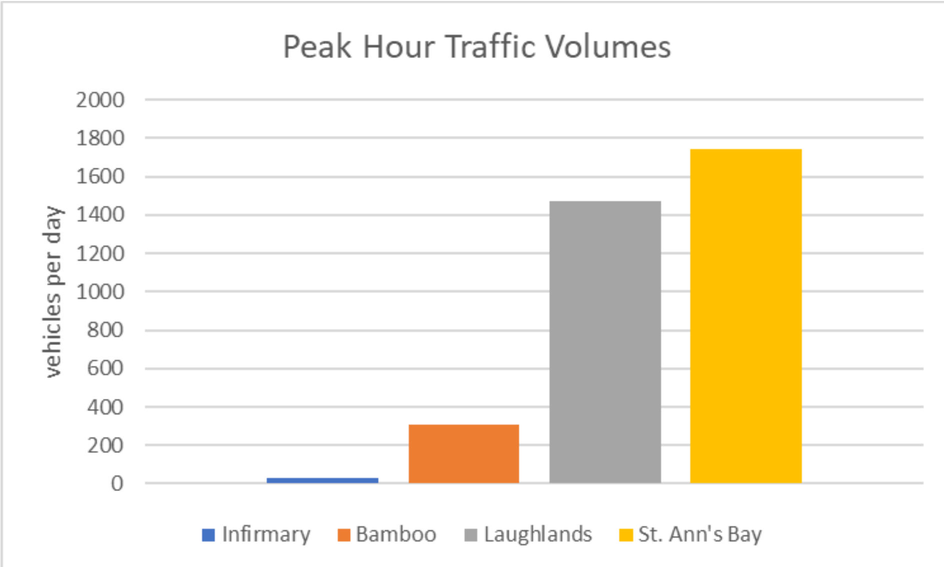


Figure 5-126 Showing peak traffic volumes arriving at the Bamboo/Laughlands intersection (8:00am – 9:00am). Estimated for 2022 using ITE trip manual rates and existing flows

Existing Bamboo Intersection

Analysis of the existing scenario gives a comparative baseline for the expected impacts of the proposed developments. The current performance shows a largely moderate to poor level of performance as motorist experience long delays to traffic flowing in most directions.

Traffic coming from the St. Ann's Bay direction experiences particularly low Level of Service as, it delays during peak go up to 160.2 seconds. Traffic moving in the opposite direction experience the highest Level of Service with average delays of 17.3 seconds. The poor Level of Service of the traffic coming from the St. Ann's Bay direction is attributable to the high traffic volume passing through a signalized intersection that was not designed to carry that volume. Figure 5-127 illustrates the Level of Service at the intersection.

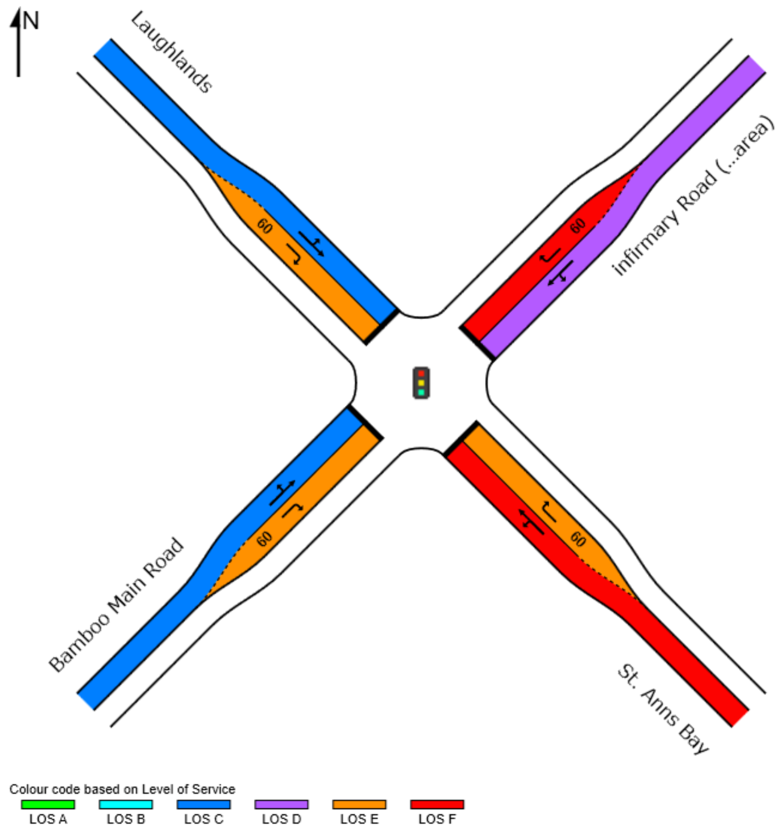


Figure 5-127 Level of Service of Roadway Network between Bamboo Main Road, Laughlands and St. Ann's Bay Intersection

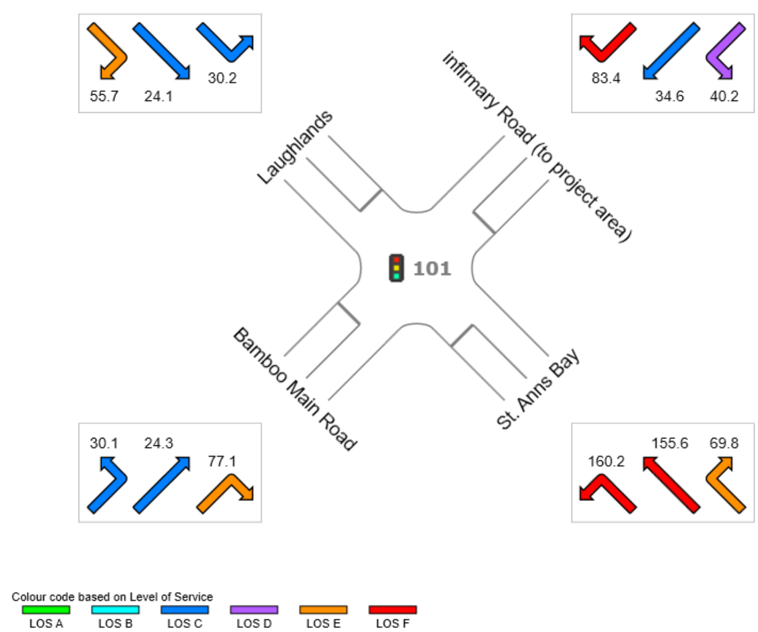


Figure 5-128 Delay at each lane at the intersections

Table 5-72 Showing the movement performance at the Bamboo Main Road/Laughlands Intersection for the AM Peak Hour Pre-Construction.

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total	HV				Vehicles	Distance				
		veh/h	%	v/c	sec		veh	m				km/h
SouthEast: St. Anns Bay												
21	L2	93	3.2	1.055	160.2	LOS F	89.3	689.5	1.00	1.55	1.87	14.4
22	T1	682	13.2	1.055	155.6	LOS F	89.3	689.5	1.00	1.55	1.87	15.8
23	R2	13	7.7	0.062	69.8	LOS E	0.8	6.3	0.89	0.68	0.89	25.3
Approach		788	11.9	1.055	154.8	LOS F	89.3	689.5	1.00	1.53	1.85	15.7
NorthEast: infirmary Road (to project area)												
24	L2	14	7.1	0.065	40.2	LOS D	0.6	4.6	0.88	0.68	0.88	35.6
25	T1	1	0.0	0.065	34.6	LOS C	0.6	4.6	0.88	0.68	0.88	36.3
26	R2	1	0.0	0.013	83.4	LOS F	0.1	0.5	0.96	0.59	0.96	26.8
Approach		16	6.3	0.065	42.6	LOS D	0.6	4.6	0.89	0.67	0.89	34.9
NorthWest: Laughlands												
27	L2	2	50.0	0.808	30.2	LOS C	33.1	246.3	0.88	0.85	0.94	42.0
28	T1	760	7.1	0.808	24.1	LOS C	33.1	246.3	0.88	0.85	0.94	44.5
29	R2	3	0.0	0.008	55.7	LOS E	0.2	1.2	0.79	0.63	0.79	32.7
Approach		765	7.2	0.808	24.3	LOS C	33.1	246.3	0.88	0.84	0.94	44.4
SouthWest: Bamboo Main Road												
30	L2	29	17.2	0.060	30.1	LOS C	1.1	8.9	0.71	0.69	0.71	41.0
31	T1	1	0.0	0.060	24.3	LOS C	1.1	8.9	0.71	0.69	0.71	40.4
32	R2	181	4.4	0.754	77.1	LOS E	13.1	94.8	0.99	0.82	0.99	26.1
Approach		211	6.2	0.754	70.4	LOS E	13.1	94.8	0.95	0.80	0.95	27.6
All Vehicles		1780	9.2	1.055	87.7	LOS F	89.3	689.5	0.94	1.14	1.35	23.7

5.6 SOCIOECONOMIC

5.6.1 Approach

To assess the social elements of the proposed project, a Social Impact Area (SIA) was established. A SIA may be described as the estimated spatial extent of the proposed project's effect on the surrounding communities; for the purposes of this study, it was delineated using a five (5) kilometre buffer around the proposed project area. The SIA comprises 44.3 km^2 of land in the parish of St. Ann. The project is located in the community of Priory, which represents the greatest proportion of land within the SIA (Figure 5-129, Table 5-73).

Table 5-73 Communities located within the SIA, sorted from largest to smallest in area of coverage within the SIA.

Community name	Parish	Land area with the SA (km^2)
Priory	**St. Ann**	**18.62**
Lime Hall	St. Ann	10.28

Community name	Parish	Land area with the SA (km^2)
St. Ann's Bay	St. Ann	7.46
Chester	St. Ann	4.39
Steer Town	St. Ann	2.00
Runaway Bay	St. Ann	1.18
Mount Zion	St. Ann	0.52
Bamboo	St. Ann	0.12
Total		**44.58**

Population data were extracted from the Statistical Institute of Jamaica (STATIN) 2011 Population Census database for the extent of the SIA by enumeration district (ED) and processed relative to the ED's percentage coverage within the SIA using Geographic Information Systems (GIS) methodologies. The following computations were made:

- *Population growth*: [$P_n = P_o (1 + r)^t$]
  Where P_o is the population at the beginning of a period, t is the period of time in years, r is the annual rate of increase, and P_n is the population at the end of the period (United Nations, 1952).
- *Dependency ratio*: [child population + aged population /working population X 100]
  Where the child population is between ages 0-14, the aged population is 65 & over, and the working population is between ages 15-64 years. This ratio is useful for understanding the economic burden being borne by the working population.
- *Male sex ratio:* [male population / female population X 100]
  This in effect denotes the number of males there are to every 100 females and is useful for determining the predominant gender in a particular area.
- *Domestic water consumption*
  Based on the assumption that water usage is 227.12 litres/capita/day and sewage generation at 80% of water consumption. Water consumption for workers in Jamaica is calculated at 19 litres/capita/day and sewage generation at 100% water consumption.
- *Domestic garbage generation*
  Calculated at 4.11 kg/household/day (National Solid Waste Management Authority).

Geospatial data for various services and infrastructure, including schools, health centres, hospitals, police stations, fire stations and post offices were obtained from the Mona GeoInformatics Institute. Other data sources are stated throughout and include organizations such as the Forestry Department, the Planning Institute of Jamaica (PIOJ), Water Resources Authority (WRA) and the National Environmental Planning Agency (NEPA). Additional data were also gleaned from the 1984 national topographic maps (metric series) and satellite imagery available for the project.

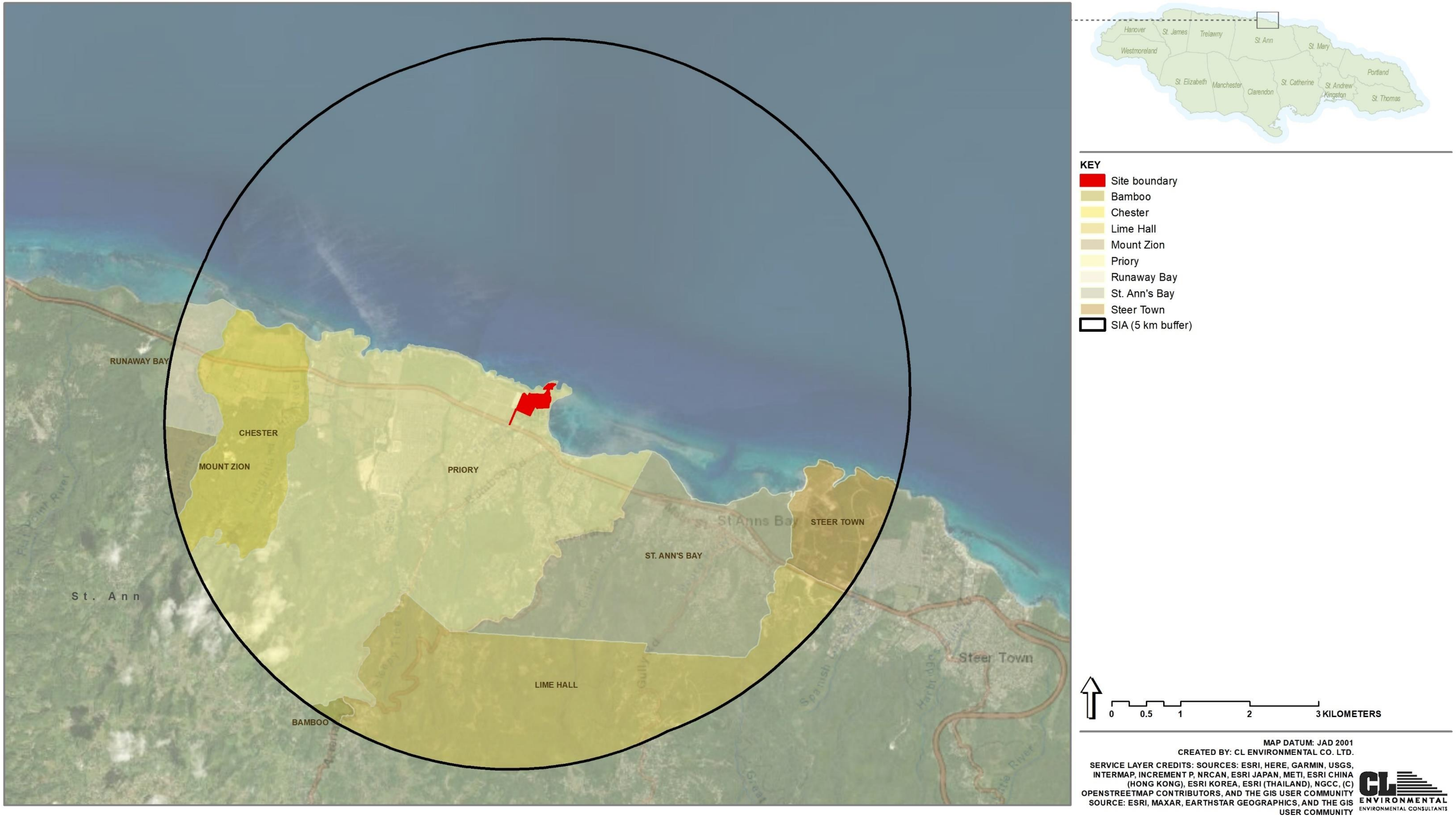


Figure 5-129 Communities within the Social Impact Area (SIA) for the proposed project

5.6.2 Demography

5.6.2.1 Population Density and Growth

The total population within the SIA in 2011 was approximately 14,813 persons (STATIN 2011 Population Census). With a land area within the SIA of approximately 44.3 km^2, the overall population density for the SIA was calculated to be 334 persons/km^2. This population density is higher than that for Jamaica and the parish of St. Ann (Table 5-74).

Table 5-74 Comparison of ED population densities for the year 2011

Category	Jamaica	St. Ann	SIA
Total ED area (km^2)	10,991.0	1,209.7	44.3
ED Population	2,697,983	172,362	14,813
ED Population density	245	142	334

Source: STATIN Population Census 2011

In 2001, there were approximately 13,490 persons living in the SIA. The overall growth within the SIA between 2001 and 2011 was approximately 0.94% per annum. However, population changes differ spatially within the SIA; EDs in proximity to the project site experienced population growth, while others within the SIA did not (Figure 5-130). Based on the growth rate of 0.94% per annum, at the time of this study (2022), the population is approximately 16,418 persons and is expected to increase to 20,744 persons over the next twenty-five years if the current population growth rate remains the same. The annual growth rate between 2001 and 2011 for the parish of St. Ann is 0.35%; using this regional rate, the population in 2022 is estimated to be 15,393 persons, and in 2047, 16,798 persons.

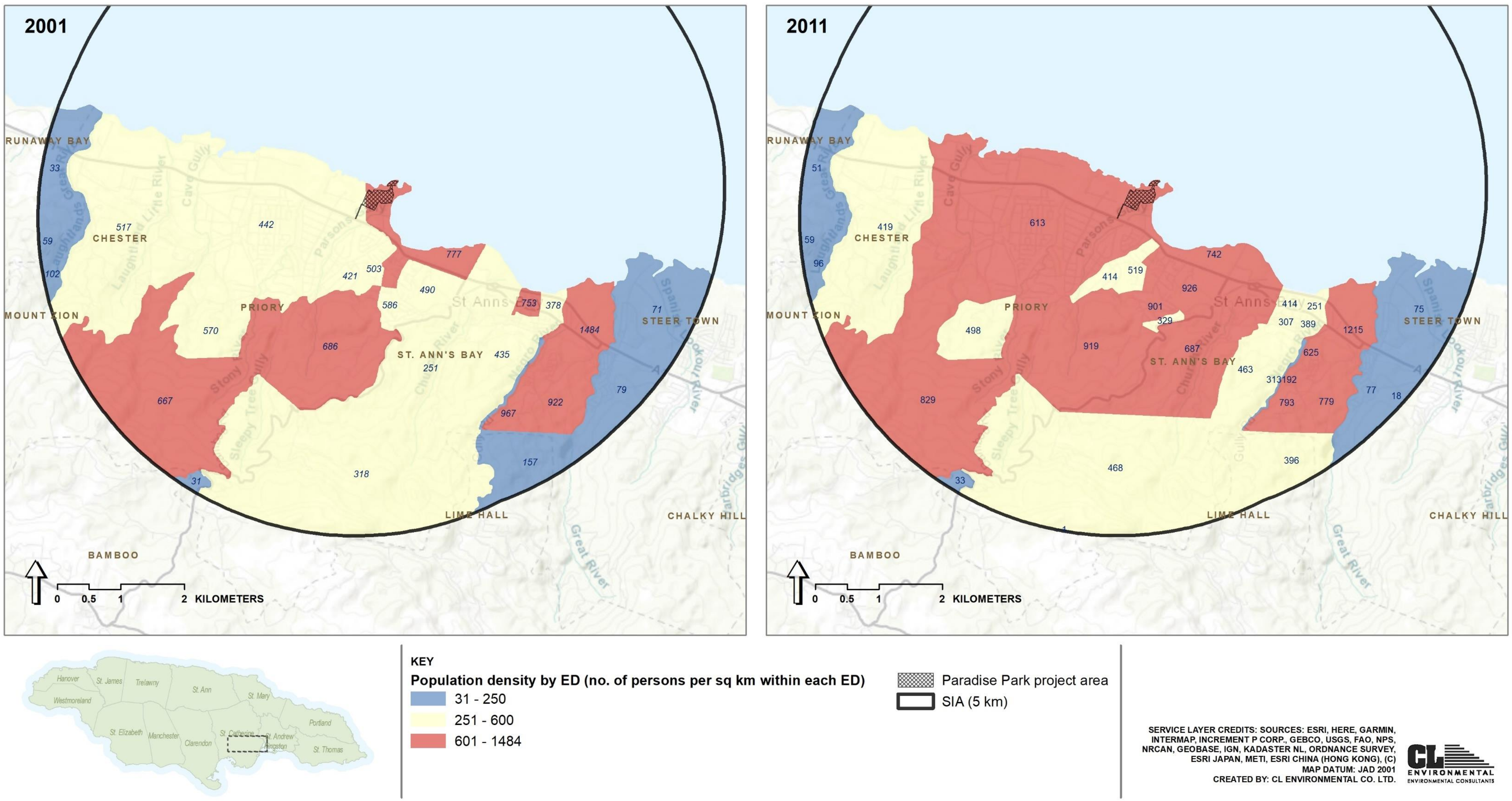


Figure 5-130 SIA 2001 and 2011 population represented by enumeration districts

5.6.2.2 Age, Sex and Dependency Ratios

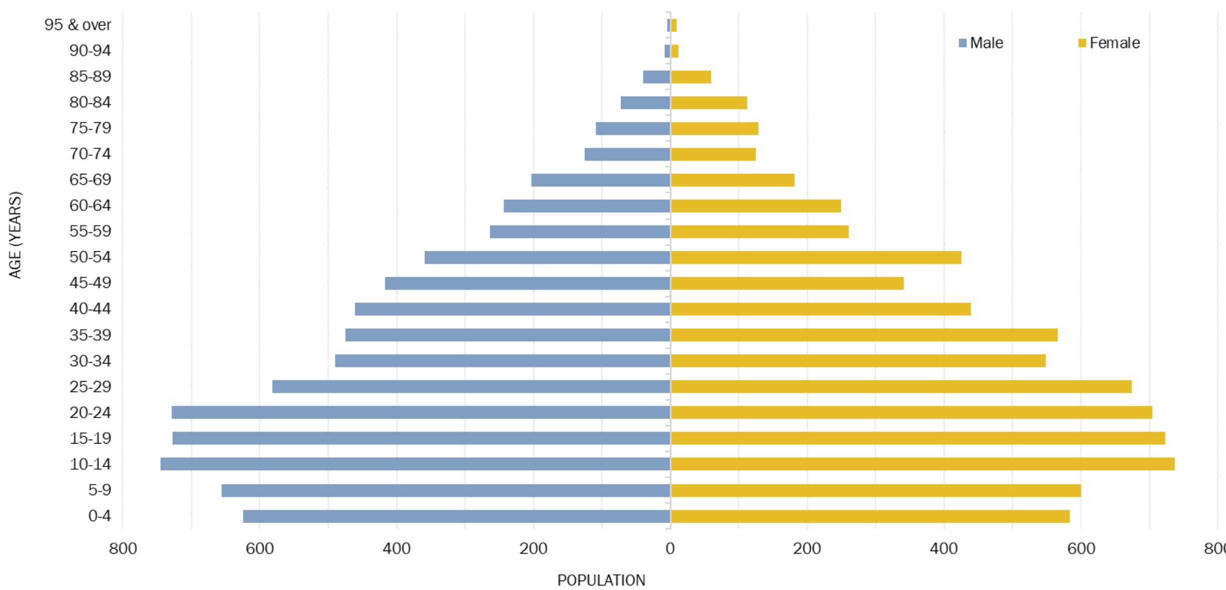
The segment of a population that is considered more vulnerable are the young (children less than five years old) and the elderly (65 years and over); in the SIA population, 8.2% comprised the vulnerable young category and 8.0% comprised the elderly. Percentage age distribution in the SIA for the 0-14 years' age cohort (26.6%) is comparable to that for St. Ann and Jamaica (Table 5-75). Within the SIA, the 15-64 years' age category accounted for 65.3% and can therefore be considered a working age population.

Table 5-75 Age categories as percentage of the population for the year 2011

Age Categories	Jamaica	St. Ann	SIA
0-14	26.1%	27.2%	26.6%
15 - 64	65.9%	64.2%	65.3%
65 & Over	8.1%	8.6%	8.0%

Source: STATIN Population Census 2011

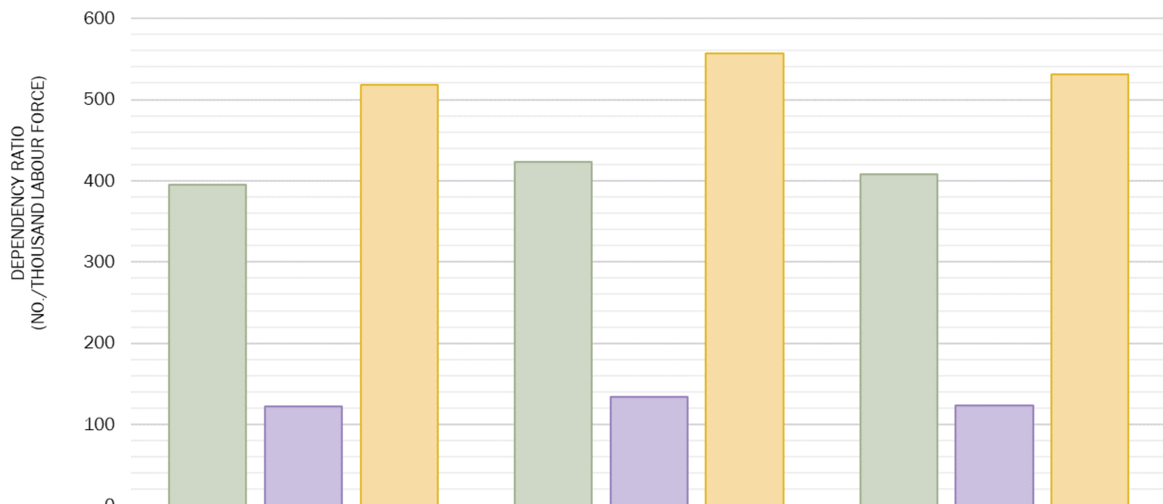
Overall sex ratio within the SIA for all age cohorts was calculated to be 98.1 males per one hundred females; however, this ratio varies across the SIA by ED, with minimum and maximum ratios of 54 and 119 males per one hundred females (Figure 5-133). For all age categories considered, there is a greater proportion of females within the SIA population than males, except for the following cohorts: 0-4, 10-14, 15-19, 40-44, 45-49 and 60-64 years, within which ranges there is a greater percentage of males (Figure 5-131).



Source data: STATIN Population Census 2011

Figure 5-131 Population pyramid in 2011 for the SIA

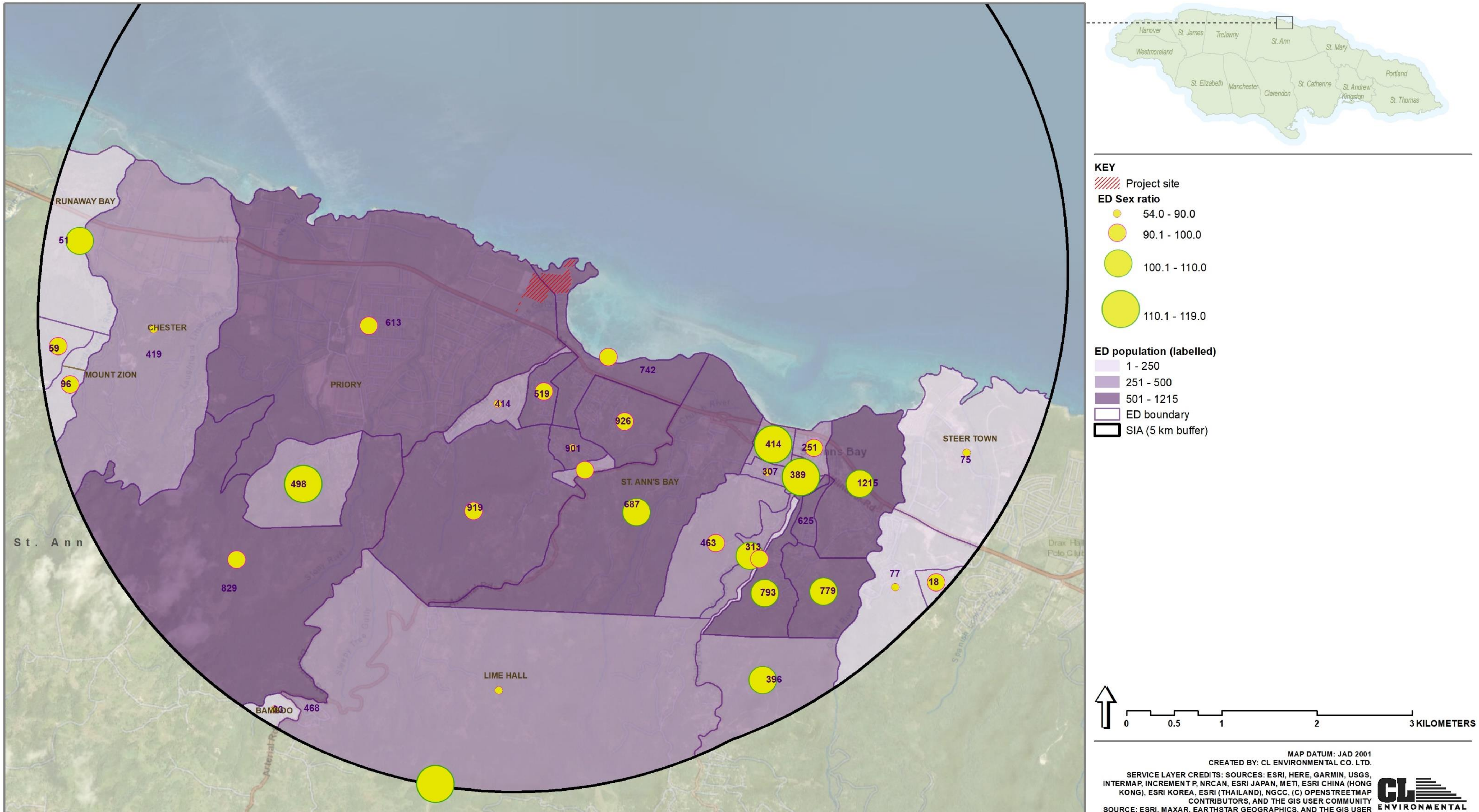
The child dependency ratio for the SIA in 2011 was 407.8 per 1000 persons of labour force age; old age dependency ratio stood at 123.2 per 1000 persons of labour force age; and societal dependency ratio of 531.1 per 1000 persons of labour force. This indicates that the youth (child dependency) are far more dependent on the labour force for support when compared with the elderly in the SIA (Figure 5-132).



	Jamaica	St. Ann	SIA
Child Dependency	395.4	422.8	407.8
Old Age Dependency	122.4	134.1	123.2
Societal Dependency	517.8	556.9	531.1

Source: STATIN Population Census 2011

Figure 5-132 Comparison of dependency ratios for the year 2011



Source data: STATIN Population Census 2011

Figure 5-133 Sex ratio by ED within the SIA

5.6.2.3 Education

Four schools are located within the demarcated SIA (Figure 5-134):

1. Chester All Age
2. Marcus Garvey Technical
3. Priory Primary
4. St. Ann's Primary

There is a propensity towards the attainment of primary and secondary education as the highest level of education, with 47.3% of the SIA population having attained secondary school education as the highest level, followed by 33.2% attaining primary education. Tertiary education attainment (combined university and other) as the highest level of education is 9.4% in the SIA, comparable with the parish and national levels of 8.4% and 9.9% respectively (Table 5-76).

Table 5-76 SIA population 3 years old and over by highest level of educational attainment as a percentage for the year 2011

	Jamaica	St. Ann	SIA
No Schooling	0.7%	0.9%	0.8%
Pre-Primary	4.8%	4.9%	4.9%
Primary	34.4%	39.2%	33.2%
Secondary	45.7%	42.8%	47.3%
University	4.7%	2.3%	2.8%
Other Tertiary	5.2%	6.1%	6.6%
Other	0.5%	0.3%	0.3%
Not Stated	4.0%	3.5%	4.1%

Source: STATIN Population Census 2011

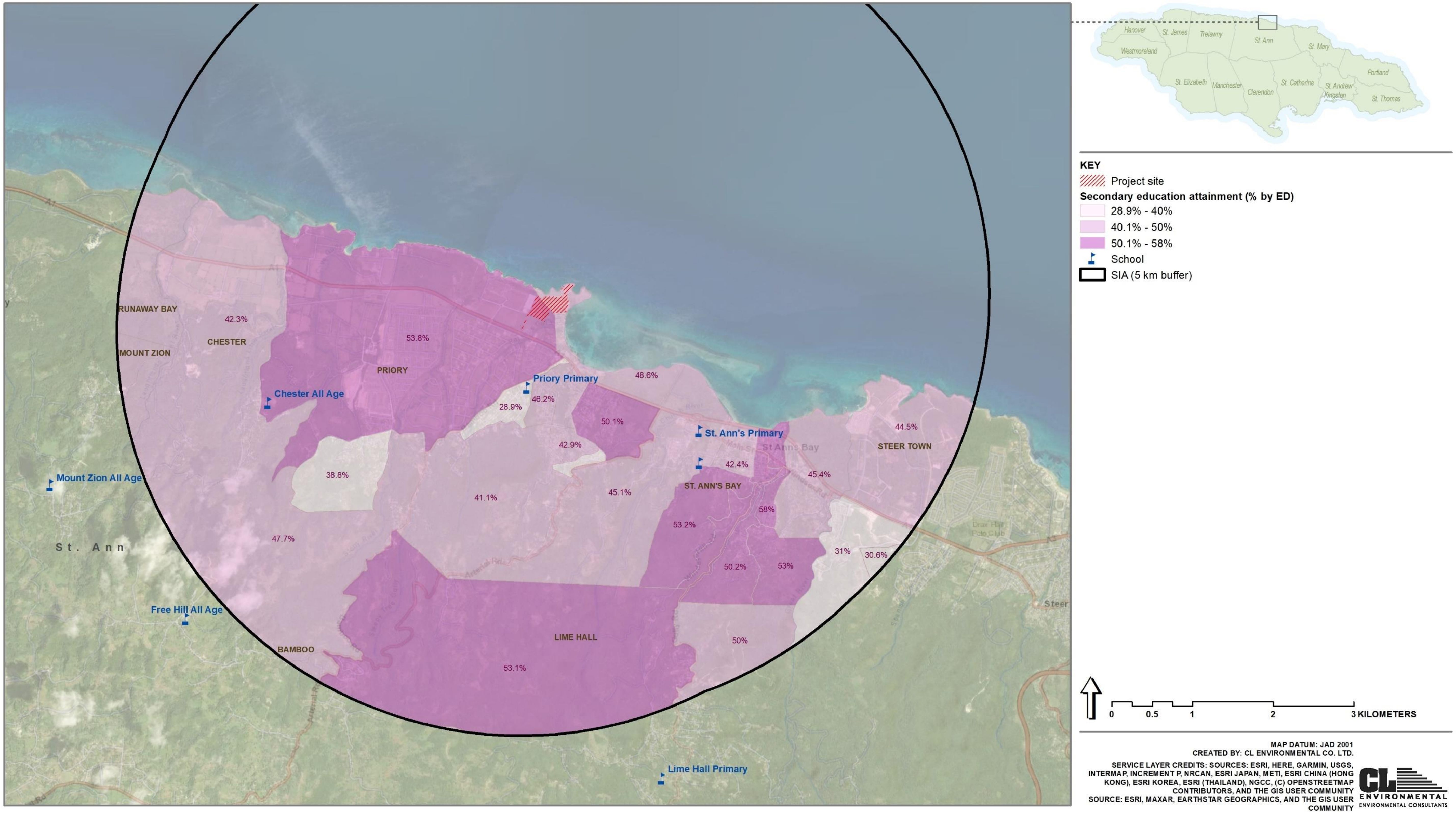


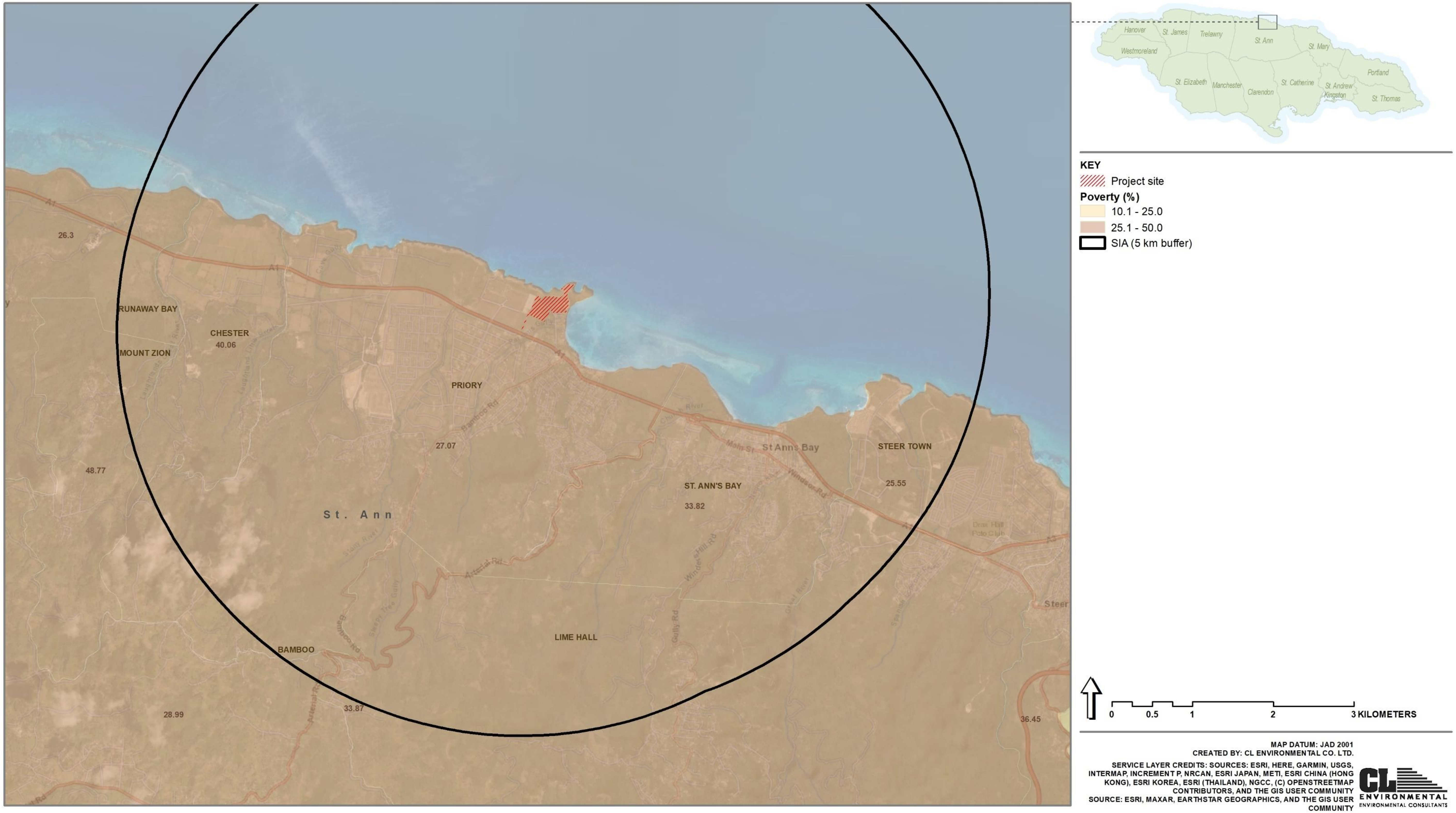
Figure 5-134 Secondary education attainment by ED and schools within the SIA

5.6.2.4 Poverty

The poverty GIS dataset developed by the Planning Institute of Jamaica (PIOJ) (with contributions from STATIN, Social Development Commission (SDC) and the University of Technology), primarily identifies areas of poverty by community. As described by PIOJ, for the 2002 poverty map:

> The indicators utilized were those that best predicted per capita consumption levels in households based on data from the Jamaica Survey of Living Conditions (JSLC) 2002. Relevant variables that were common to this survey and the Population Census 2001 were selected and tested for similarity. The satisfactory variables were then applied to the census data to obtain estimates of the consumption levels of the households that had consumption levels island wide. Members of households that had consumption levels below the poverty line for the region in which their household was located were deemed to be in poverty. The proportion of persons in poverty in each community was used to rank the 829 communities.

The SIA population has poverty levels between 25.55% and 48.77% of persons living in poverty (Figure 5-135).



Data source: PIOJ (with contributions from STATIN, SDC and the University of Technology

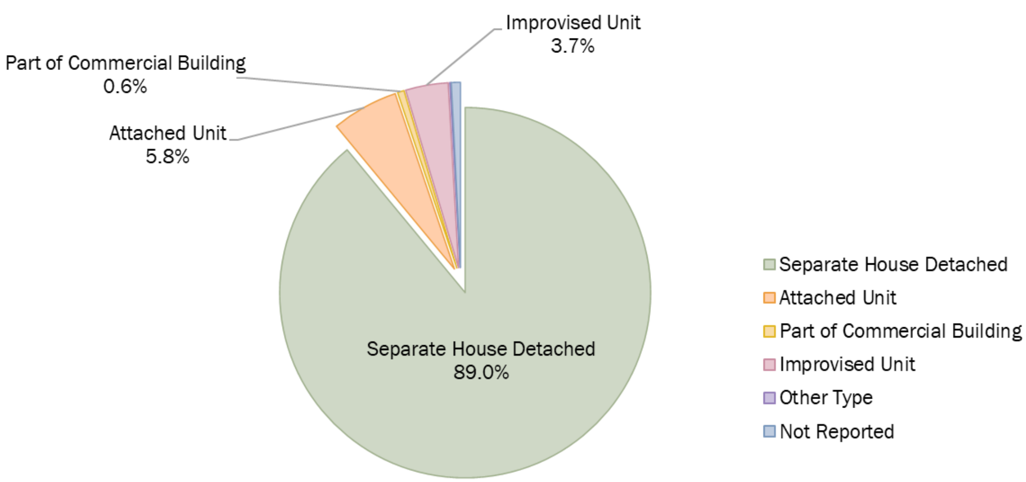
Figure 5-135 Proportion of persons in poverty in each community within the SIA

5.6.2.5 Housing

For the purposes of this study, the definitions of housing unit, dwelling and household are those used in the population census conducted by the Statistical Institute of Jamaica (STATIN). The definition states that:

- A **housing unit** is a building or buildings used for living purposes at the time of the census.
- A **dwelling** is any building or separate and independent part of a building in which a person or group of persons lived at the time of the census". The essential features of a dwelling unit are both "separateness and independence". Occupiers of a dwelling unit must have free access to the street by their own separate and independent entrance(s) without having to pass through the living quarters of another household. Private dwellings are those in which private households reside. Examples are single houses, flats, apartments and part of commercial buildings and boarding houses catering for less than six boarders.

There were 3,896 housing units (of which 89 % were separate detached houses, Figure 5-136), 4,395 dwellings and 4,568 households within the SIA in 2011.



Source: STATIN Population Census 2011

Figure 5-136 Percentage of housing units by type within the SIA

The average number of dwellings in each housing unit was 1.1 and the average household to each dwelling was also 1.0. The average household size in the SIA was 3.2 persons/ household. Comparisons of the SIA with national and regional ratios indicate that the SIA had comparable household/dwelling, average household size and dwelling/ housing unit ratios (Table 5-77).

Table 5-77 Comparison of national, regional and SIA housing ratios for 2011

	Jamaica	St. Ann	SA
Dwelling/Housing Unit	1.2	1.1	1.1
Household/Dwelling	1.0	1.0	1.0
Average Household Size	3.1	3.2	3.2

Source: STATIN Population Census 2001

5.6.3 Utilities and Infrastructure

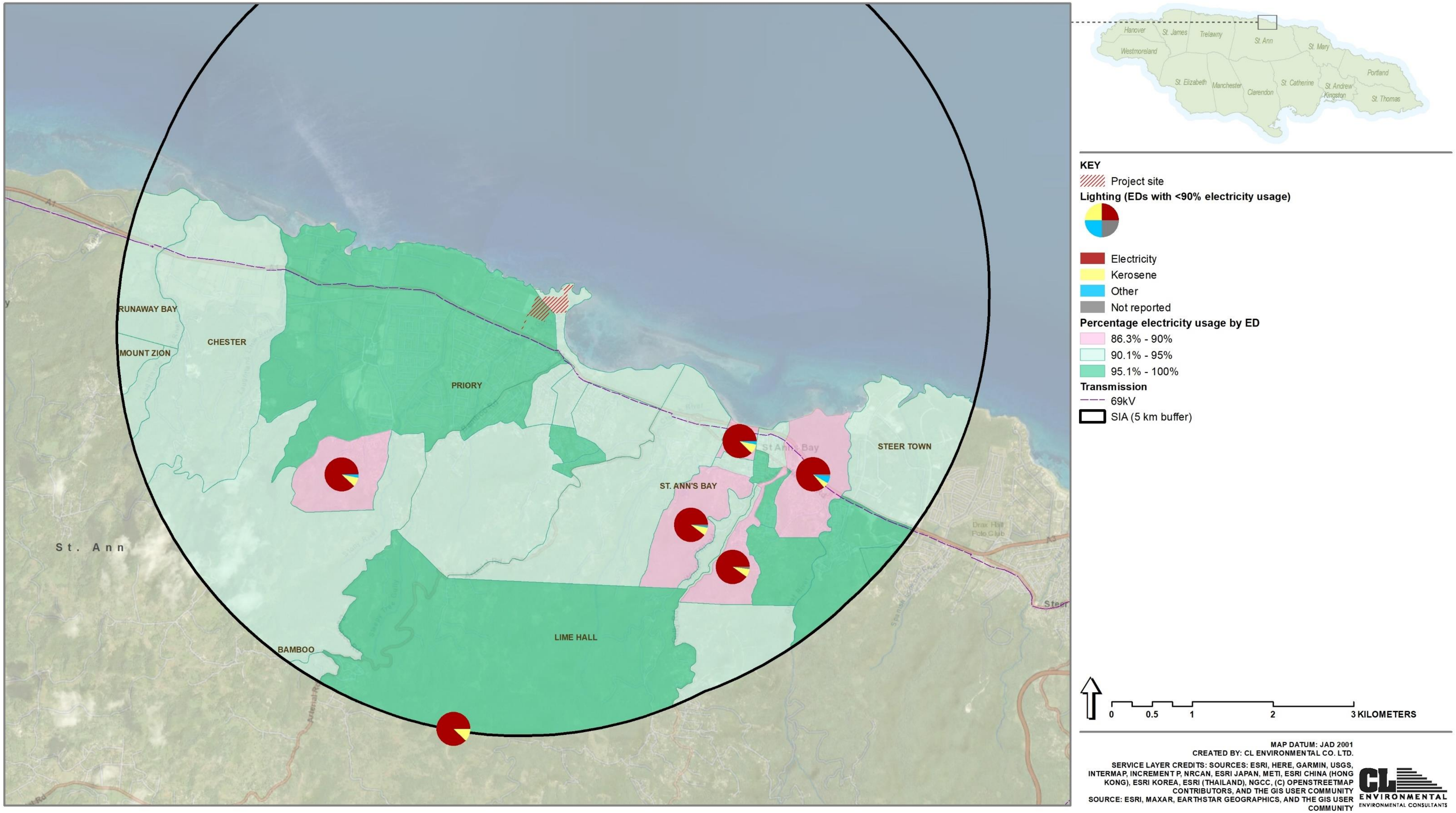
5.6.3.1 Lighting

Figure 5-137 details the percentage of households using a category of lighting. Data for all extents (SIA, parish and national) revealed that majority of the population utilises electricity as their main source of lighting. Overall, approximately ninety-three percent (93.0%) of households within the SIA use electricity; the lowest percentage of households utilizing electricity with the SIA was 86.3% and in these EDs with lower electricity usage, kerosene was the second most used source of lighting (Figure 5-138).

	Electricity	Kerosene	Other	Not Reported
Jamaica	91.9%	5.5%	0.8%	1.8%
St. Ann	90.8%	6.6%	1.2%	1.4%
SIA	93.0%	4.2%	1.4%	1.4%

Source: STATIN Population Census 2011

Figure 5-137 Percentage households by source of lighting



Source: STATIN Population Census 2011

Figure 5-138 Percentage electricity usage for the year 2011 and location of transmission lines within the SIA

5.6.3.2 Domestic Water Supply

The National Water Commission (NWC) is the public agency responsible for providing Jamaica's domestic water supply. Like the parish and national levels, the majority households within the SIA (84.7%) received their domestic water supply from NWC, whilst 10.0% from a private source, 2.4% from springs and rivers and 0.5% from water trucks (Table 5-78). Similarly, from the perception community survey carried out for the purposes of this EIA (see section 6.3.2.1), most respondents (86.3%) stated that their household domestic water supply was the public piped water supply. Less than one percent (0.9%) of respondents stated that the main source of domestic water was private tank, 1.4% indicated the public standpipe, 0.3% stated private water truck, while 1.4% stated that household water was supplied from a spring or river. Approximately ten percent (9.7%) of participants stated "other" as the main source for domestic household water supply.

Table 5-78 Percentage of households by water supply for the year 2011

	Category	Jamaica	St. Ann	SA
Public Source	Piped in Dwelling	49.7%	38.9%	57.0%
	Piped in Yard	16.5%	7.5%	16.6%
	Standpipe	7.1%	5.2%	10.4%
	Catchment	2.2%	2.8%	0.7%
Private Source	Into Dwelling	6.4%	12.4%	5.7%
	Catchment	9.8%	26.0%	4.3%
	Spring/ River	3.0%	3.5%	2.4%
	Trucked Water/Water Truck	2.1%	1.0%	0.5%
	Other	1.8%	1.7%	1.3%
	Not Reported	1.3%	1.1%	1.1%

Source: STATIN Population Census 2011

Twenty-six surface water sources, including wells and springs are found within 5 km of the proposed alignment (Table 5-79, Figure 5-139).

Table 5-79 Surface water sources found within 5km of the project site

Surface water	Hydrostratigraphy	Owner	Use
Carmel Spring	Limestone Aquiclude	NWC	Public Supply
Chester	Limestone Aquiclude		
Chester Spring	Limestone Aquiclude	NWC	National Water Commission
Church River bottom	Coastal Aquiclude		
Church River top	Limestone Aquiclude		
Clamstead	Limestone Aquiclude		
Coolshade Spring (Miller)	Basal Aquiclude	Egbert E. Miller	Irrigation
Coolshade Spring (NWC)	Basal Aquiclude	National Water Commission	
Great Laughlands River bottom	Coastal Aquiclude		
Laughland (Great River)	Coastal Aquiclude		
Laughlands Great River	Coastal Aquiclude	Petroleum Corporation of Jamaica	Hydro Power Generation
Liberty Spring	Limestone Aquiclude	NWC	
Little Laughlands River bottom	Coastal Aquiclude		

Surface water	Hydrostratigraphy	Owner	Use
Little Laughlands River top	Limestone Aquiclude		
Negro River bottom	Basal Aquiclude		
Negro River top	Limestone Aquiclude		
Richmond (Liberty) Spring	Limestone Aquiclude		
Seville (Church River)	Limestone Aquiclude		
Seville (River Head)	Limestone Aquiclude		
St. Anns Great River Windsor (gas)	Basal Aquiclude		
St. Anns Great River Windsor (water)	Basal Aquiclude		
Wakefield Spring	Basal Aquiclude		
Seville	Limestone Aquiclude	NWC	
Coolshade Spring		Richmond Development Company	Public Supply
Coolshade Spring		Murryfield Limited	Irrigation/Public Supply
Coolshade Spring Canal		Marino L. and Giuseppina Maffesannti	Public Supply

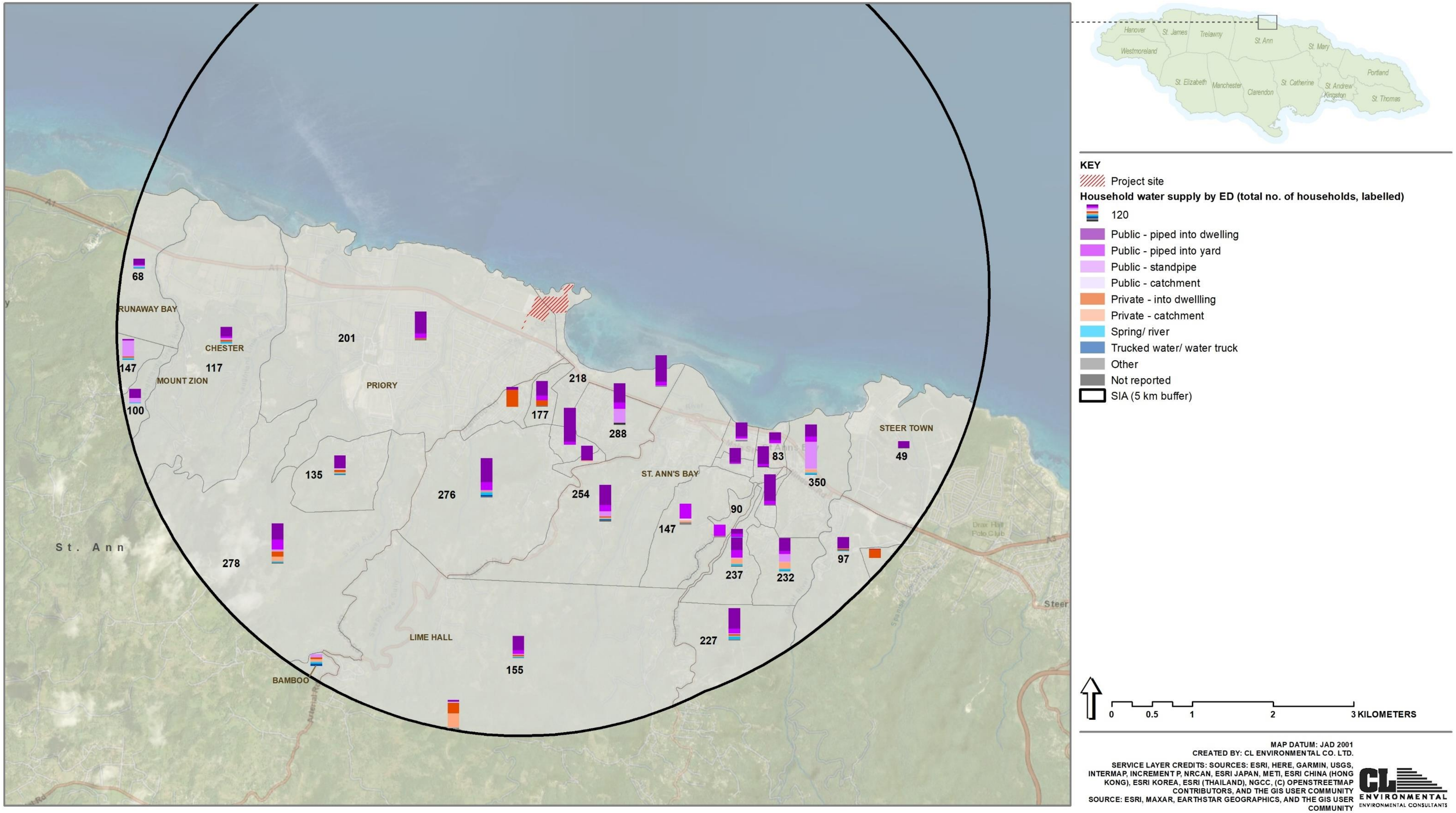
Of those who replied to the respective question during the community survey (section 6.3.2.1), 73.5% indicated that there were problems with the water supply while 26.5% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, issues included that the area had no water at all, no pipes were run in the area, water supply was irregular (as many as 89.5% confirmed this), low water pressure, and water quality. In response to how persons coped with problems related to domestic/household water supply, solutions offered included rainwater harvesting, purchase of water, collection from a spring/river, water truck, community standpipe and storage of water in various containers.

Water demand for the SIA in 2022 is estimated to be 3,728,925.63 litres/day (~985,078.11 gals/day) and is expected to increase to 4,711,409.52 litres/day (~1,244,622.95 gals/day) over the next twenty-five years based on population growth rates calculated previously.

5.6.3.3 Wastewater Generation and Disposal

It is estimated that approximately 2,983,140.50 litres/day (~788,062.49 gals/day) of wastewater is generated within the study area (for 2022) and is expected to increase to 3,769,127.62 litres/day (~995,698.36 gals/day) over the next twenty-five years based on calculated growth rates.

In the parish of St. Ann, the majority of household use shared or private water closets (68.9%) for the disposal of wastewater, whilst 25.2% use pits, 1.9% no toilet facilities, 0.1% other methods and 3.8% not reported.



Source: STATIN Population Census 2011

Figure 5-139 Source of water supply by ED within the SIA

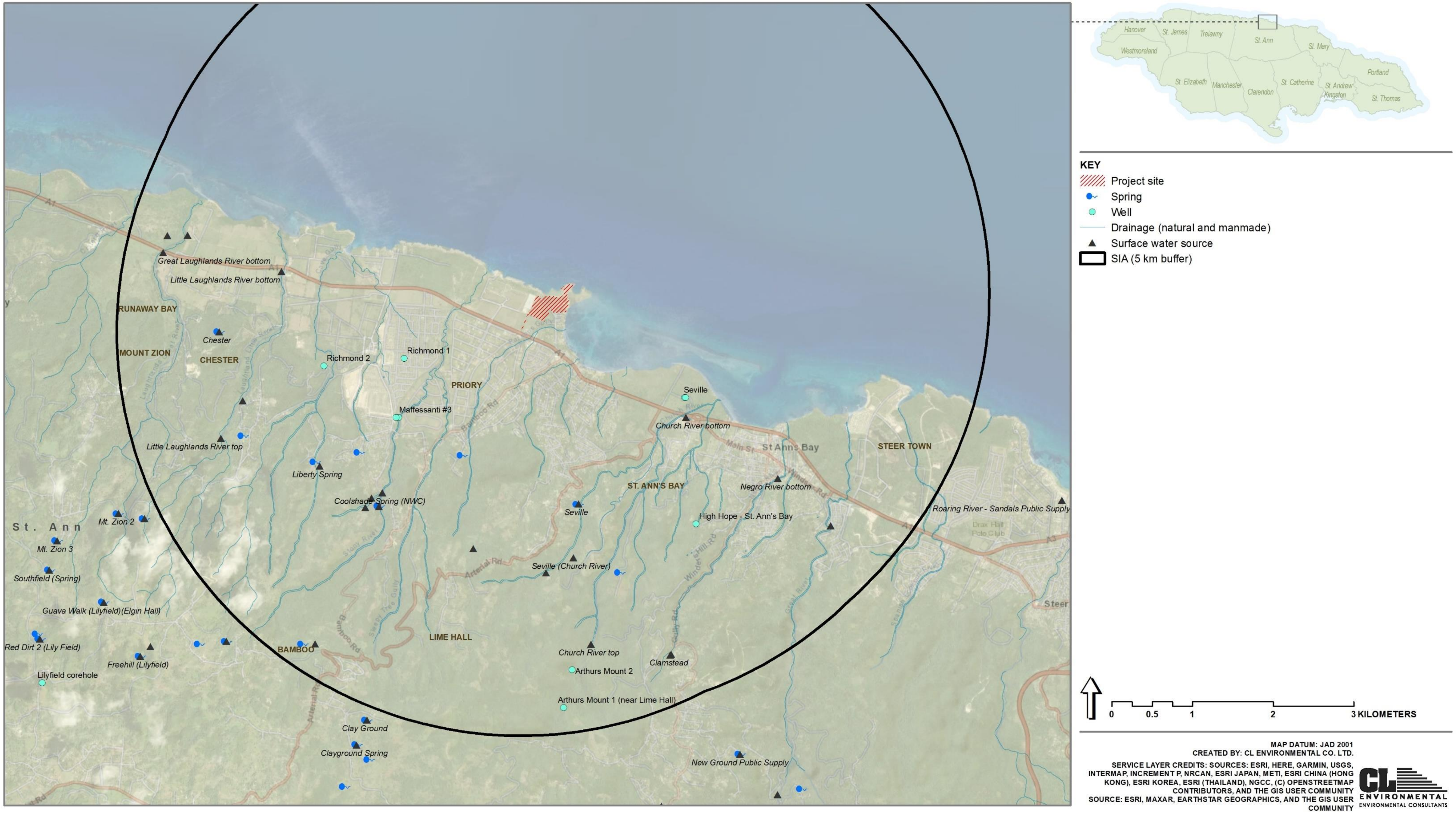


Figure 5-140 Surface water sources, wells and springs within the SIA

5.6.3.4 Solid Waste Generation and Disposal

It is estimated that at the time of this study (2022), approximately 20,807.54 kg/day (~20.81 tonnes/day) of solid waste was being generated. This is expected to increase to 26,289.83 kg (~26.29 tonnes) over the next twenty-five years based on calculated growth rates.

The National Solid Waste Management Authority (NSWMA) is responsible for domestic solid waste collection within the study area. This service is provided free (partial covered by property taxes) for the households within the area. Within the study area, the community of Priory is generally served every day of the week, with garbage typically being collected once per week and some areas, twice or three times per week (Figure 5-141). In St. Ann, 48.4% of households utilise the NSWMA public service for solid waste disposal, 45.0% burn, 3.7% dump (in sea, river, pond, gully, yard, municipal site or other), 0.6% bury, 0.3% utilise private means of disposal, 0.3% other means and 1.8% not reported.

Community	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Priory main, Priory Middle Street Heartlands, Lewis, Middle Street, Tanglewoods, Roadside	X						
Lillyfield, Bamboo, Philadelphia main & town, Lumbsden, Clay Ground, Hazelwood, Priory, , Priory main, Hartlands, Forbes Town, Lewis main, Priory main, Roadside,		X					
Tanglewoods, Priory Middle Street, Priory main, Rock Top, Lewis, Hartlands, Bottom Seville, Rock Top, Priory main, Top Seville			X				
Clay Ground, Hazelwood, Priory Middle Street, Priory main, Forbes Town, Lewis main, Seville Heights,					X		
Liberty, Back Salem						X	
St. Ann's Bay, Salem Main, Priory	X	X	X	X	X	X	X

Key

Twice Weekly
Twice Monthly
Three Times per week
Everyday

Subject to change without notice

Source: (National Solid Waste Management Authority , 2022)

Figure 5-141 NEPM Collection Schedule for Priory, St. Ann's Bay and Salem.

5.6.3.5 Telecommunication

The study area is served with landlines provided by Flow Jamaica Limited (formerly LIME Jamaica Limited). Wireless (mobile) communication is provided by Digicel Jamaica Limited and Flow and a network to support internet connectivity is also provided by Flow. In St. Ann, most household heads (83.5%) used mobile cellar services only, in comparison to other types of telephone devices (Table 5-80).

Table 5-80 Access to telephone facilities in households by age of head in St. Ann

Source: STATIN Population Census 2011

Parish and Device	Total Heads	Age of Head			
		Under 25	25-44	45-64	65+
St Ann	**52,647**	**2,592**	**21,008**	**19,188**	**9,859**
Fixed Cellular or Landline only	1,249	18	316	424	491
Mobile Cellular only	43,978	2,415	18,796	15,807	6,960
Both Fixed and Mobile	4,737	67	1,284	1,913	1,473
None	1,923	53	340	753	777
Not Stated	760	39	272	291	158

5.6.3.6 Transportation

Major Roadways and Primary Modes of Transport

The major roadway in the project area is the ARG Byfield leg of the A1 highway (Figure 5-142), which links the residential communities in Plantation Village and Priory and the commercial town of St. Ann's Bay. The major roadway is part of the north coast corridor, which, over the past decade, has seen substantial traffic increases such that earlier volume projections have been exceeded, resulting in a capacity deficit of more than 5,000 vehicles a day on multiple sections of corridor. This has ultimately led to slower moving traffic and road delays (Ministry of Finance & the Public Service, 2021). The planned expansion of roads on the North Coast Corridor from two to four lanes and other improvements are deemed critical to improving transportation and access between Montego Bay and Ocho Rios.

Please see section 5.5 for further detail regarding transportation and the traffic impact assessment undertaken for the project, as well as section 5.6.5.3 for future road improvement plans.

As shown in Table 5-81, the primary modes of transport in St. Ann in 2011 were taxis (66.6% route and robot taxis combined), walking (13.2%) and private vehicles (11.9%).

Table 5-81 Total population 3 years old and over by usual mode of transportation in St. Ann

Source: STATIN Population Census 2011

Mode of Transportation and Parish	Total Population	Age Group			
		Under 15	15-29	30-64	65+
St Ann	**162,904**	**38,287**	**46,994**	**62,872**	**14,751**
JUTC/Govt	0	0	0	0	0
Minibus	6,332	1,467	2,458	2,038	369
Hackney Carriage Taxi	24	11	0	6	7
Motorcycle	253	2	46	198	7
Walk	21,573	11,319	3,556	5,527	1,171
Chartered Vehicle	1,402	679	151	151	421
Robot Taxi	25,093	5,098	7,870	9,781	2,344
Coaster/Hino Bus	351	141	132	72	6
Route Taxi	83,399	16,393	28,595	31,657	6,754
Company Vehicle	623	35	183	385	20
Bicycle	819	24	209	531	55
Private Vehicle	19,377	2,357	3,115	11,431	2,474
Other	205	111	39	37	18
Never Went Out	1,881	233	197	501	950
Not Stated	1,572	417	443	557	155

Air Transport

Llandovery Airfield is located within the SIA, 4.7 km west of the project site (Figure 319). The closest airport facility is the Ian Fleming International Airport, 28 km east of the project site in Boscobel, St. Mary.

5.6.3.7 Emergency Services

Healthcare

Two health centres are located within the SIA: St. Ann's Bay and Beth Jacob Family Planning (Figure 5-142). St. Ann's Bay Regional Hospital (SABRH) is also located within the SIA, 2.4km southeast of the project site in St. Ann's Bay. It is the Regional Hospital serving the parishes of Portland, St. Mary and St. Ann. It is a Type B Hospital and is the referral hospital for the three (3) general hospitals and seventy (70) health centres located in Portland, St. Mary and St. Ann. In turn, cases that cannot be managed in this hospital are referred to a Type A or a Specialist hospital such as Cornwall Regional, Kingston Public Hospital, The University of the West Indies and Bustamante Hospital for Children. St. Ann's Bay Hospital provides health care services to a population of approximately 360,000 persons.

The health facilities in the SIA are part of the Northeast Regional Health Authority, which provides healthcare to the population of Jamaica's north-eastern parishes of St. Ann, St. Mary and Portland.

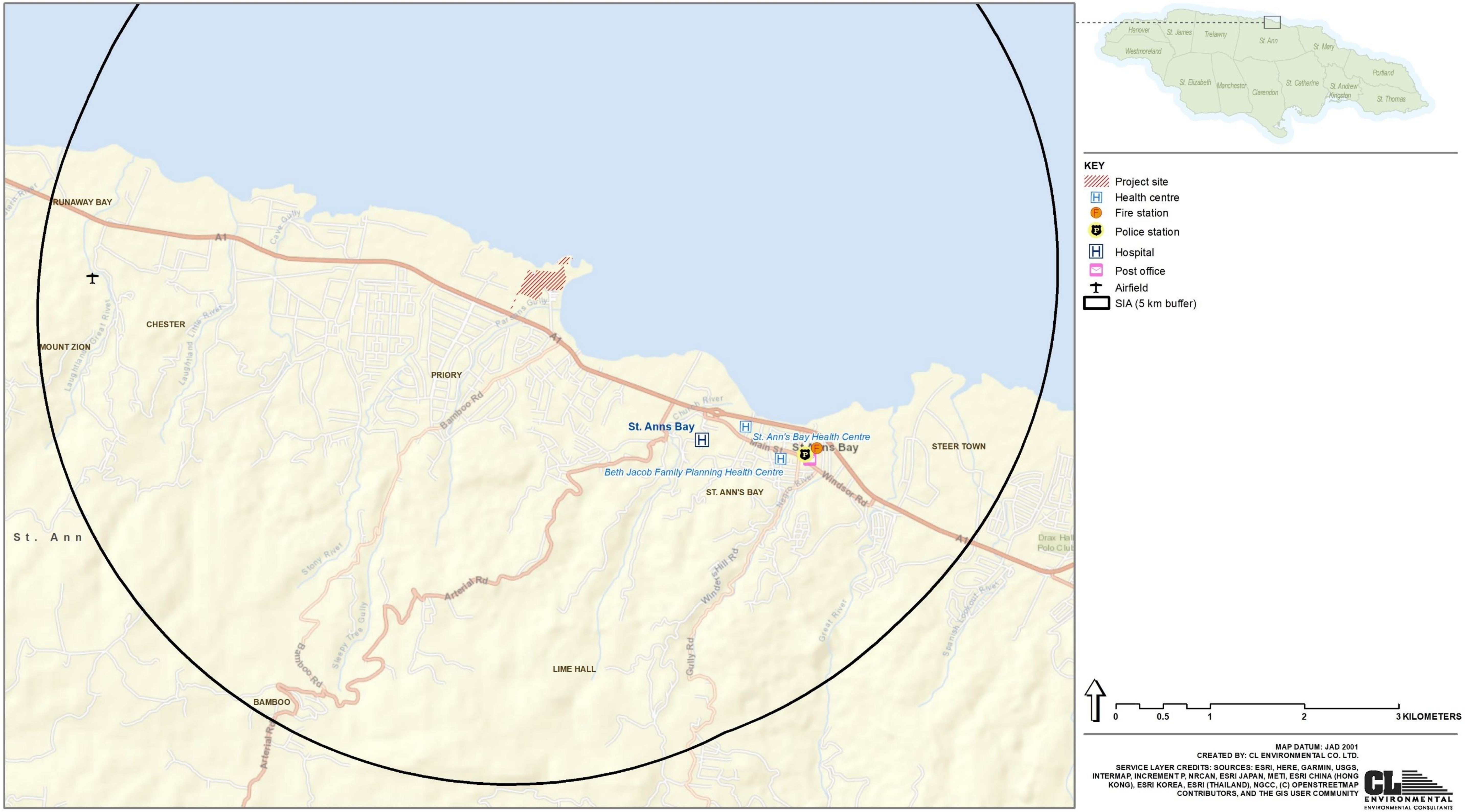


Figure 5-142 Road network and services located in the SIA

Fire Response

JAMAICA FIRE BRIGADE DIVISIONS AND SERVICES

The role of the Jamaica Fire Brigade is to protect life and property from fire or other disasters within the Island and its territorial seas. For operational management the Fire Brigade is divided into four areas: Area 1, Area 2, Area 3, and Area 4. The St. Ann Division along with Portland, St. Mary and Trelawny Divisions comprise Area 2.

The St. Ann Division has a staff complement of over two hundred (200) firefighters, which includes Operational/Suppression teams and Fire Prevention team. The Operation/Suppression teams respond to fires and other emergencies, while the Fire Prevention team is comprised of firefighters trained as Fire Prevention Inspectors. These Inspectors are trained to review building plans, inspect building to ensure that they are fire and structurally safe, conduct fire and life safety educational exercises with schools, communities, hospitals, and other groups. Another aspect of response is from the Marine Section which comprise a Fire Boat and trained firefighters geared to respond to fire and other emergency in the island's territorial waters; however, the vessel is not operational currently (St. Ann Division, Jamaica Fire Brigade Divisional Headquarters, 2023).

Plans are to provide Emergency Medical Service (EMS) in the parish. This service will involve firefighters, trained as Emergency Medical Technician (EMT), responding to incidents in an ambulance to offer pre- hospital care to victims, package same and transport to the nearest health facility for further medical care. Provisions to deliver this service are at an advance stage (St. Ann Division, Jamaica Fire Brigade Divisional Headquarters, 2023).

RESPONSE SUPPORT IN THE PROJECT AREA

Responses to fire and other emergencies are actioned from three (3) fire stations in the parish: St. Ann's Bay, Ocho Rios and Brown's Town. The closest fire station to the project is found in St. Ann's Bay, approximately 3km southeast of the proposed site (Figure 5-142). This station, as well as the other two within the St. Ann Division, are equipped with first responding units (Pumper/Fire Engine). There is also a Turn Table Rescue Unit and a Water Tanker assigned to the St. Ann's Bay station (St. Ann Division, Jamaica Fire Brigade Divisional Headquarters, 2023).

The primary response team to incidents in the Priory/Richmond Area would be dispatched from the St. Ann's Bay fire station. Support if required can be obtained from the Brown's Town station and the Ocho Rios station. Further support can also be acquired by the Falmouth station. Please note that the Falmouth Fire Station has the capacity to provide firefighting and rescue response as well as Emergency Medical Service (EMS) response.

INCIDENT RESPONSES 2018 - 2022

According to the Statistical Data, between January 2018 and October 2022, the St. Ann Division of the Jamaica Fire Brigade has responded to a total of three hundred and forty-one (341) Incident Calls in the St. Ann's Bay, Priory, Seville Heights and Richmond areas. This includes forty-two (42) Structural Fires, two hundred and twelve (212) Bush Fires, thirty-five (35) Motor Vehicle Accidents and fifty-two

(52) Special Service Calls (Non-Emergency) (St. Ann Division, Jamaica Fire Brigade Divisional Headquarters, 2023).

Police Stations

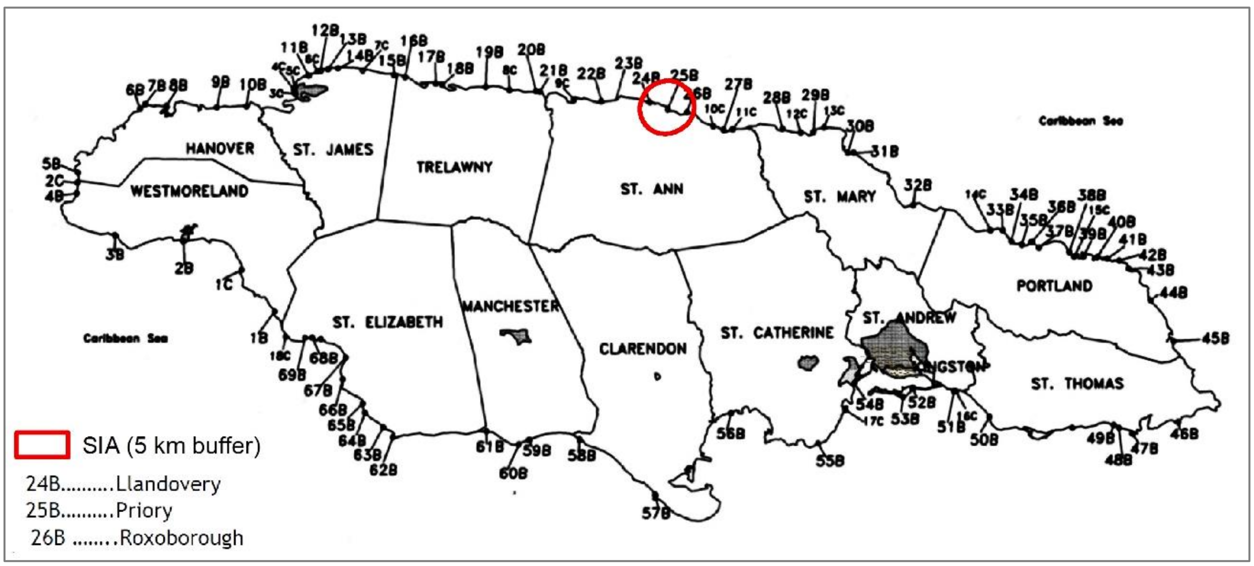
One police station is located within the SIA, St. Ann's Bay Police Station, located about 3.3 km southeast of the site (Figure 5-142). Threats and crimes reported in the area include robbery and murder, but the community is generally quiet most of the time (Coley, 2022). Issues are typically reported by residents; complaints are not received from visitors (Coley, 2022).

5.6.4 Economic Activity

5.6.4.1 Tourism

Hotels and Attractions

Tourism is a major activity along the north coast of Jamaica. Guest accommodations are located along the coast of the eastern bay of the study area, including SeaScape Villas, Richmond Beach Club, The Columbus Inn, Hunny Bay Resort and Seacrest Beach Hotel. Major attractions within the SIA and closest to the project site are the Priory public bathing beach (25B, Figure 5-147), otherwise known as Fantasy Beach, situated southeast of the project area, and Chukka Cove attraction, west of the project site.



Source: (Natural Resources Conservation Authority, 2000)

Figure 5-143 Public bathing beaches in Jamaica, with those located within the project SIA circled in red

International and Regional Trends

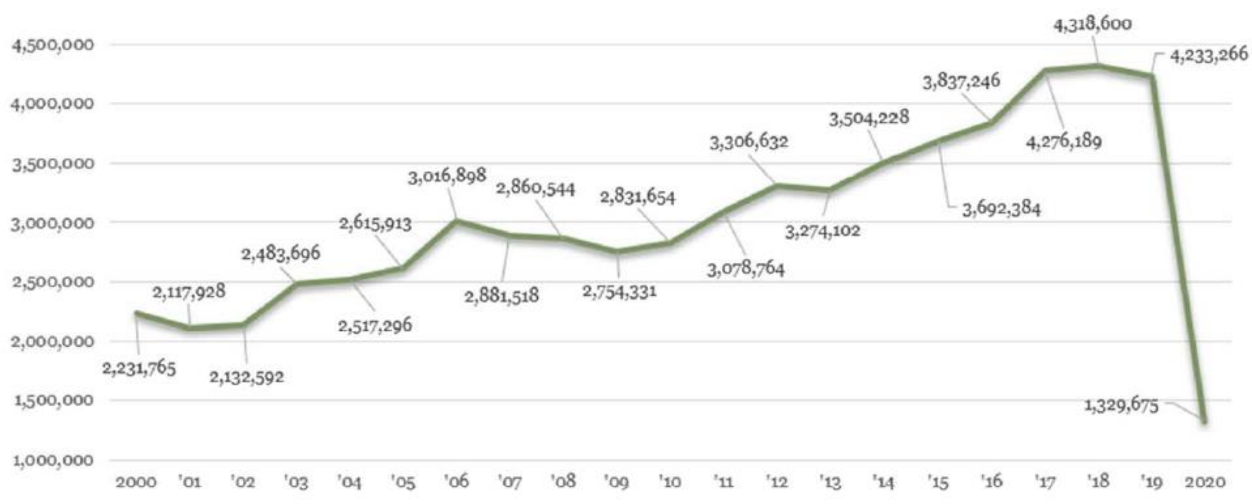
The year 2020 suffered the greatest crisis on record in international travel worldwide. The outbreak of the COVID-19 pandemic created an unprecedented health, social and economic emergency. The World Tourism Organization (UNWTO) reported that international tourist arrivals plunged by 74.0% in 2020 compared to the same period in 2019, reaching a low of 381 million (Jamaica Tourist Board, 2020). All world regions recorded declines in international tourist arrivals for 2020; the Americas, to which Jamaica is a part, recorded a decline of 150.1 million international tourists lowering the total to 69.0 million.

The Caribbean Tourism Organization (CTO) reported that in 2020 there was an estimated 11.1 million visitors who came to 'enjoy the un-equalled and diverse experiences' the Caribbean had to offer. This was a contraction of approximately 21.0 million less tourist arrivals, a 65.5% decrease over the 32.0 million in 2019. No Caribbean destination recorded growth for 2020, all had travel restrictions, border, and port closures, so as to contain the spread of COVID-19 (Jamaica Tourist Board, 2020).

Arrivals to Jamaica

Total visitor arrivals for the year 2020 reached a total of 1,329,675, which was 68.6% below the 4,234,150 arrivals recorded in 2019. This figure represents 2,903,595 less arrivals than in 2019 (Figure 5-144). Stopover arrivals of 80,404 decreased by 67.2%; foreign national of 798,290 decreased by 67.9%; non-resident Jamaicans of 82,114 decreased by 58.5%; and cruise passenger arrivals of 449,271 decreased by 71.1%. The global health crisis associated with the COVID-19 pandemic significantly impacted visitor arrivals to Jamaica (Jamaica Tourist Board, 2020).

The most popular resort region to which visitors stayed in 2020 was Montego Bay (34.4% of visitors), followed by Ocho Rios (20.1%). The accommodation of choice which visitors stayed during 2020 was Hotels with 560,314 or 63.6% (Jamaica Tourist Board, 2020).



Source: (Jamaica Tourist Board, 2020)

Figure 5-144 Visitor arrivals to Jamaica, 2006-2020

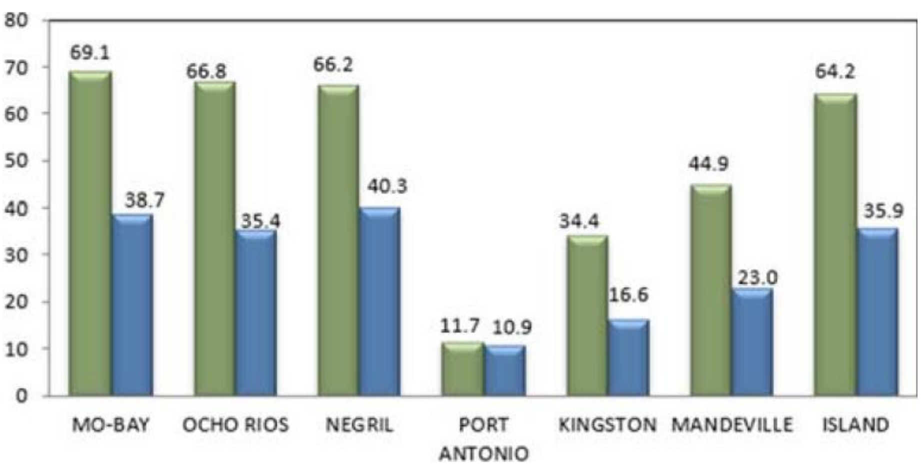
Table 5-82 Visitors to Jamaica by type of accommodation and region, 2020

Source: (Jamaica Tourist Board, 2020)

ACCOMMODATION	Kingston	Mandeville	Montego Bay	Ocho Rios	Port Antonio	Negril	Other Areas	Total	% Share	Average Length of Stay
Hotels	18,034	11,465	248,474	131,147	528	150,513	153	560,314	63.6%	6.3
Resort Villas	4	1,956	14,057	7,070	1,138	4,477	36	28,738	3.3%	8.8
Guesthouses	2,784	1,251	3,792	1,685	468	5,289	335	15,604	1.8%	12.8
Apartments	203	-	1,656	2,588	-	518	-	4,965	0.6%	12.1
Private Homes	59,922	36,988	32,681	33,208	7,887	15,115	71,223	257,024	29.2%	20.0
Other/Not Stated	2,298	1,054	2,369	1,375	333	944	5,386	13,759	1.6%	14.9
Total	**83,245**	**52,714**	**303,029**	**177,073**	**10,354**	**176,856**	**77,133**	**880,404**	**100.0%**	**10.7**
% Share	9.5%	6.0%	34.4%	20.1%	1.2%	20.1%	8.8%	100.0%		
Average Length of Stay	15.8	17.8	7.5	9.5	20.0	8.6	18.7	10.7		

HOTEL ROOM OCCUPANCY

The average available room capacity fell by 35.7% in 2020, moving from 24,432 rooms in 2019 to 15,709 rooms in 2020. In the resort region of Ocho Rios, the annual hotel room occupancy rate was 35.4%, compared to 66.8% recorded in 2019. The total number of room nights sold fell by 64.6% moving from 1,490,992 in 2019 to 527,530 in 2020. The number of stopovers that intended to stay in Ocho Rios at hotel accommodations declined from 451,465 in 2019 to 131,147 in 2020, a decrease of 71.0% (Jamaica Tourist Board, 2020).

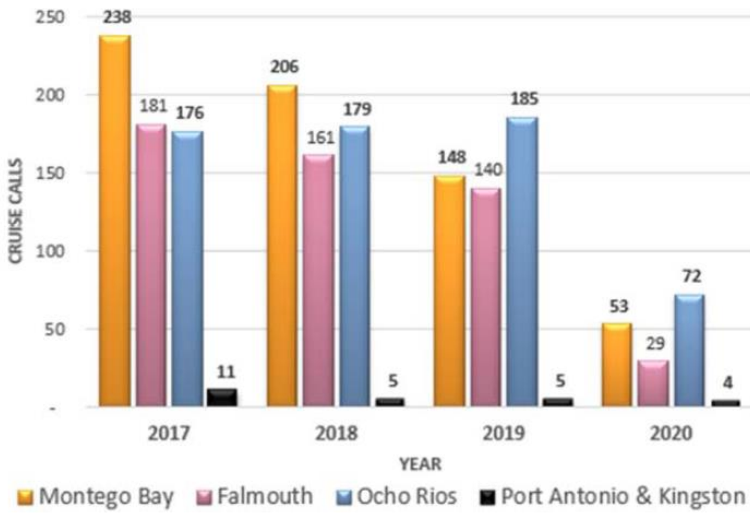


Source: (Jamaica Tourist Board, 2020)

Figure 5-145 Hotel room occupancy by resort area (2019- green, 2020 – blue)

CRUISE PASSENGERS

The port of Ocho Rios provided the largest share of Jamaica's cruise arrivals, accounting for 229,311 or 51.0% of the 449,271 who arrived in 2020.



Source: (Jamaica Tourist Board, 2020)

Figure 5-146 Cruise calls by port of arrivals, 2017-2020

VISITOR EXPENDITURE

Gross visitor expenditure in 2020 was estimated at approximately US$1.256 billion; this represents a decrease of 65.5% against the estimated US$3,639 billion earned in 2019 (Jamaica Tourist Board, 2020).

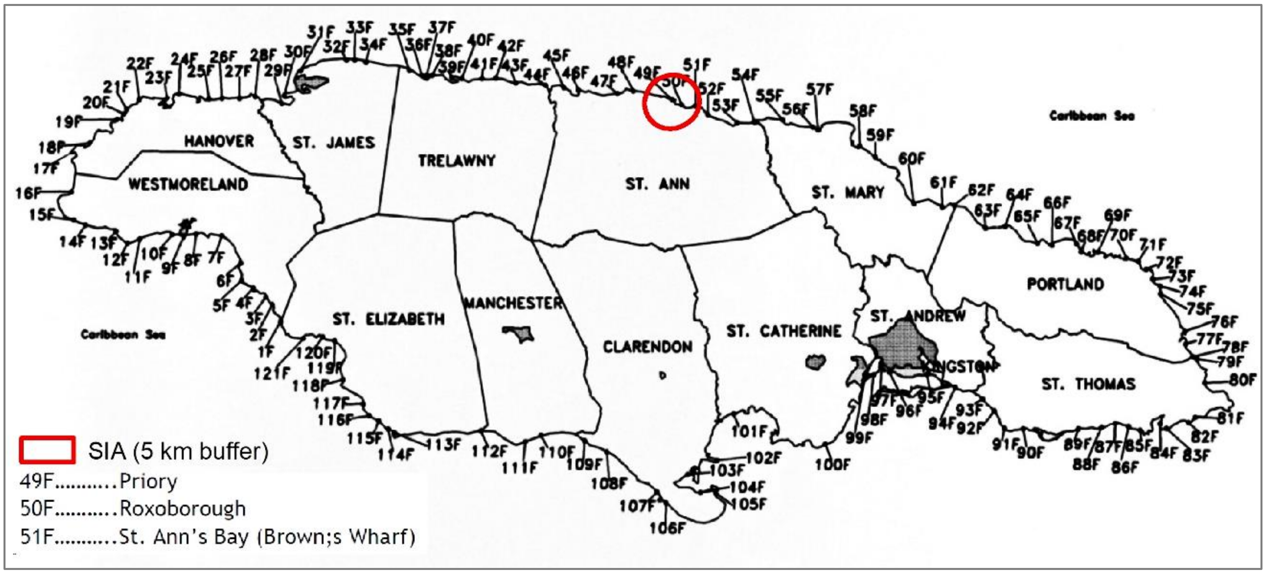
EMPLOYMENT

The average number of employees per room in 2020 was estimated at 1.22. The number of persons employed directly in the accommodation sub-sector was adversely affected by the closure of properties due to the Covid-19 pandemic. Between April and May approximately 90% of the accommodation staff were laid off and by the end of 2020, 30% of tourism workers had been brought back on a fulltime basis and another 10- 20 % part-time, moving from 51,226 in 2019 to 30,655, a significant decrease of 40.2%.

The main resort regions of Montego Bay, Ocho Rios and Negril accounted for 25,089 persons or 81.8% of the total number of persons employed directly in the accommodation sub-sector. Ocho Rios with 7,928 direct jobs represented 25.9% (Jamaica Tourist Board, 2020).

5.6.4.2 Fisheries

Fishing beaches within the SIA are Priory, Roxoborough and St. Ann's Bay (Natural Resources Conservation Authority, 2000). In 2008, the parish St. Ann had 282 registered vessels and 979 registered fishers (The Ministry Of Agriculture & Fisheries, 2008).



Source: (Natural Resources Conservation Authority, 2000)

Figure 5-147 Fishing beaches in Jamaica, with those located within the project SIA circled in red

5.6.5 Land Use and Zonation

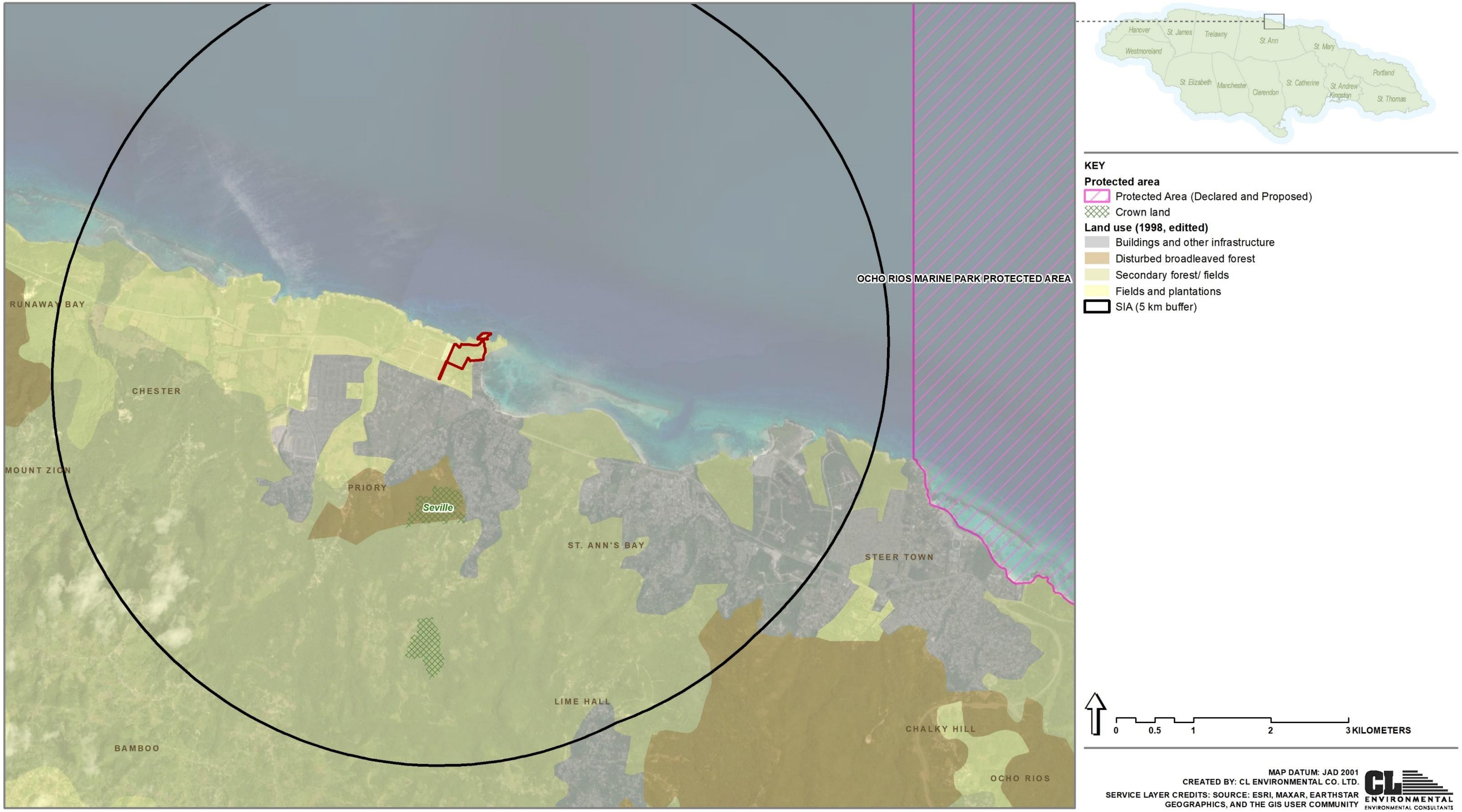
5.6.5.1 Land Cover and Use

Within the SIA

Land cover within the SIA consists of buildings and other infrastructure, disturbed broadleaved forest, secondary forest and fields, and plantation (crops) (Figure 5-148). The ARG Byfield leg of the A1 highway is part of the north coast corridor and links various residential communities in the Richmond and Priory area with the commercial town of St. Ann's Bay, about 3 km east of the project. The residential communities are primarily located on the southern side of the main road and include Richmond Estates, Plantation Village and Hartland Estates (Figure 5-149).

South of the project site, St. Ann's Bay infirmary, a Youth Mentoring Ministry, Salem Car Rental, guest accommodations (including Seacrest Beach Hotel, Richmond Beach Club, Honey Bay Resort, The Columbus Inn and the Priory Place) and residential properties are located along the current access road that branches off the main road (Figure 5-149). Most of these buildings located along the access road are noted to be present since 2002[4] (Table 5-83). On the lands to the west of the site, are a greenhouse and unfinished residential developments.

[4] 2002 is the earliest imagery available for the site from Google Earth; it does not constitute the build date of infrastructure located south of the site along the access road.



Data sources: Land use (Edited based on Forestry Department, 1998), forest estates (Forestry Department) and protected areas (NEPA and MGI)

Figure 5-148 Land cover, protected areas and forest estates within the SIA

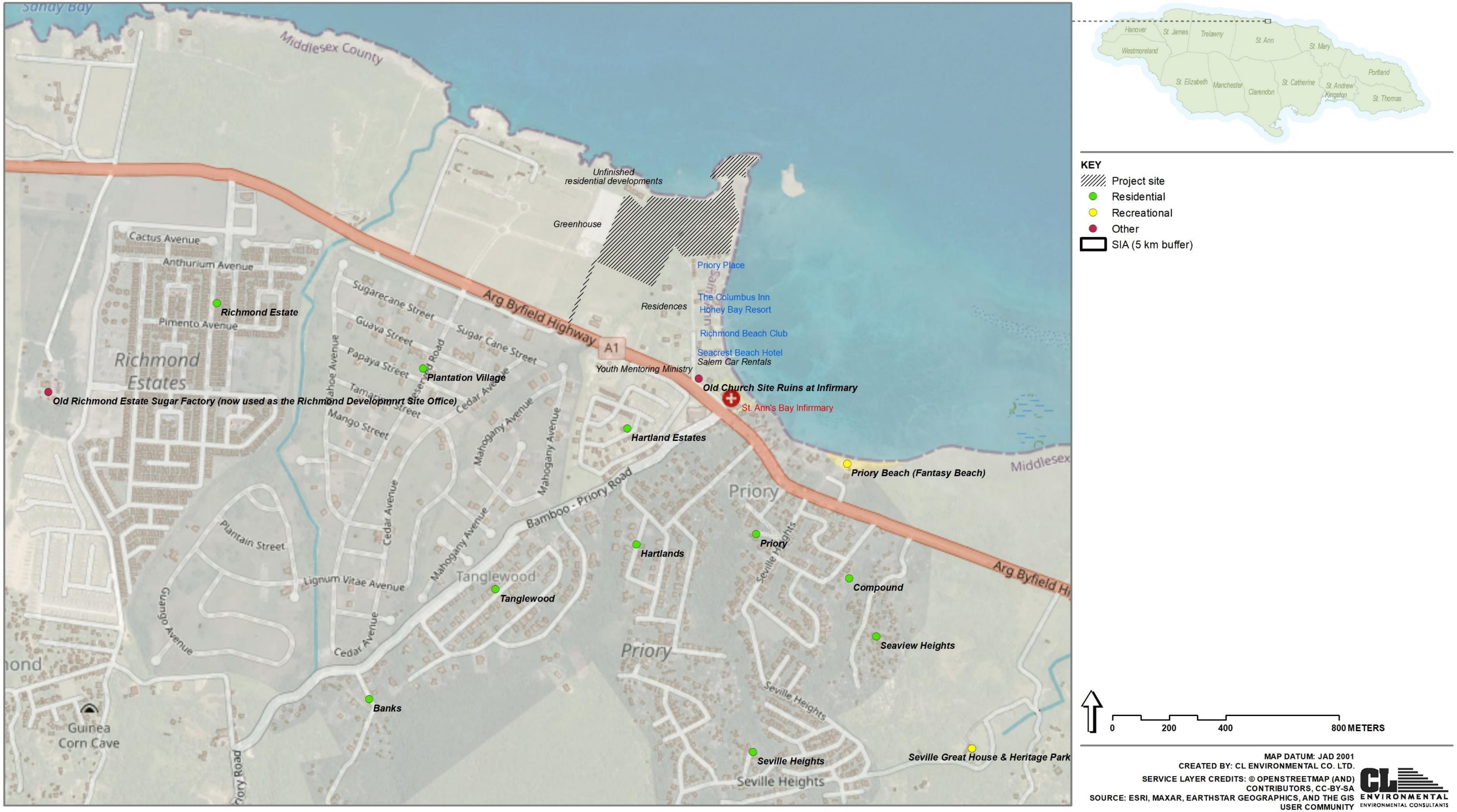


Figure 5-149 Land use in proximity to the project site

Table 5-83 Historical Google Earth imagery, 2002 to 2021 (site boundary in red)

2002	2009	2014
		
2017	**2020**	**2021**
		

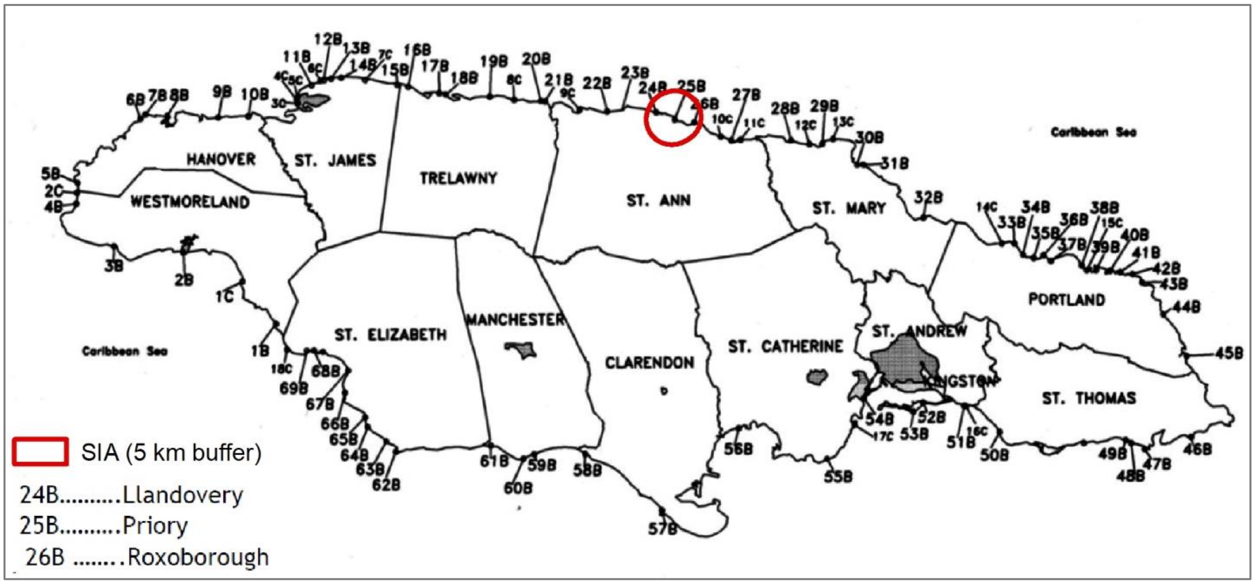


Figure 5-150 Bathing beaches in Jamaica, with those located within the project SIA circled in red

Priory Beach is located less than 1km southeast of the site; it is popular bathing beach used for recreational purposes but is also categorised as a fishing beach. Other bathing beaches with the SIA include Llandovery and Roxoborough (Figure 5-150).

Project Site

At the project site, vegetation is the dominant land cover (Figure 5-151). The overall classification is described as open fields, consisting primarily of trees and shrubs with some grasses, as well as coastal vegetation along the coastline with patches of mangroves to the north and southeast of the property. Two bays exist, a smaller west bay and larger eastern bay, both possessing sandy beaches, actively used by turtles for nesting.

The site appears to have remained undeveloped since 2002 with vegetation as the predominant land cover; however, in 2018 the vegetated area towards the south eastern section of the site appeared to have been cleared (Table 5-83). Human activity over the years has modified the project site in various ways; roads, trails and derelict buildings exist, and improper garbage disposal is profuse. The site and adjacent coastal areas are used by fishermen, as is evidenced by the functional fishing paraphernalia such as nets and fishing lines observed. It is also used for recreational visits and activities, e.g., swimming/bathing.

Figure 5-151 Land cover classification at the project site

5.6.5.2 Beach Carrying Capacity

The beach carrying capacity for the proposed project was calculated. The beach areas (dry sand area and licenced swim (wet) areas) are listed below:

The total **Dry Beach area** is as follows:

- Perched Beach – 2,912 square meters.
- Western Beach – 3,718 square meters
- Pebble Beach – 297 square meters.
- Eastern Beach – 5,329 square meters.
- **Total Dry Beach – 12,256 square meters**

The total **Wet Beach area** is as follows:

- Western Beach – 1,943 square meters
- Eastern Beach – 3,966 square meters
- Circulation Channel (overwater rooms) – 14,828 square meters
- **Total Wet Beach – 20,737 square meters**

Overall Total Beach Area (wet and dry): 32,993 square metres

The data below represents the actual real-world data of 2.6 persons per room for the hotel developer (from longstanding operations in several other countries). It assumes an occupancy level 100% all the time and does not take into account occupancy levels below, nor does it take into account the pool areas. At no point is it expected that all guests would want to use the beach at the same time.

If it is assumed that each beach goer utilises 3 m^2 of beach and given the total number of proposed rooms (715) with 2.6 persons staying in each room on average, then at 100% occupancy (1,859 guests), 5,577 m^2 of beach would be required for use.

The combined wet and dry beach area total of 32,993 m^2 is adequate for the expected visitors and would be able to accommodate guests at full hotel capacity. Based on these calculations, the number of beach goers who could comfortably use the beach is 10,998 users. The percentage capacity of the beach to be utilized based on the maximum number of hotel guests, is 17%, thus the hotel beach areas will not be overburdened at full occupancy (Table 5-84).

Table 5-84 Beach carrying capacity for Richmond Hotel beach areas

Location	# of rooms	Avg. # of pers/room	Avg. # of potential beach users	Total Area of beach needed to accommodate Avg. # of potential beach users (m2)	Total Wet and Dry Beach Area (m2)	Beach Carrying Capacity (# of beach users that can comfortably hold on beach)	Max. % of capacity to be used based on max # of guests (%)
Richmond Hotel Beach Areas	715	2.6	1859	5577	32993	10998	17

5.6.5.3 Future Developments

The following developments in the study area are currently being developed or are slated for the future:

- **North Coast Highway Project** - Jamaica signed a US$800 million agreement with the International Finance Corporation (IFC) to develop the North Coast Highway Project. Under the Financial Advisory Services Agreement (FASA), the IFC will assist the government in all steps of project structuring and implementation to successful closure of the expansion, improvement, and maintenance of three road segments: Mammee Bay to Salem (12.3km), Seacastles to Greenwood (6.8km) and **Greenwood to Discovery Bay (40.7km). As seen in Figure 5-154, the Mammee Bay to Salem Road se**gment is the major roadway leading to the project site. The planned expansion of roads on the North Coast Corridor from two to four lanes and other improvements are deemed critical to improving transportation and access between Montego Bay and Ocho Rios. As stated by Nigel Clarke, Minister of Finance and the Public Service, "Jamaica's North Coast Road infrastructure is facing capacity constraints and is inadequate to sustain anticipated future economic activity. As such, the GoJ is intent on pursuing an open, competitive, and transparent process to attract large investors who have the capital and ability to procure construction services from providers, who have the expertise to undertake this project, which will be the single largest infrastructure project in Jamaica's history" (Ministry of Finance & the Public Service, 2021).
- **Renovation of Priory Beach** – The redevelopment of Priory Beach, located approximately 1 km southeast of the project site (Figure 5-152 and Figure 5-153), is a part of the Tourism Enhancement Fund's Beaches Programme and includes improvements to the beach facilities. It is the intention that the beach will remain accessible to residents and free-to-use (Jamaica Observer, 2022).
- **Sugarcane by Karisma Jamaica** – This is a multi-hotel project situated on 226 acres in Llandovery, St Ann, about 5.2 km west of the project site (Figure 5-154). The proposed development comprises approximately 4,700 hotels rooms and the potential to create up to 10,000 jobs. It is stated to be a part of Jamaica's plan to add some 15,000 new hotel rooms over the next three to five years (Caribbean Journal, 2022). Site preparation works have commenced (Jamaica Today, 2022).
- **Paradisiac Beach Club – The Jewel of the Caribbean** – These luxury boutique residences are being developed by Manukah Development Company Ltd. Paradisiac will be located across from Richmond Estate, 2.5 km west of proposed hotel (Figure 5-154). It will also include convenient stores, restaurants, parks and public areas on property (Paradisiac Beach Club – The Jewel of the Caribbean, 2022).
- **Mahogany Hill Housing Development** – London-based Wots Hot Energy is spearheading the development of a green, sustainable community consisting of 211 eco-friendly homes for middle-income and high-end buyers in Chester, St Ann. (The Gleaner Company (Media) Limited, 2022). As seen in Figure 5-154, it is situated approximately 3.4 km southwest of the hotel site.

Figure 5-152 Proposed redevelopment of Priory Beach (plan view)

Figure 5-153 Proposed redevelopment of Priory Beach (3D view)

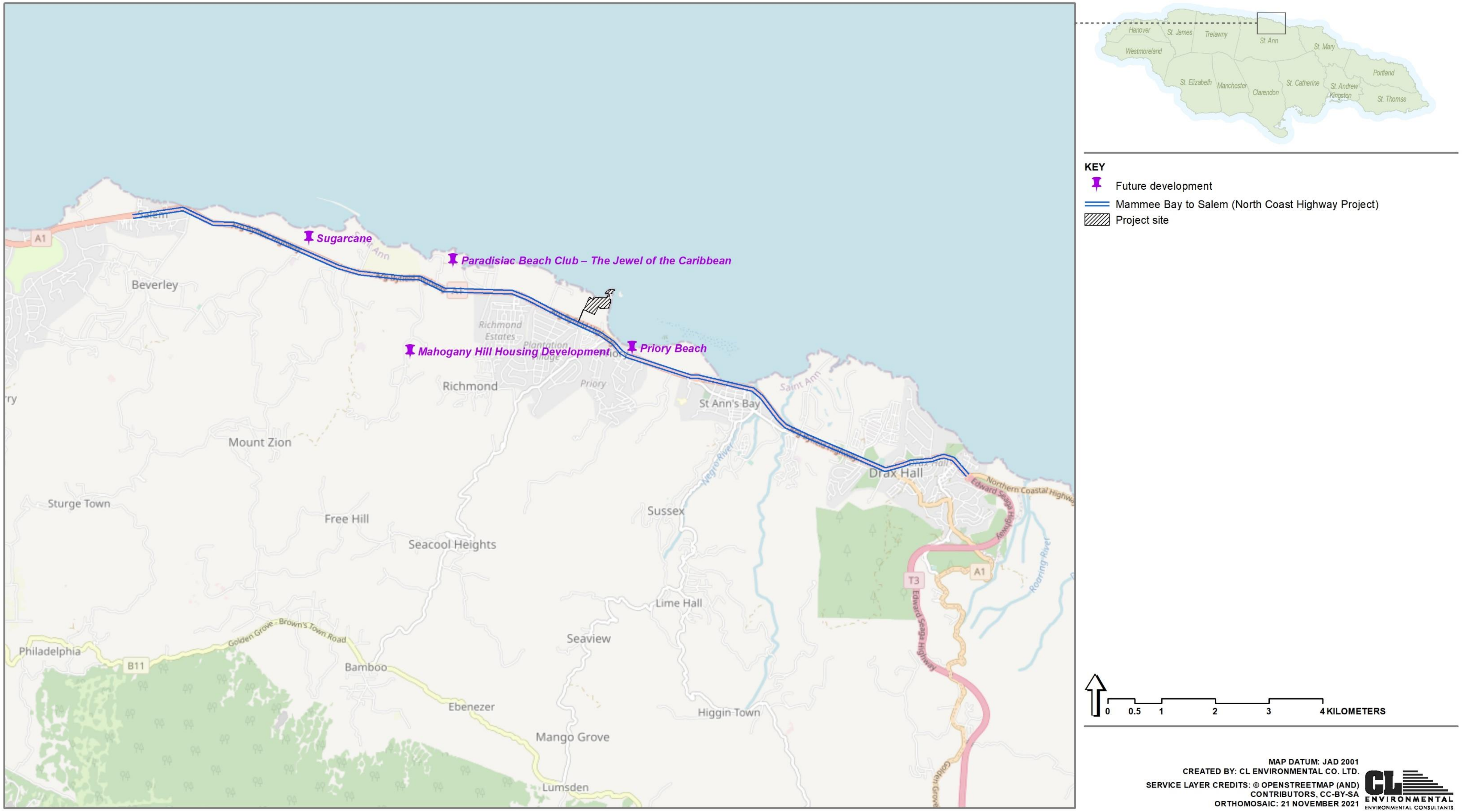


Figure 5-154 Approximate location of future developments in proximity to the project site

5.6.5.4 Protected Areas

Protected areas examined here include all areas of land or water protected by various laws in Jamaica, as well as international agreements, that fall within or in proximity to the project area; these include fish sanctuaries or Special Fishery Conservation Areas (SFCAs), protected areas (declared and proposed), national parks, forest reserves, marine parks, game reserves and national heritage and monuments. Specific to this project, no protected area is located within the SIA; the closest area is the Ocho Rios Marine Park Protected Area, whose western boundary is found about 5.5km east of the project site (Figure 5-148). A forest estate is also located 2km south of the project, named Seville; it is classified as government-owned crown land.

5.6.5.5 Zoning

The Town and Country Planning (St. Ann Parish) Confirmed Development Order 2000 is applicable to the proposed project. Figure 5-155 provides an overview of the development order map for St. Ann; the project area does not fall within the bounds of the St. Ann's Bay Local Planning Area; however, it is the closest local planning area in proximity to the site. The order states that a potential for growth in the tourism industry in the St. Ann's Bay area is noted, though careful control will be required to avoid problems created by unbridled growth and overdependence on one sector.

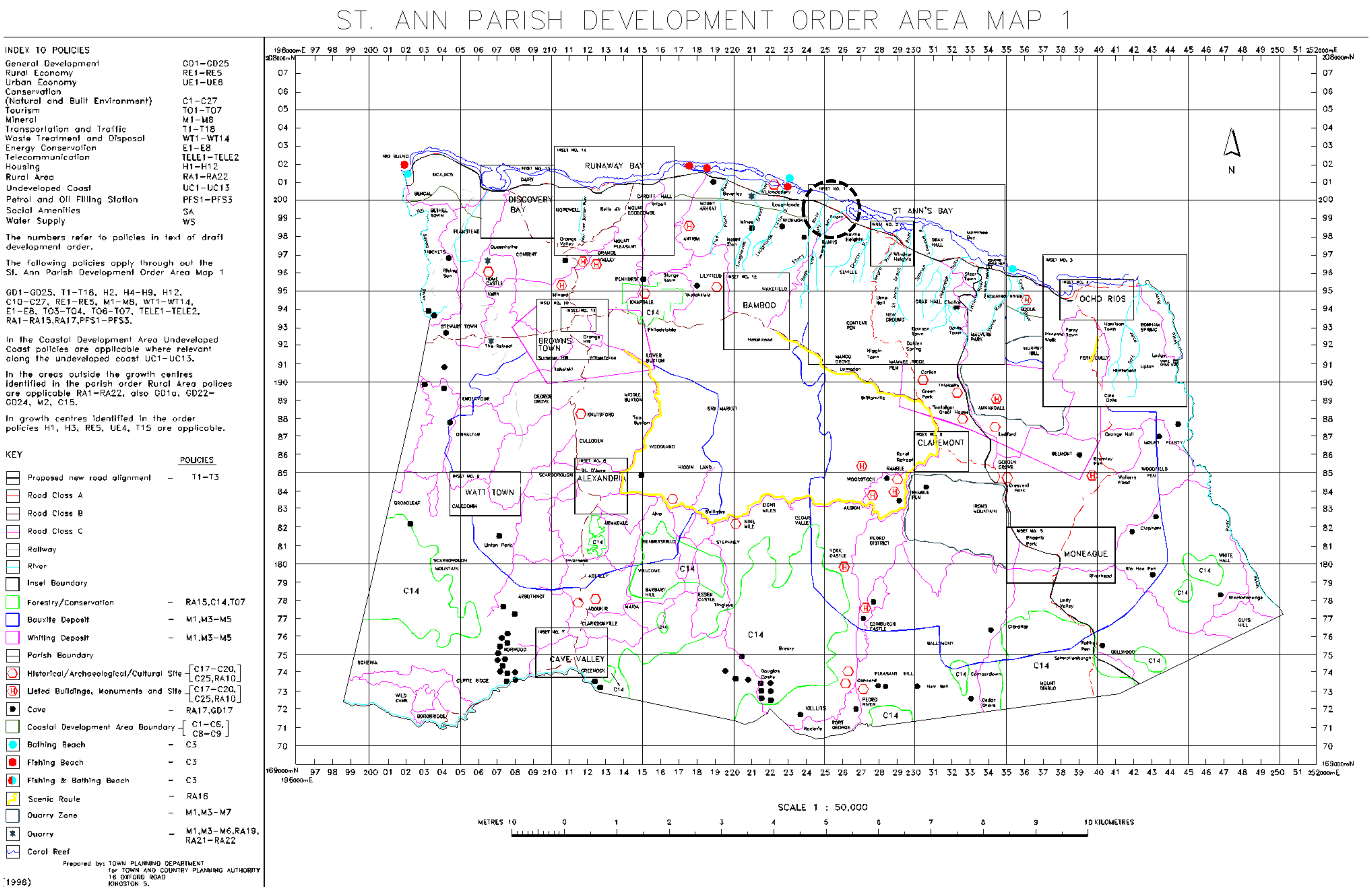


Figure 5-155 St. Ann Development Order area map (approximate project area shown by black dotted circle)

6.0 PUBLIC PARTICIPATION

6.1 APPROACH

The survey area for the perception study was established to be a two-kilometre radius around the proposed site boundary. Using the Raosoft calculator[5] set at 95% confidence level and the population within the 2km buffer of the proposed site (4,685 persons), the total sample size was estimated to be 356 persons. Using the ratio of the sample size versus the total survey area population (1:13.16), the sample sizes for each ED within the survey area was calculated (Figure 6-1). These ED sample sizes were used to guide the number of questionnaires randomly administered within each ED.

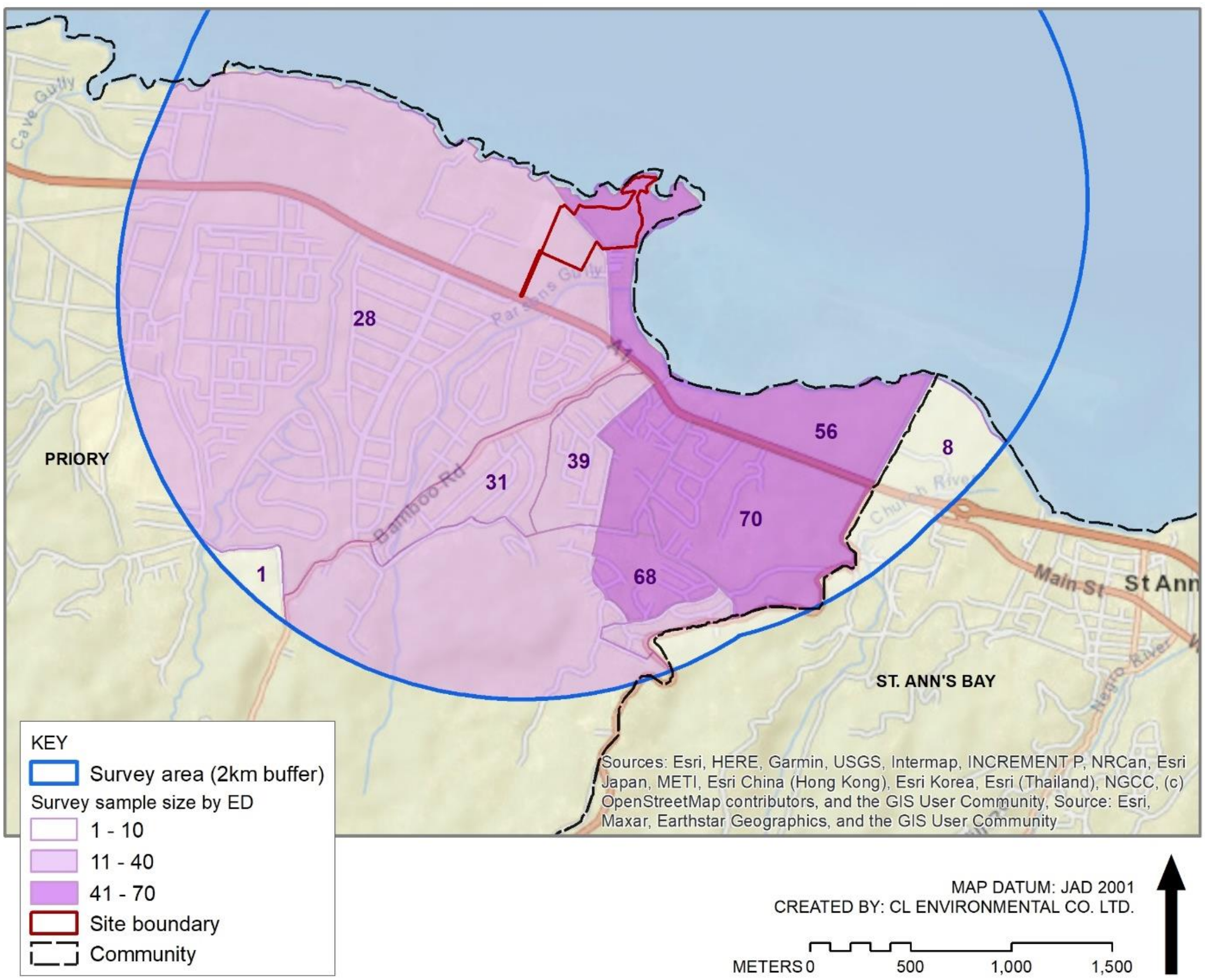


Figure 6-1 Survey sample size by ED for a 2 km buffer around the proposed project site

[5] Sample Size Calculator by Raosoft, Inc.

Residents, fishers and stakeholders were the major target groupings for the public participation survey. Questionnaires were administered for each grouping within the 2km survey area during the periods September 21 - 30 and October 1 – 15, 2022 as follows:

- three hundred and fifty-one (351) community questionnaires (Appendix 6) (respondents);
- six (6) fishers questionnaires (Appendix 7); and
- one (1) stakeholder questionnaire (St. Ann's Bay Infirmary).

Results of the resident, fisher and stakeholder interviews are summarised in subsequent sections.

6.2 ASSUMPTIONS AND LIMITATIONS

During the survey exercise the following challenges were experienced:

- Lack of participation by residents. This was experienced in the Tanglewood community. Five surveys were administered in this community. Tanglewood was observed to be a community with many retired residents. Residents did not respond when attempts were made to solicit participation or declined to participate. It was also observed during the survey exercise, that homes in this community were recessed from the roadway and therefore made it difficult to get the attention of residents. Additionally, many persons encountered were household workers and/or groundskeepers employed in the community but did not reside in the community.
- Difficulty accessing gated residential communities. This was experienced in the Plantation Village and Richmond Estate communities. Despite telephone and email contact to the respective property management offices seeking access permission, and submitting the survey instrument electronically and by hardcopy, there was no participation or very poor participation from these gated communities. In the case of Plantation Village, the survey team was permitted to interview some members of the Homeowners' Association. For Richmond Estates, the survey team was not granted access. This unwillingness to participation is similar to the challenges faced by Census takers. This unwillingness to participate in surveys is similar to the challenges faced by Census takers (The Gleaner Company (Media) Limited, 2022).
- Active fisherfolk were not encountered during the community survey exercise. Despite multiple visits to the proposed project site, the Priory Beach (Fantasy Beach) and the accessible coastline in the general Priory community, no active fisherfolk were encountered in the study area. Anecdotal information suggested that fishers in the area were mainly spear fishers who were transient and not normally present in the area. It was also realised that some persons who anticipated an impact on fishing activities engaged in fishing for mainly recreational and domestic purposes and did not engage in fishing as a profession. In an effort to obtain feedback from active fisherfolk, surveys were administered at the St. Ann's Bay Fishing Beach, which is the nearest recognised fishing beach to the study area.
- Comments were requested from the National Fisheries Authority (The Ministry Of Agriculture & Fisheries); however a response was not received before the submission of this report.

6.3 COMMUNITY

6.3.1 Introduction

For respondents participating in the community perception survey, approximately fifty-nine percent (58.8%) of respondents were male while 41.2% were female.

Of the Three Hundred and Fifty-One (351) respondents age cohort distribution was as follows; 10.2% were 18-25 years of age, 14.3% were 26-33 years, 14.0% were age 34-41 years, 19.7% were age 42-50 years, 18.5% were age 51-60 years and 23.3% were older than sixty years of age.

As seen in Figure 6-2 and Figure 6-3, respondents were from eleven main communities. These communities were Priory (30.5%), Seville Heights (41.9%), Seaview Heights (5.1%), Compound (2.0%), Hartland (4.0%), Hartland Estates (6.3%), Tanglewood (1.4%), Banks (4.8%), Farmers Heights (1.4%), Plantation Village (0.9%) and Richmond Estates (1.7%). Three of these communities, Plantation Village, Hartland Estates and Richmond Estates are gated communities.

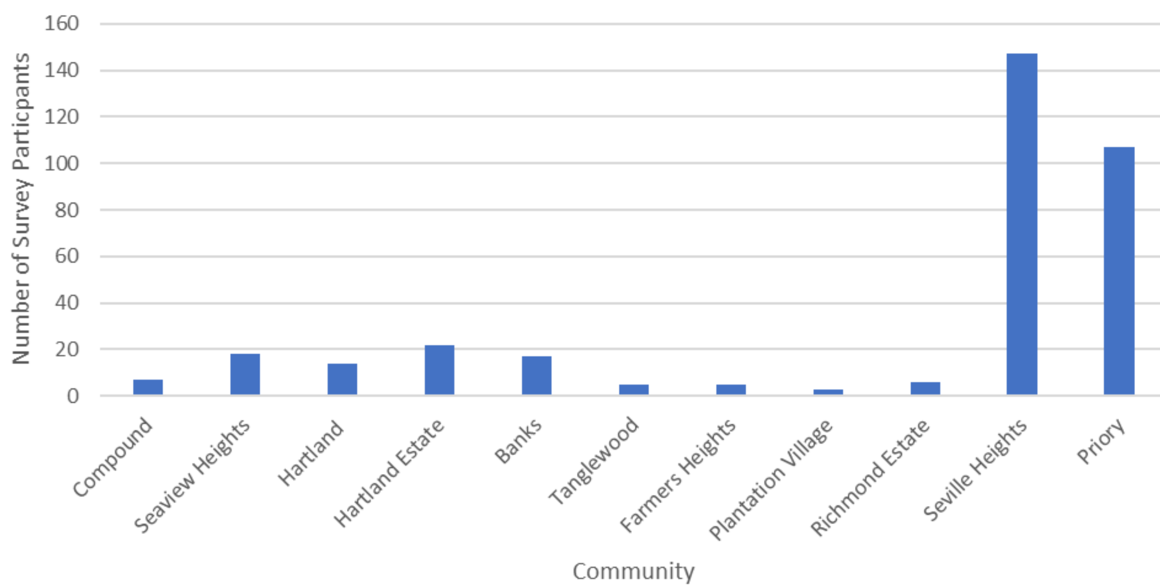


Figure 6-2 Graph showing number of survey participants per community

While limited responses were received from some communities, such as Tanglewood, Richmond Estates, Plantation Village (Figure 6-2) and may not be representative of the community, they have been incorporated in the overall analysis.

Percentages presented are for the total number of persons offering responses; in instances where respondents did not offer an answer to a question, they were not considered part of the analysis for the specific question(s).

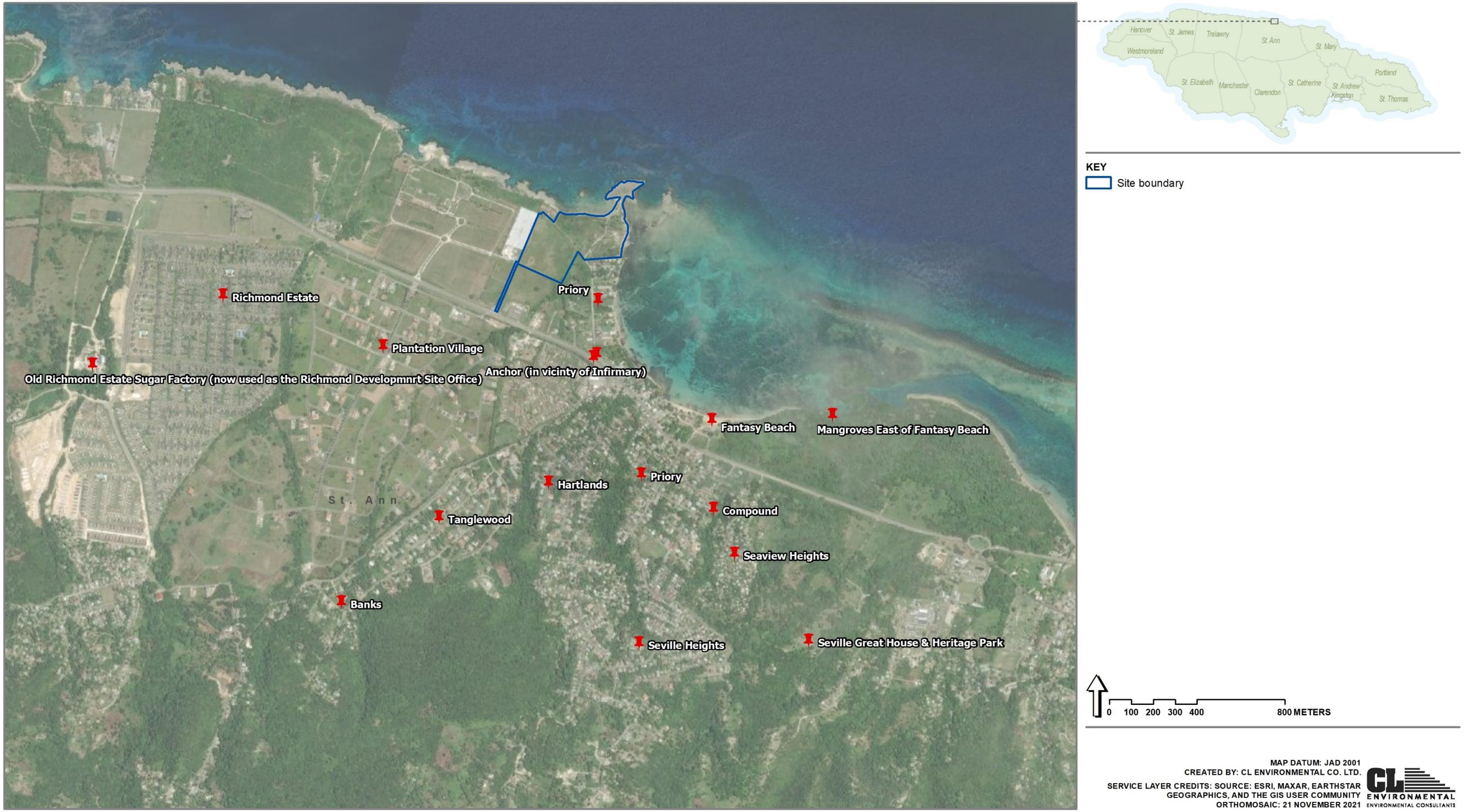


Figure 6-3 Map showing communities and other places of interest visited during the perception survey

6.3.2 Results and Findings

6.3.2.1 Overview

Of those persons interviewed who offered a response (95.4%), 34.6% indicated that they were self-employed, while 31.4% stated that they were employed (by a third party) and 18.8% stated they were unemployed. Approximately fifteen percent (15.2%) of individuals were retired. Additionally, 67.5% of interviewees when asked, confirmed that they were the head of their household while 32.5% indicated that they were not the household head.

Regarding the number of persons residing in households, just under twenty-one percent (20.6%) of households had one occupant while 20.0% had two occupants, 16.4% had three occupants and 15.5% had four persons living in the household. Approximately eight percent (8.4%) had five persons living in the household and 19.1% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Forty-two percent (42.0%) of individuals resided in their communities for all their life, and 28.7% resided in their community more than fifteen years. Approximately five percent (4.8%) stated that they lived in their community for between ten and fifteen years; 10.7% resided for between five and ten years. Just under ten percent (9.9%) resided in their community for between three and five years and 3.9% for under two years.

On the issue of where healthcare was mostly obtained, 10.8% stated the public clinic, 50.7% stated the public hospital and 37.0% stated that healthcare needs were mostly sourced through the private doctor. Less than one percent (0.3%) of interviewees stated the private hospital. As it pertained to the specific healthcare provider, the public hospital most referenced was the St. Ann's Bay Regional Hospital, while the health centre most referenced was the St. Ann's Bay Health Centre. Some respondents (1.2%) did not offer a response.

As it related to whether respondents suffered from specific medical conditions, 10.0% of interviewees indicated that they were asthmatic, 17.9% indicated that they suffered from sinusitis, 1.1% confirmed coughing as an ailment. No one interviewed (0.0%) indicated that they suffered from congestion/bronchial problems, chest pains or frequent bouts of diarrhoea as ailments. Approximately sixty-nine (68.9%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named. It should be noted that 2.1% of interviewees offered no response.

Respondents in general, expressed some reluctance to disclose information pertaining to income. Of those interviewed, approximately fifty-one percent (50.7%) of respondents declined to offer a response relating to their personal weekly income. Approximately fifteen percent (15.2%) of persons indicated that they did not have a weekly income, while 4.8% indicated that their weekly income was under the national minimum wage of $9,000.00 per week. Just under two percent (1.8%) of interviewees indicated that their weekly income was $9,000.00 per week; 10.1% stated that their weekly income was between $9,001.00 and $12,000.00, while 8.7% stated a weekly income ranging between

$12,001.00 and $20,000.00. Approximately nine percent (8.7%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00) per week.

Regarding the highest level of education completed, 94.9% of those interviewed offered a response. Of this number 0.9% of persons stated that they did not attend any type of learning institution. Approximately eighteen percent (17.7%) stated they completed primary/all age school, 2.7% stated that they started but did not complete high school, 50.5% completed high school, 12.0% college, 7.2% university and 9.0% HEART/Vocational Training Institution.

As it pertained to education, 56.9% of those interviewed stated that no one in the household was currently attending school while, 43.1% of interviewees indicated someone in the household was attending school. As it related to the school being attended 18.1% stated that the school being attended was infant/basic, 54.9% stated primary/all age, 45.8% stated high school, 7.6% stated college, 6.3% stated university while 2.1% stated that HEART/a vocational training institute was the school being attended. It should be noted that percentages exceeded one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 58.2% of those offering a response indicated that a recreational space was present while 41.8% stated that no recreational space was present in the community. Recreational spaces named were:

- Seville Heights Community Centre/Playing Field (81.5%)
- Green Space within community (informally used) (7.7%)
- Lewis Community Centre (2.6%)
- Zinc Shed (2.1%)
- Hope Centre (2.1%)
- Fantasy Beach (1.0%)
- No further response offered (3.0%)

On the issue of respondents' awareness of a company named Richmond Vista Limited, all interviewees (100.0%) offered a response. Of these persons 6.8% indicated that they heard of Richmond Vista Limited while 93.2% stated that they had not heard of that company name. When asked if they had heard of a project called "Secrets Resort and Spa", 100.0% of survey participants offered a response. Approximately thirty-six percent (36.2%) of interviewees stated that they had heard of the project name while 63.8% stated that they had never heard of any project by that name.

Regarding respondents knowing what a desalination plant was, all interviewees (100.0%) offered a response. Approximately twenty-eight percent (27.9%) of respondents stated that they knew what the term meant while 72.1% indicated that they did not know what a desalination plant was.

On the issue of respondents knowing what an overwater suite/villa was, all interviewees (100.0%) offered a response. Approximately forty-one percent (40.7%) of respondents stated that they knew what the term meant while 59.3% indicated that they did not know what an overwater suite was.

As it pertained to respondents' awareness of the proposal by Richmond Vista Limited to construct a 715-room hotel development in the Richmond Estate (Priory) area of St. Ann, 100.0% of participants responded. Approximately eleven percent (10.5%) of those interviewed stated that they were aware of the project while 89.5% stated that they were not aware of the project (Figure 6-4).

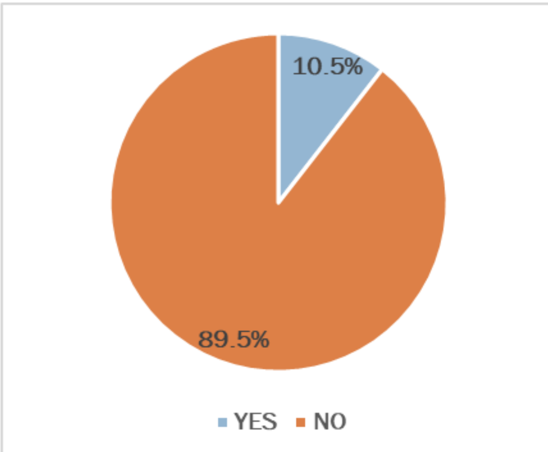


Figure 6-4 Percentage of respondents' awareness and unawareness of the 715-room proposed development

Of the 10.5% of interviewees confirming awareness of the proposed project:

- 27.0% stated that they were aware that the development would include fifteen (15) overwater villas, while 73.0% indicated that they were not aware
- 29.7% stated that they were aware that the development would include two buildings comprising 700 rooms, while 70.3% indicated that they were not aware
- 16.2% stated that they were aware that the development would include modifying a section of existing beach, while 83.8% indicated that they were not aware
- 8.1% stated that they were aware that the development would include constructing a wastewater treatment plant, while 91.9% indicated that they were not aware.
- 16.2% stated that they were aware that the development would include constructing a seawater desalination plant, while 83.8% indicated that they were not aware.
- 5.4% stated that they were aware that the development would include constructing a batching plant for concrete mixing, while 94.6% indicated that they were not aware.
- 2.7% stated that awareness of the project was via the television medium, 2.7% also stated radio, and 75.7% stated "word of mouth' as the medium by which they were made aware of the project. Approximately nineteen percent (18.8%) stated "other" and further explained that they observed activities being undertaken at the project site.

When asked if there have been any problems/issues on the proposed development site, all interviewees (100.0%) offered a response. Just over nineteen percent (19.1%) of interviewees stated that they were unaware of the site having problems/issues in the past, while 78.9% of persons stated that there were no problems/issues with the proposed site. Two percent (2.0%) of respondents indicated that there have been problems/issues at the proposed site in the past. Of this 2.0%, just over fifty-seven percent (57.1%) stated that flooding was the issue, 14.3% stated that the beach area was damaged from past hurricanes, while 14.3% stated that the area was affected by crime. No responses were offered by 14.3% of survey participants.

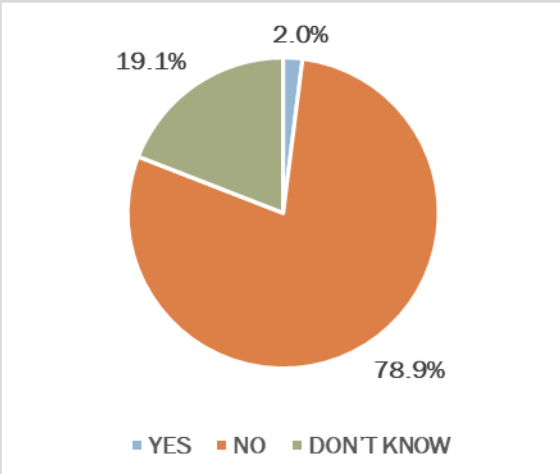


Figure 6-5 Percentage of respondents indicating if there have been problems at the proposed site

As it related to respondents having any general concerns pertaining to the proposed development project, 3.2% of those interviewed expressed uncertainty, 73.2% of interviewees indicated that they did not have any concern, and 23.6% indicated that they had concerns with the project as proposed. Concerns highlighted pertained to the following:

- Increased Traffic congestion (24.1%)
- Loss of beach access (31.3%)
- Loss of view (3.6%)
- Increased security risk (influx of criminal elements) (3.6%)
- Added strain on existing (public) infrastructure and/or social amenities (healthcare, emergency services) (6.0%)
- The capability of the existing soil type to accommodate the weight of the structures to be built (2.4%)
- The impact of the batching plant on the nearby areas (3.6%)
- The lack of public consultation (2.4%)
- Improper sewage disposal (12.0%)
- Loss of mangroves (4.8%)
- Squatting of construction workers (1.2%)
- The availability of equal work opportunities for locals/community persons (7.2%)
- Loss of marine wildlife (7.2%)
- Environmental pollution (to include air, water, and land) (9.6%)
- Beach erosion (2.4%)

- Possible relocation/displacement of residents (2.4%)
- Loss of livelihood of fisherfolk (4.8%)
- Adequate (long term) housing for migrant workers (1.2%)

Percentages exceeded 100.0% as some respondents expressed multiple concerns.

When asked about possible suggestions to address highlighted concerns, the following suggestions were put forward:

- Upgrade the existing traffic corridor (widening, bypass road) (16.9%)
- Leave an area to access the beach (20.5%)
- Reduce the building height (2.4%)
- Engage the constabulary force to assist in regulating traffic flow (2.4%)
- Develop and implement a traffic management plan (2.4%)
- Convene a community meeting (3.6%)
- Upgrade infrastructure to facilitate increased demand (6.0%)
- Do not build on the land (7.2%)
- Build an adequate sewage treatment facility (9.6%)
- Do not disturb the mangroves (1.2%)
- Minimise harmful environmental emissions (3.6%)
- Do not discriminate against local workers (7.2%)
- Conduct an environmental assessment to determine the development that is best suited (2.4%)
- Enforce anti-litter measures (1.2%)
- Do not disturb the reef (1.2%)
- Create (long term) housing solutions for migrant workers (1.2%)
- No suggestion offered (11.0%)

When asked if there were specific concerns regarding a section of the beach being modified, 100.0% of interviewees offered a response. Of these individuals, 4.6% expressed uncertainty, 84.0% stated that they had no concerns, while 11.4% indicated that they were concerned about a section of the beach being modified. Concerns highlighted were:

- The development may have a negative impact on nearby beaches (e.g., Fantasy Beach) (20.0%)
- Impact on the ecosystem (22.5%)
- Possible damage to the coral reef (12.5%)
- Dislocation of fishers (5.0%)
- Loss of access to beach and shoreline (32.5%)
- Beach erosion (20.0%)
- Increased risk of flooding due to storm surge (2.5%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Suggestions put forward to address highlighted concerns were:

- Employ measures to mitigate potential negative impact (10.0%)
- Involve the government environmental regulatory agency (NEPA) in project monitoring (2.5%)
- Construct an artificial reef (2.5%)
- Not modify the beach (20.0%)
- Allow for free movement along the beach/shoreline (25.0%)
- Not develop (build) on the project site (5.0%)
- Build shops and other business enterprises (2.5%)
- No suggestion offered (32.5%)

In response to whether there were specific concerns relating to suites/villas being built over water, all (100.0%) survey participants offered a response. Of these respondents, 4.3% expressed uncertainty, 84.3% stated that they had no concerns, while 11.4% indicated that they were concerned about suites being built over water. Concerns expressed were:

- Improper effluent disposal (12.5%)
- Improper solid waste disposal from the over water suites (during operation) (27.5%)
- Impact from hurricane and associated storm surge (27.5%)
- Impact on the coral reef (5.0%)
- Loss of access to the shoreline (5.0%)
- Loss of marine life (27.5%)
- Possible dredging of the sea floor (2.5%)
- Loss of view (2.5%)

Percentages exceeded 100.0% as multiple concerns were expressed.

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- Ensure oversight by the government environmental regulatory agency (NEPA) (10.0%)
- (During Operation) Sensitise guests on the proper solid waste disposal (12.5%)
- Construct an adequate sewage treatment facility (7.5%)
- Do not build the over water suites (10.0%)
- Build the suites above the storm surge height (5.0%)
- Construct an artificial coral reef (2.5%)
- Allow free movement along the shoreline (5.0%)
- Ensure that the design of the suites can withstand adverse weather events/conditions (2.5%)
- Recycle generated solid waste (2.5%)
- Dredge the seafloor only as necessary (2.5%)
- Not develop (build) on the project site (2.5%)
- No suggestion offered (37.5%)

As it pertained to respondents having specific concerns relating to the seawater desalination plant, all (100.0%) persons interviewed offered a response. Of these respondents, 5.7% expressed uncertainty, 87.5% stated that they had no concerns, while 6.8% indicated that they were concerned about the seawater desalination plant. Concerns expressed were:

- The purpose for which the water will be used (will it be safe) (33.3%)
- Lack of information on the desalination process (16.7%)
- Negative impact on marine wildlife (33.3%)
- Handling and disposal of waste (specifically extracted salt) (12.5%)
- Harmful environmental emissions (20.8%)

Percentages exceeded 100.0% as multiple concerns were expressed.

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- Ensure water is good for potable use (12.5%)
- Provide information on the desalination process (20.8%)
- Provide information on potential health and safety risks associated with desalination (12.5%)
- Mitigate against impact to the ecosystem (16.7%)
- Do not build the desalination plant (12.5%)
- Use the National Water Commission as the water supply source (12.5%)
- No suggestion offered (12.5%)

On the issue of having specific concerns regarding the project having its own batching plant for the mixing of concrete, 100.0% of interviewees offered a response. Of these individuals, 5.5% expressed uncertainty, 78.3% stated that they had no concerns, while 16.2% indicated that they were concerned about the project having its own concrete batching plant. Concerns expressed were:

- Dust and noise nuisance (54.4%)
- Proximity to the ocean (3.5%)
- Marine pollution resulting from surface water run-off (12.3%)
- Harmful emissions from the batching plant (19.3%)
- Loss of earning opportunity for existing concrete batching plant (nearby) (28.1%)
- Improper disposal of excess concrete (3.5%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Suggestions put forward to address highlighted concerns were:

- Properly hoard the site (3.5%)
- Implement systems to mitigate against harmful emissions/discharge/dust/surface run-off (21.1%)

- Install the wastewater treatment plant first to ensure proper disposal of wastewater from the batching plant (1.8%)
- Install the desalination plant first to ensure that water is adequate and available for concrete mixing (1.8%)
- Do not build the batching plant (3.5%)
- Use already existing local concrete batching plant (36.8%)
- Educate persons on potential health risks associated with the batching plant operations (1.8%)
- Wet the area (1.8%)
- Properly dispose of excess concrete (1.8%)
- Do not build the hotel (1.8%)
- Do not operate the batching plant during hours of normal quiet time (1.8%)
- No suggestion offered (22.5%)

In response to whether there was dependence on/use of the proposed site (lands to include the beach area) for any type of activity, all persons interviewed (100.0%) offered a response. Of these respondents, 23.1% of individuals confirmed that they depended on the proposed site while 76.9% stated that they did not depend on the site (Figure 6-6). The 23.1% of respondents indicated that the proposed site was used for:

- Recreation (to include swimming) (53.1%)
- Fishing (to include boat docking) (56.8%)
- Crab and whelks hunting (7.4%)
- Camping (1.2%)

Percentages exceeded 100.0% as some respondents offered multiple responses.

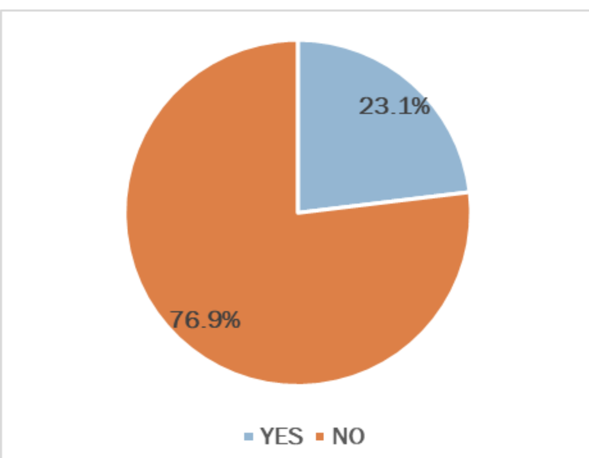


Figure 6-6 Percentage of respondents indicating use/non-use of the proposed site

On the issue of using the section of the marine environment proposed for the overwater villas for any type of activity, 100.0% of interviewees offered a response. Of these individuals, 4.6% confirmed that they used the area while 95.4% stated that they did not use the overwater villas area for any activity. The 4.6% of respondents indicated that the proposed overwater villas area was used for:

- Fishing (93.8%)
- Crab hunting (6.2%)

When asked about walking through the site in the past, all survey participants offered a response. Approximately fifty-two percent (51.6%) of respondents stated that they did not walk through the proposed site in the past, while 48.4% indicated that in past years they walked through the site. As it pertained to why individuals walked through the site, respondents indicated:

- to access the beach for recreational purposes (65.9%)
- fishing (39.4%)
- Crab and/or whelks hunting (4.1%)
- Footpath to adjacent villas (1.8%)
- Cattle rearing (0.6%)

Percentages exceeded 100.0% as multiples responses were offered.

When asked, the 48.4% of persons indicating that they walked through the site, stated that they had been walking through the site for:

- Less than a year (8.2%)
- Between one and five years (20.6%)
- Between six and ten years (17.6%)
- Between eleven and fifteen years (10.6%)
- Between sixteen and nineteen years (0.6%)
- More than twenty years (34.7%)
- No timeline stated (7.7%)

Regarding whether persons still walked through the proposed site, all interviewees offered a response (100.0%). Of these respondents, 74.6% of respondents indicated that they were no longer walking through the site, while 25.4% of interviewees indicated that they were still walking through the site. In response to why they were still traversing the site, of the 25.4% of persons confirming that they were still walking through the site, respondents stated:

- For access to the beach (65.9%)
- Fishing (41.6%)
- Crab and/or whelks hunting (7.9%)

Percentages exceeded 100.0% as interviewees offered multiple responses.

When asked if they knew anyone who depends on/uses the proposed site for any type of activity all (100.0%) survey participants responded. Approximately twenty-two percent (21.9%) stated that they knew of persons who used the area, while 78.1% of respondents stated that they did not know of anyone who used the proposed location. The purposes that these persons depended on/used the area for were stated as follows:

- Beach access for recreation (to include swimming) (24.7%)
- Recreation (Beach Party) (3.9%)
- Fishing (74.0%)
- Crab and/or whelks hunting (6.5%)
- To buy fish (1.3%)
- Animal grazing (1.3%)

Percentages exceeded 100.0% as some respondents stated that the area was used for multiple purposes.

On the issue of whether respondents thought the project would affect their life 100.0% of interviewees offered a response. Just over forty percent (40.2%) of respondents indicated that the project would not affect their life in any way, while 23.0% were not sure if the project would affect their life. Of the 36.2% of persons anticipating some effect on their lives, 5.4% anticipated a negative impact while 30.8% anticipated a positive impact from the project and 0.6% anticipated both positive and negative impacts (Figure 6-7). For those anticipating some positive effect, they anticipated:

- Increased opportunity to generate income (15.5%)
- Employment opportunity (80.9%)
- Property appreciation (4.5%)

Percentages exceeded 100.0% as some respondents anticipated multiple positive impacts.

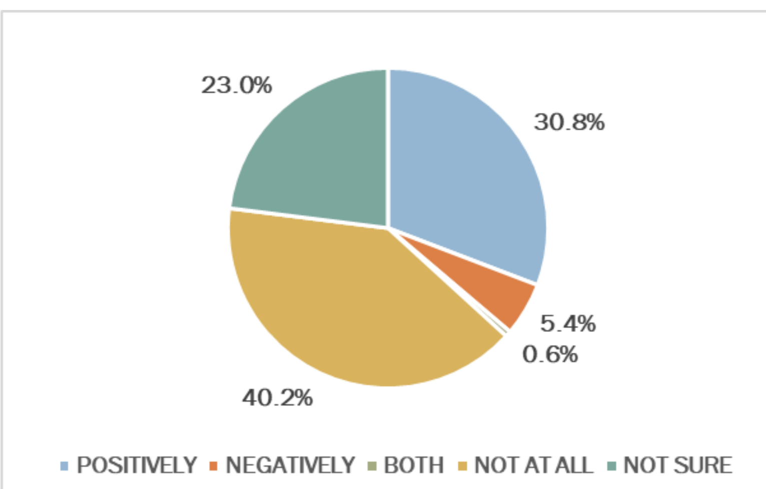


Figure 6-7 Percentage of respondents and the potential impact of the project on respondent's lives/livelihood

For those anticipating a negative effect, they anticipated:

- Loss of fishing livelihood (47.6%)
- Increased traffic congestion (19.0%)
- Loss of view (4.8%)
- Loss of beach access (14.3%)
- No further response offered (14.3%)

When asked about possible suggestions to mitigate/address the anticipated negative impact, the following suggestions were offered:

- Implement traffic management strategies (14.3%)
- Engage the traffic management of the Jamaica Constabulary Force to monitor traffic flow (4.8%)
- Reduce building heights (4.8%)
- Allow access for fishing (9.5%)
- Allow beach access for recreation (14.3%)
- No suggestion offered (52.3%)

Regarding whether respondents thought the project would affect their community 100.0% of interviewees offered a response. Just over nineteen percent (19.4%) stated that they were unsure if there would be an impact while 21.4% of individuals interviewed indicated that the project would not have any impact on the community. Approximately fifty-nine (59.2%) percent of respondents anticipated that the project would impact their community. Of these respondents, just over fifty-four percent (54.1%) of interviewees anticipated a positive effect, 3.4% anticipated a negative effect and 1.7% anticipated both positive and negative impacts on the community.

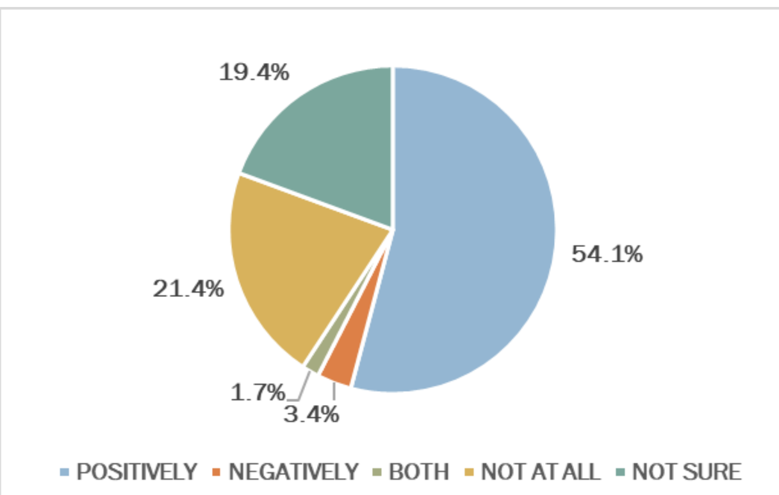


Figure 6-8 Percentage of respondents and the potential impact of the project on the community

For those interviewees anticipating a positive effect on the community, the following were stated:

- employment opportunities will be created (87.8%)
- There will be community/national development (20.4%)
- Property appreciation (2.0%)
- Increased income (4.1%)

Percentages exceeded 100.0% as multiple responses were offered.

For those anticipating a negative effect on the community, the following were stated:

- Increased traffic congestion (16.7%)
- Influx of criminal elements into the community (16.7%)
- Squatting by construction site workers (5.6%)
- Loss of access to the beach (38.9%)
- Loss of fishing area (27.8%)
- Dust pollution (22.2%)
- Beach erosion (5.6%)
- Increased risk of storm surge (5.6%)

Percentages exceeded 100.0% as multiple negative impacts were anticipated by some respondents.

When asked about possible suggestions to mitigate/address the anticipated negative impact, the following suggestions were offered by respondents:

- Employ local (community) tradesmen (11.1%)
- Screen workers prior to employment (5.6%)
- Provide adequate housing solutions for construction workers (5.6%)
- Provide beach access for local (community) residents (5.6%)
- No suggestions (72.1%)

As it pertained to whether respondents thought the project would affect the environment, 100.0% of persons interviewed offered a response. Just under forty-six percent (45.6%) of respondents stated that the project would not have an impact on the environment, while 36.7% stated that they were unsure if there would be any impact. Approximately eighteen percent (17.7%) of interviewees anticipated an impact to the environment. Of these respondents, twelve percent (12.0%) anticipated a negative effect while 5.4% anticipated a positive effect and less than one percent (0.3%) anticipated both positive and negative impacts on the environment. For those anticipating a positive effect on the environment, the following were stated:

- Better waste management (10.0%)
- Community Development (35.0%)
- Infrastructure upgrades (35.0%)

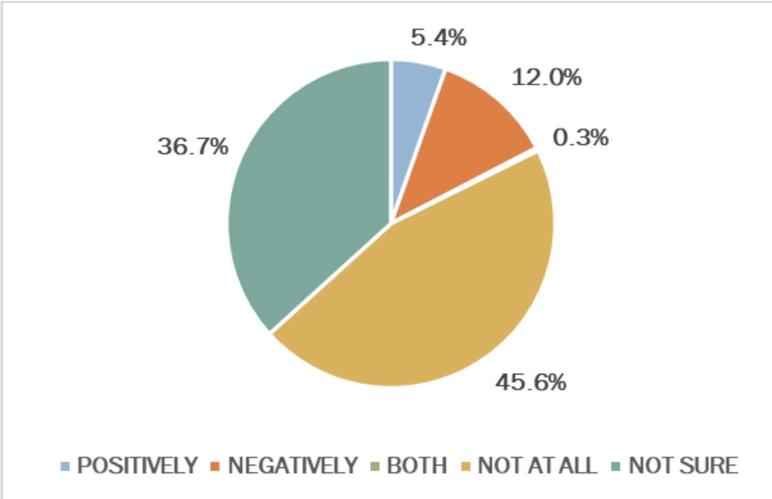


Figure 6-9 Percentage of respondents and the potential impact of the project on the environment

The remaining 20.0%, while anticipating a positive impact did not offer specific information. It should be noted that those anticipating a positive impact on the environment were anticipating an impact on the physical environment. For those anticipating a negative effect on the environment, the following were stated:

- Loss of wildlife (fish, turtles) (20.9%)
- Harmful emissions (7.0%)
- Environmental degradation (32.6%)
- Loss of natural landscape (2.3%)
- Noise and/or dust pollution (23.3%)
- Loss of mangroves (4.7%)
- Change in tidal flow (4.7%)
- Improper discharge of sewage effluent into the ocean (16.3%)

Percentages exceeded 100.0% as multiple responses were offered.

When asked about possible suggestions to mitigate/address the anticipated negative impact on the environment, the following suggestions were offered by interviewees:

- The government environmental regulatory agency (NEPA) should ensure that clean energy solutions are implemented (7.0%)
- The government environmental regulatory agency (NEPA) should be engaged to monitor and give project oversight (7.0%)
- Do not develop the property (7.1%)
- Maintain the natural landscape (4.7%)
- Re-establish mangroves post construction (2.3%)

- Ensure pollution prevention measures are in place (14.0%)
- Ensure that there is proper disposal of sewage effluent (2.3%)

Some respondents (55.6%) offered no suggestion regarding how the anticipated negative impact could be addressed.

As it related to housing 100.0% of interviewees offered responses. Forty-three percent (43.0%) of respondents stated that they owned the house they lived in, 1.2 % stated that their residence was leased, 13.7% lived in rented homes, 2.8% lived in government own housing, 0.3% indicated that they squatted in their residence while 36.2% stated that they lived in family-owned homes. Just under three percent (2.8%) stated "other" and further indicated that they were caretakers or lived in the homes owned by their employers.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Just over thirty-four percent (34.2%) of respondents stated that they owned the land on which the house is located, 2.8% stated that the land was leased, 7.2% indicated that lands were government owned, 2.8% indicated that they squatted on the land, while 36.8% stated that their homes were built on family land. Approximately sixteen percent (16.2%) stated "other" and indicated that the home they lived in was rented or employer owned, but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 82.6% of interviewees indicated that the walls of their homes was made of concrete and blocks, 14.6% stated wood/board while 2.8% stated that walls were made of both concrete and blocks as well as wood/board. It should be noted that for respondents who indicated that the walls of their homes were made of both materials, this was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 63.0% of respondents indicated that the roof of their homes was metal sheeting, while 30.8% stated concrete and 0.6% stated wood as the roof material. Just under five percent (4.8%) of interviewees stated that their roofs were made of multiple materials, and specified metal sheeting and concrete as the materials. This was due to structural additions to increase habitable living space. Less than one percent (0.8%) stated "other" as the roof material but did not specify the type of roof material.

As it pertained to the type of toilet facility present 100.0% of respondents offered a response. Approximately ninety-two percent (91.7%) of respondents indicated that their homes had water closets, while 8.3% stated that pit latrine was the toilet facility. No one (0.0%) indicated that their homes did not have a toilet facility.

As it related to what the household used for lighting 100.0% of respondents offered a response. Ninety-eight percent (98.0%) of interviewees stated that electricity was used while 1.4% stated kerosene oil was used for household lighting and 0.6% stated solar as the household lighting source.

Regarding the type of fuel used mostly for cooking 100.0% of respondents offered a response. Approximately ninety-seven percent (97.4%) of persons interviewed indicated that gas was used mostly, 2.3% stated electricity, while 0.3% stated that they mostly used coal for cooking.

On the issue of the main source of household domestic water supply 100.0% of survey participants offered a response. Just over eighty-six percent (86.3%) of respondents confirmed that their household domestic water supply was the public piped water supply. Less than one percent (0.9%) of respondents stated that the main source of domestic water was private tank, 1.4% indicated the public standpipe, 0.3% stated private water truck, while 1.4% stated that household water was supplied from a spring or river. Approximately ten percent (9.7%) of participants stated “other” as the main source for domestic household water supply and further explained that their community received water from a private source used to supply the community. I was also explained that water was sourced from nearby neighbours.

As it pertained to respondents’ having any problems with the domestic water supply 100.0% of interviewees offered a response, and 73.5% of those who responded indicated that there were problems with the water supply while 26.5% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 1.2% stated that the area had no water at all, 2.3% stated that no pipes were run in the area, 89.5% indicated that the water supply was irregular while 5.8% stated that water pressure was low. Additionally, some respondents indicated that problems with their domestic water supply included:

- High calcium content (hardness) of water (1.2%)
- High chlorine content in water (0.4%)
- Lack of knowledge on the compliance of potable water with applicable standards (0.4%)
- Turbidity (2.3%)

Percentages exceeded 100.0% as some respondents stated that they had multiple problems with the domestic water supply.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply, 28.3% stated that rainwater was harvested, 7.4% stated that they bought water, 10.5% collected water from a spring/river. Approximately two percent (1.9%) stated that the water truck supplied water, while 3.1% stated that they used the community standpipe and 50.8% indicated that they stored water in various containers ranging from small containers to large plastic water tanks. Percentages exceeded 100.0% as some respondents employed multiple strategies to cope with problems related to domestic water supply.

On the issue of access to a residential (fixed line/landline) telephone 100.0% of respondents offered a response. Just over seventy percent (70.1%) of interviewees indicated that they did not have access to a residential telephone while 29.9% confirmed that they had access. Of the 70.1% of persons indicating that they did not have a fixed line at their residence 93.1% of these individuals indicated that they owned a mobile phone, while 6.5% stated that they did not own a mobile phone. Less than one percent (0.4%) of these respondents offered no response.

As it pertained to respondents' awareness of fixed line telephone service being in their community, 100.0% of respondents offered a response. Approximately seven percent (7.2%) of respondents stated that they were not aware of fixed line service being in the community, while 12.5% stated that the community did not have fixed line service. Just over eighty percent (80.3%) of interviewees stated that fixed line telephone service was present in the community.

Regarding the main method of garbage disposal for households 100.0% of respondents offered a response. Eighty-four percent (84.0%) of those interviewed indicated that the public garbage truck was the main garbage disposal method, 8.8% indicated private collection while 4.6% indicated that burning was the main method used to dispose of garbage and 2.6% stated "other" and further indicated that garbage was taken to a community skip for disposal.

Regarding the frequency of collections, of the 84.0% of respondents who indicated that the garbage truck was the main method of garbage disposal, 47.5% indicated that garbage collections were done once per week, 16.3% stated twice per week while 22.4% stated every two weeks as the collection frequency. Just under fourteen percent (13.6%) stated garbage collection was done once per month while 0.2% stated that collections were done less than once per month.

When asked about flooding, 100.0% of respondents offered a response. Of these respondents 97.4% of respondents indicated that their community was not affected by flooding, 1.7% indicated that they did not know if the community was affected, while less than one percent (0.9%) stated that their community experienced frequent flood events. Of the 0.9% of survey participants confirming community flooding all persons (100.0%) stated that flooding occurred only in times of heavy rainfall.

Regarding the frequency of rain events resulting in community flooding, 33.3% of respondents stated a frequency of once in three months while 66.7% stated once in six months. The affected areas named were the:

- Priory Main Road
- Section of private dwelling house

As it pertained to the depth of flood water, 33.3% stated that water levels were less than 0.3 metres (1.0 foot) in depth, while 66.7% stated that water levels ranged between depths of 0.3-1.5m (1.0-5.0ft).

Regarding whether there were problems with frequent flooding at or near the proposed site 100.0% of respondents offered a response. Approximately sixty-two percent (61.5%) of interviewees, stated that the area was not affected by flooding, while 33.9% stated that they did not know if the area was affected, and 4.6% stated that the area was affected by flooding. Of the 4.6% of those stating that there were flooding problems at or near the proposed site, 6.3% stated that flooding occurred each time there was a rainfall event, 81.3% stated flooding occurred only on times of heavy rains, while 12.4% offered no response.

When asked about the frequency of occurrence of rain events causing flooding at or near the proposed site, 12.5% stated that rain event occurred once weekly, 12.5% also stated once monthly, and 12.5% also stated once in six months. Just under nineteen percent (18.8%) stated once per year and 25.0% stated that rain events resulting in flooding at or near the proposed site occurred less than once in a year. Some respondents (18.7%) offered no response. Affected areas named were:

- The Priory Main Road
- The west side of the property
- The entire property (swampy and prone to waterlogging)
- The existing minor road to access the site and some buildings along the roadway

As it pertained to the depth of flood water at or near the proposed site, 42.9% stated that water levels were less than 0.3 metres (1.0 foot) in depth, while 50.0% stated that water levels ranged between depths of 0.3-1.5m (1.0-5.0ft) and 7.1% stated more than 1.5 metres (5ft).

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately forty-six percent (45.9%) of respondents stated that they did not know if the area was affected while 46.4% stated that the area was not affected by tidal changes and 7.7% indicated that the area was affected by tidal changes.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 100.0% of interviewees offered a response. Just over twenty-five percent (25.1%) of interviewees stated they did not know of any such area or site, 31.1% stated that no such area was located near to the proposed area while 43.9% indicated that there was an area/site considered to be a protected area or area of historic, national, or environmental importance. The main places named were:

- The Seville Great House and Heritage Park
- The Anchor (in the vicinity of the Infirmary)
- Nearby Mangroves (east of Fantasy Beach)
- UWI Fish Sanctuary
- Fantasy Beach
- The Old Richmond Estate Sugar Factory
- Old Church Site at the Infirmary

6.3.2.2 Community Analysis

Percentages presented for each community cohort are for the total number of persons within the specific community offering responses. Where community respondents did not offer an answer to a question, they were not considered part of the analysis for the specific question(s).

Priory

Approximately thirty one percent (30.5%) of survey participants were from the Priory community. Just over fifty-three percent (53.3%) of respondents were male while 46.7% were female.

Age cohort distribution was as follows; 9.3% were 18-25 years of age, 16.8% were 26-33 years, 13.2% were age 34-41 years, 19.6% were age 42-50 years, 19.6% were age 51-60 years and 20.5% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 36.4% indicated that they were self-employed, while 32.7% stated that they were employed (by a third party) and 20.6% stated they were unemployed. Approximately ten percent (10.3%) of individuals were retired. Additionally, 66.4% of interviewees when asked confirmed that they were the head of their household while 33.6% indicated that they were not the household head.

Regarding the number of persons residing in households, just under twenty-one percent (20.6%) of households had one occupant while 13.6% had two occupants, 19.6% had three occupants and 18.7% had four persons living in the household. Approximately eight percent (8.4%) had five persons living in the household and 19.6% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Fifty-nine percent (59%) of individuals resided in their communities for all their life, and 21.5% resided in their community more than fifteen years. Approximately four percent (3.7%) stated that they lived in their community for between ten and fifteen years; 6.5% resided for between five and ten years. Just over eight percent (8.4%) resided in their community for between three and five years and less than one percent (0.9%) for under two years.

On the issue of where healthcare was mostly obtained, 8.4% stated the public clinic, 68.2% stated the public hospital and 26.2% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital. As it pertained to the specific healthcare provider, the public hospital most referenced was the St. Ann's Bay Regional Hospital, while the health centre most referenced was the St. Ann's Bay Health Centre. Percentages exceeded 100.0% as some respondents indicated that healthcare was sought through multiple sources.

As it related to whether respondents suffered from specific medical conditions, 8.4% of interviewees indicated that they were asthmatic and 18.7% indicated that they suffered from sinusitis, as an ailment. No one interviewed (0.0%) indicated that they suffered from coughing, congestion/bronchial problems, chest pains or frequent bouts of diarrhoea as ailments. Approximately seventy-six (75.7%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named. Percentages exceeded 100.0% as some respondents indicated that that they suffered from multiple medical conditions.

Respondents in general, expressed some reluctance to disclose information pertaining to income. Of those interviewed, approximately forty-two percent (42.1%) of respondents declined to offer a response relating to their personal weekly income. Approximately twenty percent (19.6%) of persons indicated that they did not have a weekly income, while 6.5% indicated that their weekly income was under the national minimum wage of $9,000.00 per week. One percent (1.0%) of interviewees indicated that their weekly income was $9,000.00 per week; 11.2% stated that their weekly income was between $9,001.00 and $12,000.00, while 12.1% stated a weekly income ranging between $12,001.00 and $20,000.00. Approximately eight percent (7.5%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00) per week.

Regarding the highest level of education completed, 100% of those interviewed offered a response. Of this number, no one interviewed (0.0%) stated that they did not attend any type of learning institution. Approximately twenty percent (19.6%) stated they completed primary/all age school, 2.0% stated that they started but did not complete high school, 49.5% completed high school, 14.0% college, 3.7% university and 11.2% HEART/Vocational Training Institution.

As it pertained to education, 52.3% of those interviewed stated that no one in the household was currently attending school while, 47.7% of interviewees indicated someone in the household was attending school. As it related to the school being attended 13.7% stated that the school being attended was infant/basic, 51.0% stated primary/all age, 47.1% stated high school, 17.6% stated college, 2.0% stated university while 2.0% stated that HEART/a vocational training institute was the school being attended. It should be noted that percentages exceeded one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 54.2% of those offering a response indicated that a recreational space was present while 45.8% stated that no recreational space was present in the community. Recreational spaces named were:

- Seville Heights Community Centre/Playing Field (93.1%)
- Fantasy Beach (3.4%)
- No further response offered (3.5%)

On the issue of respondents' awareness of a company named Richmond Vista Limited, all interviewees (100.0%) offered a response. Of these persons 7.5% indicated that they heard of Richmond Vista Limited while 92.5% stated that they had not heard of that company name. When asked if they had heard of a project called "Secrets Resort and Spa", 100.0% of survey participants offered a response. Approximately thirty-two percent (31.8%) of interviewees stated that they had heard of the project name while 68.2% stated that they had never heard of any project by that name.

Regarding respondents knowing what a desalination plant was, all interviewees (100.0%) offered a response. Approximately twenty-seven percent (27.1%) of respondents stated that they knew what the term meant while 72.9% indicated that they did not know what a desalination plant was.

On the issue of respondents knowing what an overwater suite/villa was, all interviewees (100.0%) offered a response. Approximately forty-eight percent (47.7%) of respondents stated that they knew what the term meant while 52.3% indicated that they did not know what an overwater suite was.

As it pertained to respondents' awareness of the proposal by Richmond Vista Limited to construct a 715-room hotel development in the Richmond Estate (Priory) area of St. Ann, 100.0% of participants responded. Approximately seventeen percent (16.8%) of those interviewed stated that they were aware of the project while 83.2% stated that they were not aware of the project. Of the 16.8% of interviewees confirming awareness of the proposed project:

- 11.1% stated that they were aware that the development would include fifteen (15) overwater villas, while 88.9% indicated that they were not aware
- 11.1% stated that they were aware that the development would include two buildings comprising 700 rooms, while 88.9% indicated that they were not aware
- 16.7% stated that they were aware that the development would include modifying a section of existing beach, while 83.3% indicated that they were not aware
- 5.6% stated that they were aware that the development would include constructing a wastewater treatment plant, while 94.4% indicated that they were not aware.
- 5.6% stated that they were aware that the development would include constructing a seawater desalination plant, while 94.4% indicated that they were not aware.
- 5.6% stated that they were aware that the development would include constructing a batching plant for concrete mixing, while 94.4% indicated that they were not aware.
- 5.6% stated radio and 94.4% stated "word of mouth' as the medium by which they were made aware of the project.

When asked if there have been any problems/issues on the proposed development site, all interviewees (100.0%) offered a response. Just under eighteen percent (17.8%) of interviewees stated that they were unaware of the site having problems/issues in the past, while 80.4% of persons stated that there were no problems/issues with the proposed site. Approximately two percent (1.8%) of respondents indicated that there have been problems/issues at the proposed site in the past. Of this 1.8%, fifty percent (50.0%) stated that flooding was the issue and 50.0% stated that the beach area was damaged from past hurricanes.

As it related to respondents having any general concerns pertaining to the proposed development project, 3.8% of those interviewed expressed uncertainty while, 73.8% of interviewees indicated that they did not have any concern while 22.4% indicated that they had concerns with the project as proposed. Concerns highlighted pertained to the following:

- Increased Traffic congestion (16.7%)
- Loss of beach access (50.0%)
- Added strain on existing (public) infrastructure and/or social amenities (healthcare, emergency services) (8.3%)

- The capability of the existing soil type to accommodate the weight of the structures to be built (4.2%)
- Improper sewage disposal (8.3%)
- Loss of mangroves (8.3%)
- The availability of equal work opportunities for locals/community persons (8.3%)
- Loss of marine wildlife (12.5%)
- Environmental pollution (to include air, water, and land) (12.5%)
- Beach erosion (4.2%)

Percentages exceeded 100.0% as some respondents expressed multiple concerns.

When asked about possible suggestions to address highlighted concerns, the following suggestions were put forward:

- Upgrade the existing traffic corridor (widening, bypass road) (12.5%)
- Leave an area to access the beach (29.2%)
- Reduce the building height (4.2%)
- Upgrade infrastructure to facilitate increased demand (8.3%)
- Build an adequate sewage treatment facility (8.3%)
- Do not disturb the mangroves (4.2%)
- Minimise harmful environmental emissions (4.2%)
- Do not discriminate against local workers (8.3%)
- Enforce anti-litter measures (4.2%)
- Do not disturb the reef (4.2%)
- No suggestion offered (12.4%)

When asked if there were specific concerns regarding a section of the beach being modified, 100.0% of interviewees offered a response. Of these individuals, 7.5% expressed uncertainty, 81.3% stated that they had no concerns, while 11.2% indicated that they were concerned about a section of the beach being modified. Concerns highlighted were:

- The development may have a negative impact on nearby beaches (e.g., Fantasy Beach) (8.3%)
- Impact on the ecosystem (16.7%)
- Possible damage to the coral reef (8.3%)
- Dislocation of fishers (8.3%)
- Loss of access to beach and shoreline (33.3%)
- Beach erosion (33.3%)
- Increased risk of flooding due to storm surge (8.3%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Suggestions put forward to address highlighted concerns were:

- Not modify the beach (33.3%)
- Allow for free movement along the beach/shoreline (33.3%)
- No suggestion offered (33.4%)

In response to whether there were specific concerns relating to suites/villas being built over water, all (100.0%) survey participants offered a response. Of these respondents, 5.6% expressed uncertainty, 83.2% stated that they had no concerns, while 11.2% indicated that they were concerned about suites being built over water. Concerns expressed were:

- Improper effluent disposal (8.3%)
- Improper solid waste disposal from the over water suites (during operation) (50.0%)
- Impact from hurricane and associated storm surge (16.7%)
- Impact on the coral reef (8.3%)
- Loss of access to the shoreline (8.3%)
- Loss of marine life (25.0%)

Percentages exceeded 100.0% as multiple concerns were expressed.

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- Ensure oversight by the government environmental regulatory agency (NEPA) (8.3%)
- (During Operation) Sensitise guests on the proper solid waste disposal (16.7%)
- Construct an adequate sewage treatment facility (8.3%)
- Do not build the over water suites (8.3%)
- Build the suites above the storm surge height (8.3%)
- Recycle generated solid waste (8.3%)
- No suggestion offered (41.8%)

As it pertained to respondents having specific concerns relating to the seawater desalination plant, all (100.0%) persons interviewed offered a response. Of these respondents, 8.4% expressed uncertainty, 87.9% stated that they had no concerns, while 3.7% indicated that they were concerned about the seawater desalination plant. Concerns expressed were:

- Negative impact on marine wildlife (25.0%)
- Handling and disposal of waste (specifically extracted salt) (25.0%)
- Harmful environmental emissions (50.0%)

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- Use the National Water Commission as the water supply source (25.0%)
- No suggestion offered (75.0%)

On the issue of having specific concerns regarding the project having its own batching plant for the mixing of concrete, 100.0% of interviewees offered a response. Of these individuals, 2.8% expressed uncertainty, 84.1% stated that they had no concerns, while 13.1% indicated that they were concerned about the project having its own concrete batching plant. Concerns expressed were:

- Dust and noise nuisance (50.0%)
- Marine pollution resulting from surface water run-off (7.1%)
- Loss of earning opportunity for existing concrete batching plant (nearby) (42.9%)
- Improper disposal of excess concrete (7.1%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Suggestions put forward to address highlighted concerns were:

- Implement systems to mitigate against harmful emissions/discharge/dust/surface run-off (21.4%)
- Use already existing local concrete batching plant (42.9%)
- Properly dispose of excess concrete (7.1%)
- Do not operate the batching plant during hours of normal quiet time (7.1%)
- No suggestion offered (21.5%)

In response to whether there was dependence on/use of the proposed site (lands to include the beach area) for any type of activity, all persons interviewed (100.0%) offered a response. Of these respondents, 27.1% of individuals confirmed that they depended on the proposed site while 72.9% stated that they did not depend on the site. The 27.1% of respondents indicated that the proposed site was used for:

- Recreation (to include swimming) (41.4%)
- Fishing (to include boat docking) (69.0%)
- Crab and whelks hunting (13.8%)
- Camping (3.4%)

Percentages exceeded 100.0% as some respondents offered multiple responses.

On the issue of using the section of the marine environment proposed for the overwater villas for any type of activity, 100.0% of interviewees offered a response. Of these individuals, 6.5% confirmed that they used the area while 93.5% stated that they did not use the overwater villas area for any activity. The 6.5% of respondents indicated that the proposed overwater villas area was used for:

- Fishing (85.7%)
- Crab hunting (14.3%)

When asked about walking through the site in the past, all survey participants offered a response. Approximately forty-four percent (43.9%) of respondents stated that they did not walk through the proposed site in the past, while 56.1% indicated that in past years they walked through the site. As it pertained to why individuals walked through the site, respondents indicated:

- to access the beach for recreational purposes (63.3%)
- fishing (46.7%)
- Crab and/or whelks hunting (3.3%)

Percentages exceeded 100.0% as multiples responses were offered.

When asked, the 43.9% of persons indicating that they walked through the site, stated that they had been walking through the site for:

- Less than a year (5.0%)
- Between one and five years (8.3%)
- Between six and ten years (15.0%)
- Between eleven and fifteen years (15.0%)
- Between sixteen and nineteen years (0.0%)
- More than twenty years (48.3%)
- No timeline stated (8.4%)

Regarding whether persons still walked through the proposed site, all interviewees offered a response (100.0%). Of these respondents, 67.3% of respondents indicated that they were no longer walking through the site, while 32.7% of interviewees indicated that they were still walking through the site.

In response to why they were still traversing the site, of the 32.7% of persons confirming that they were still walking through the site, respondents stated:

- For access to the beach (60.0%)
- Fishing (51.4%)
- Crab and/or whelks hunting (5.7%)

Percentages exceeded 100.0% as interviewees offered multiple responses.

When asked if they knew anyone who depends on/uses the proposed site for any type of activity all (100.0%) survey participants responded. Approximately thirty-three percent (32.7%) stated that they knew of persons who used the area, while 67.3% of respondents stated that they did not know of anyone who used the proposed location. The purposes that these persons depended on/used the area for were stated as follows:

- Beach access for recreation (to include swimming) (17.1%)
- Recreation (Beach Party) (2.9%)
- Fishing (82.9%)

- Crab and/or whelks hunting (11.4%)

Percentages exceeded 100.0% as some respondents stated that the area was used for multiple purposes.

On the issue of whether respondents thought the project would affect their life 100.0% of interviewees offered a response. Just over thirty-six percent (36.4%) of respondents indicated that the project would not affect their life in any way, while 23.4% were not sure if the project would affect their life. Of the 40.2% of persons anticipating some effect on their lives, 3.8% anticipated a negative impact while 36.4% anticipated a positive impact from the project. For those anticipating some positive effect, they anticipated:

- Increased opportunity to generate income (20.5%)
- Employment opportunity (84.6%)

Percentages exceeded 100.0% as some respondents anticipated multiple positive impacts.

For those anticipating a negative effect, they anticipated:

- Loss of fishing livelihood (25.0%)
- Loss of beach access (25.0%)
- No further response offered (50.0%)

When asked about possible suggestions to mitigate/address the anticipated negative impact, the following suggestions were offered:

- Allow beach access for recreation (25.0%)
- No suggestion offered (75.0%)

Regarding whether respondents thought the project would affect their community 100.0% of interviewees offered a response. Just under nineteen percent (18.7%) stated that they were unsure if there would be an impact while 13.1% of individuals interviewed indicated that the project would not have any impact on the community. Approximately sixty-eight (68.2%) percent of respondents anticipated that the project would impact their community. Of these respondents, just over sixty-five percent (65.4%) of interviewees anticipated a positive effect, 1.9% anticipated a negative effect and 0.9% anticipated both positive and negative impacts on the community. For those interviewees anticipating a positive effect on the community, the following were stated:

- employment opportunities will be created (91.5%)
- There will be community/national development (19.7%)
- Increased income (8.5%)

Percentages exceeded 100.0% as multiple responses were offered.

For those anticipating a negative effect on the community, the following were stated:

- Loss of access to the beach (66.7%)
- Dust pollution (33.3%)

Although anticipating negative impact, none (0.0%) of the of respondents anticipating a negative impact offered suggestions to mitigate highlighted impacts.

As it pertained to whether respondents thought the project would affect the environment, 100.0% of persons interviewed offered a response. Just over thirty-eight percent (38.3%) of respondents stated that the project would not have an impact on the environment, while 45.8% stated that they were unsure if there would be any impact. Approximately sixteen percent (15.9%) of interviewees anticipated an impact to the environment. Of these respondents, approximately eleven percent (11.2%) anticipated a negative effect while 3.8% anticipated a positive effect and less than one percent (0.9%) anticipated both positive and negative impacts on the environment. For those anticipating a positive effect on the environment, the following were stated:

- Better waste management (20.0%)
- Community Development (40.0%)
- Infrastructure upgrades (40.0%)

It should be noted that those anticipating a positive impact on the environment were anticipating an impact on the physical environment.

For those anticipating a negative effect on the environment, the following were stated:

- Loss of wildlife (fish, turtles) (15.4%)
- Environmental degradation (46.2%)
- Noise and/or dust pollution (15.4%)
- Improper discharge of sewage effluent into the ocean (30.8%)

Percentages exceeded 100.0% as multiple responses were offered.

When asked about possible suggestions to mitigate/address the anticipated negative impact on the environment, the following suggestions were offered by interviewees:

- Maintain the natural landscape (7.7%)
- Ensure pollution prevention measures are in place (23.1%)
- Ensure that there is proper disposal of sewage effluent (7.7%)

Some respondents (61.5%) offered no suggestion regarding how the anticipated negative impact could be addressed.

As it related to housing 100.0% of interviewees offered responses. Approximately thirty-three percent (32.7%) of respondents stated that they owned the house they lived in, 2.8 % stated that their residence was leased, 11.2% lived in rented homes, 1.0% lived in government own housing, no one (0.0%) indicated that they squatted in their residence while 49.5% stated that they lived in family-owned homes. Just under three percent (2.8%) stated "other" and further indicated that they were caretakers.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Approximately twenty-two percent (21.5%) of respondents stated that they owned the land on which the house is located, 7.5% stated that the land was leased, 1.9% indicated that lands were government owned, 0.9% indicated that they squatted on the land, while 55.1% stated that their homes were built on family land. Approximately thirteen percent (13.1%) stated "other" and indicated that the home they lived in was rented or employer owned, but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 81.3% of interviewees indicated that the walls of their homes was made of concrete and blocks, 15.9% stated wood/board while 2.8% stated that walls were made of both concrete and blocks as well as wood/board. It should be noted that for respondents who indicated that the walls of their homes were made of both materials, this was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 54.2% of respondents indicated that the roof of their homes was metal sheeting, while 39.3% stated concrete and 0.6% stated wood as the roof material. Approximately seven percent (6.5%) of interviewees stated that their roofs were made of multiple materials, and specified metal sheeting and concrete as the materials. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present 100.0% of respondents offered a response. Approximately ninety-four percent (93.5%) of respondents indicated that their homes had water closets, while 6.5% stated that pit latrine was the toilet facility. No one (0.0%) indicated that their homes did not have a toilet facility.

As it related to what the household used for lighting 100.0% of respondents offered a response. Just over ninety-nine percent (99.1%) of interviewees stated that electricity was used while less than one percent (0.9%) stated kerosene oil was used for household lighting.

Regarding the type of fuel used mostly for cooking 100.0% of respondents offered a response and all persons further indicated that gas was used mostly for cooking.

On the issue of the main source of household domestic water supply 100.0% of survey participants offered a response. Just over ninety-nine percent (99.1%) of respondents confirmed that their household domestic water supply was the public piped water supply. Less than one percent (0.9%) of respondents stated “other” as the main source for domestic household water supply and further explained that domestic water was from neighbours.

As it pertained to respondents’ having any problems with the domestic water supply 100.0% of interviewees offered a response, and 77.6% of those who responded indicated that there were problems with the water supply while 22.4% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 1.2% stated that the area had no water at all, 97.6% indicated that the water supply was irregular while 8.4% stated that water pressure was low.

Percentages exceeded 100.0% as some respondents stated that they had multiple problems with the domestic water supply.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply, 27.7% stated that rainwater was harvested, 4.8% stated that they bought water, 2.4% collected water from a spring/river. Approximately five percent (4.8%) stated that the water truck supplied water, while 1.2% stated that they used the community standpipe and 67.5% indicated that they stored water in various containers ranging from small containers to large plastic water tanks. Percentages exceeded 100.0% as some respondents employed multiple strategies to cope with problems related to domestic water supply.

On the issue of access to a residential (fixed line/landline) telephone 100.0% of respondents offered a response. Just over eighty-three percent (83.2%) of interviewees indicated that they did not have access to a residential telephone while 16.8% confirmed that they had access. Of the 83.2% of persons indicating that they did not have a fixed line at their residence 93.3% of these individuals indicated that they owned a mobile phone, while 6.7% stated that they did not own a mobile phone.

As it pertained to respondents’ awareness of fixed line telephone service being in their community, 100.0% of respondents offered a response. Just over nine percent (9.3%) of respondents stated that they were not aware of fixed line service being in the community, while 9.3% stated that the community did not have fixed line service. Just over eighty-one percent (81.4%) of interviewees stated that fixed line telephone service was present in the community.

Regarding the main method of garbage disposal for households 100.0% of respondents offered a response. Just over ninety-seven percent (97.2%) of those interviewed indicated that the public garbage truck was the main garbage disposal method, while 2.8% stated “other” and further indicated that garbage was taken to a community skip for disposal.

Regarding the frequency of collections, of the 97.2% of respondents who indicated that the garbage truck was the main method of garbage disposal, 40.4% indicated that garbage collections were done once per week, 24.0% stated twice per week while 25.0% stated every two weeks as the collection frequency. Approximately ten percent (9.6%) stated garbage collection was done once per month while 1.0% stated that collections were done less than once per month.

When asked about flooding, 100.0% of respondents offered a response. Of these respondents 97.2% of respondents indicated that their community was not affected by flooding, less than one percent (0.9%) indicated that they did not know if the community was affected, while 1.9% stated that their community experienced frequent flood events. Of the 1.9% of survey participants confirming community flooding all persons (100.0%) stated that flooding occurred only in times of heavy rainfall.

Regarding the frequency of rain events resulting in community flooding, 100.0% stated once in six months. The affected area named was the:

- Priory Main Road

As it pertained to the depth of flood water, 100.0% stated that water levels ranged between depths of 0.3-1.5m (1.0-5.0ft).

Regarding whether there were problems with frequent flooding at or near the proposed site 100.0% of respondents offered a response. Just under seventy-three percent (72.9%) of interviewees, stated that the area was not affected by flooding, while 24.3% stated that they did not know if the area was affected, and 2.8% stated that the area was affected by flooding. Of the 2.8% of those stating that there were flooding problems at or near the proposed site, 33.3% stated that flooding occurred each time there was a rainfall event, while 66.7% offered no response.

When asked about the frequency of occurrence of rain events causing flooding at or near the proposed site, none (0.0%) of the respondents confirming flooding offered a response on the frequency of rain events, however, the Priory Main Road was named as the affected area.

As it pertained to the depth of flood water at or near the proposed site, 50.0% stated that water levels were less than 0.3 metres (1.0 foot) in depth, while 50.0% stated that water levels ranged between depths of 0.3-1.5m (1.0-5.0ft)

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately thirty-one percent (30.8%) of respondents stated that they did not know if the area was affected while 57.9% stated that the area was not affected by tidal changes and 11.3% indicated that the area was affected by tidal changes.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 100.0% of interviewees offered a response. Approximately twenty-two percent (21.5%) of interviewees stated they did not know of any such area or site, 37.4% stated that no such area was located near to the proposed area while 41.1% indicated that there was an area/site considered to be a protected area or area of historic, national, or environmental importance. The main places named were:

- The Seville Great House and Heritage Park
- The Anchor (in the vicinity of the Infirmary)
- Nearby Mangroves (east of Fantasy Beach)
- UWI Fish Sanctuary
- Fantasy Beach
- The Old Richmond Estate Sugar Factory
- Old Church Site at the Infirmary

Seville Heights & Farmers Heights

Approximately forty-two percent (41.9%) of survey participants were from the Seville Heights community and 1.4% were from the Farmers Heights community. These communities are in close proximity and have been merged and discussed together. Approximately sixty-two percent (61.8%) of respondents were male while 38.2% were female.

Age cohort distribution was as follows; 9.3% were 18-25 years of age, 15.8% were 26-33 years, 14.5% were age 34-41 years, 19.7% were age 42-50 years, 16.4% were age 51-60 years and 24.3% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 31.6% indicated that they were self-employed, while 30.9% stated that they were employed (by a third party) and 21.7% stated they were unemployed. Approximately sixteen percent (15.8%) of individuals were retired. Additionally, 65.8% of interviewees when asked confirmed that they were the head of their household while 34.2% indicated that they were not the household head.

Regarding the number of persons residing in households, just under eighteen percent (17.8%) of households had one occupant while 23.0% had two occupants, 19.1% had three occupants and 11.8% had four persons living in the household. Just over seven percent (7.2%) had five persons living in the household and 21.1% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Just over forty-three percent (43.4%) of individuals resided in their communities for all their life, and 37.5% resided in their community more than fifteen years. Approximately five percent (4.6%) stated that they lived in their community for between ten and fifteen years; 4.6% resided for between five and ten years. Six percent (6.0%) resided in their community for between three and five years and 3.9% for under two years.

On the issue of where healthcare was mostly obtained, 13.2% stated the public clinic, 47.4% stated the public hospital and 40.1% stated that healthcare needs were mostly sourced through the private doctor. No one interviewed (0.0%) stated the private hospital. As it pertained to the specific healthcare provider, the public hospital most referenced was the St. Ann's Bay Regional Hospital, while the health centre most referenced was the St. Ann's Bay Health Centre. Percentages exceeded 100.0% as some respondents indicated that medical care was sought through multiple healthcare options.

As it related to whether respondents suffered from specific medical conditions, 7.9% of interviewees indicated that they were asthmatic, 23.7% indicated that they suffered from sinusitis, 1.3% confirmed coughing as an ailment. No one interviewed (0.0%) indicated that they suffered from congestion/bronchial problems, chest pains or frequent bouts of diarrhoea as ailments. Approximately seventy (70.4%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named. Percentages exceeded 100.0% as some respondents indicated that they suffered from multiple ailments.

Respondents in general, expressed some reluctance to disclose information pertaining to income. Of those interviewed, approximately fifty-one percent (51.3%) of respondents declined to offer a response relating to their personal weekly income. Just under eighteen percent (17.8%) of persons indicated that they did not have a weekly income, while 4.6% indicated that their weekly income was under the national minimum wage of $9,000.00 per week. Just under three percent (2.6%) of interviewees indicated that their weekly income was $9,000.00 per week; 8.6% stated that their weekly income was between $9,001.00 and $12,000.00, while 5.9% stated a weekly income ranging between $12,001.00 and $20,000.00. Approximately nine percent (9.2%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00) per week.

Regarding the highest level of education completed, 100.0% of those interviewed offered a response. Of this number 2.0% of persons stated that they did not attend any type of learning institution. Approximately seventeen percent (17.1%) stated they completed primary/all age school, 3.9% stated that they started but did not complete high school, 53.3% completed high school, 11.2% college, 5.9% university and 6.6% HEART/Vocational Training Institution.

As it pertained to education, 59.2% of those interviewed stated that no one in the household was currently attending school while, 40.8% of interviewees indicated someone in the household was attending school. As it related to the school being attended 24.2% stated that the school being attended was infant/basic, 53.2% stated primary/all age, 45.2% stated high school, 4.8% stated college, 8.1% stated university while 3.2% stated that HEART/a vocational training institute was the school being attended. It should be noted that percentages exceeded one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 70.4% of those offering a response indicated that a recreational space was present while 29.6% stated that no recreational space was present in the community. Recreational spaces named were:

- Seville Heights Community Centre/Playing Field (92.5%)
- Zinc Shed (3.7%)
- No further response offered (3.8%)

On the issue of respondents' awareness of a company named Richmond Vista Limited, all interviewees (100.0%) offered a response. Of these persons 3.9% indicated that they heard of Richmond Vista Limited while 96.1% stated that they had not heard of that company name. When asked if they had heard of a project called "Secrets Resort and Spa", 100.0% of survey participants offered a response. Approximately thirty-seven percent (36.8%) of interviewees stated that they had heard of the project name while 63.2% stated that they had never heard of any project by that name.

Regarding respondents knowing what a desalination plant was, all interviewees (100.0%) offered a response. Approximately twenty-two percent (21.7%) of respondents stated that they knew what the term meant while 78.3% indicated that they did not know what a desalination plant was.

On the issue of respondents knowing what an overwater suite/villa was, all interviewees (100.0%) offered a response. Approximately thirty-one percent (30.9%) of respondents stated that they knew what the term meant while 69.1% indicated that they did not know what an overwater suite was.

As it pertained to respondents' awareness of the proposal by Richmond Vista Limited to construct a 715-room hotel development in the Richmond Estate (Priory) area of St. Ann, 100.0% of participants responded. Approximately five percent (4.6%) of those interviewed stated that they were aware of the project while 95.4% stated that they were not aware of the project. Of the 4.6% of interviewees confirming awareness of the proposed project:

- 100.0% indicated that they were not aware that the development would include fifteen (15) overwater villas
- 14.3% stated that they were aware that the development would include two buildings comprising 700 rooms, while 85.7% indicated that they were not aware
- 42.9% stated that they were aware that the development would include modifying a section of existing beach, while 57.1% indicated that they were not aware
- 28.6% stated that they were aware that the development would include constructing a wastewater treatment plant, while 71.4% indicated that they were not aware.
- 100.0% indicated that they were not aware that the development would include constructing a seawater desalination plant.
- 14.3% stated that they were aware that the development would include constructing a batching plant for concrete mixing, while 85.7% indicated that they were not aware.
- 14.3% stated that awareness of the project was via the television medium, and 85.7% stated "word of mouth' as the medium by which they were made aware of the project.

When asked if there have been any problems/issues on the proposed development site, all interviewees (100.0%) offered a response. Just over sixteen percent (16.4%) of interviewees stated that they were unaware of the site having problems/issues in the past, while 80.3% of persons stated that there were no problems/issues with the proposed site. Approximately three percent (3.3%) of respondents indicated that there have been problems/issues at the proposed site in the past. Of this 3.3%, sixty percent (60.0%) stated that flooding was the issue, while 20.0% stated that the area was affected by crime. No responses were offered by 20.0% of survey participants.

As it related to respondents having any general concerns pertaining to the proposed development project, 3.3% of those interviewed expressed uncertainty while, 78.3% of interviewees indicated that they did not have any concern while 18.4% indicated that they had concerns with the project as proposed. Concerns highlighted pertained to the following:

- Increased Traffic congestion (7.1%)
- Loss of beach access (28.6%)
- Increased security risk (influx of criminal elements) (3.6%)
- Added strain on existing (public) infrastructure and/or social amenities (healthcare, emergency services) (7.2%)
- The impact of the batching plant on the nearby areas (3.6%)
- The lack of public consultation (3.6%)
- Improper sewage disposal (14.3%)
- The availability of equal work opportunities for locals/community persons (10.7%)
- Loss of marine wildlife (3.6%)
- Environmental pollution (to include air, water, and land) (10.7%)
- Beach erosion (3.6%)
- Possible relocation/displacement of residents (3.6%)
- Loss of livelihood of fisherfolk (14.3%)

Percentages exceeded 100.0% as some respondents expressed multiple concerns.

When asked about possible suggestions to address highlighted concerns, the following suggestions were put forward:

- Upgrade the existing traffic corridor (widening, bypass road) (7.1%)
- Leave an area to access the beach (21.4%)
- Upgrade infrastructure to facilitate increased demand (7.2%)
- Do not build on the land (10.7%)
- Build an adequate sewage treatment facility (7.1%)
- Minimise harmful environmental emissions (3.6%)
- Do not discriminate against local workers (10.7%)
- Conduct an environmental assessment to determine the development that is best suited (3.6%)
- No suggestion offered (28.6%)

When asked if there were specific concerns regarding a section of the beach being modified, 100.0% of interviewees offered a response. Of these individuals, 2.0% expressed uncertainty, 91.4% stated that they had no concerns, while 6.6% indicated that they were concerned about a section of the beach being modified. Concerns highlighted were:

- The development may have a negative impact on nearby beaches (e.g., Fantasy Beach) (20.0%)
- Impact on the ecosystem (20.0%)
- Possible damage to the coral reef (10.0%)
- Loss of access to beach and shoreline (40.0%)
- Beach erosion (40.0%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Suggestions put forward to address highlighted concerns were:

- Not modify the beach (20.0%)
- Allow for free movement along the beach/shoreline (40.0%)
- Not develop (build) on the project site (10.0%)
- Build shops and other business enterprises (10%)
- No suggestion offered (20.0%)

In response to whether there were specific concerns relating to suites/villas being built over water, all (100.0%) survey participants offered a response. Of these respondents, 3.3% expressed uncertainty, 90.1% stated that they had no concerns, while 6.6% indicated that they were concerned about suites being built over water. Concerns expressed were:

- Improper solid waste disposal from the over water suites (during operation) (10.0%)
- Impact from hurricane and associated storm surge (30.0%)
- Loss of marine life (40.0%)
- Possible dredging of the sea floor (10.0%)
- Loss of view (10.0%)

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- Ensure oversight by the government environmental regulatory agency (NEPA) (10.0%)
- Do not build the over water suites (10.0%)
- Ensure that the design of the suites can withstand adverse weather events/conditions (10.0%)
- Dredge the seafloor only as necessary (10.0%)
- Not develop (build) on the project site (10.0%)
- No suggestion offered (50.0%)

As it pertained to respondents having specific concerns relating to the seawater desalination plant, all (100.0%) persons interviewed offered a response. Of these respondents, 4.6% expressed uncertainty, 90.8% stated that they had no concerns, while 4.6% indicated that they were concerned about the seawater desalination plant. Concerns expressed were:

- The purpose for which the water will be used (will it be safe) (14.3%)

- Negative impact on marine wildlife (57.1%)
- Handling and disposal of waste (specifically extracted salt) (14.3%)
- Harmful environmental emissions (14.3%)

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- Do not build the desalination plant (28.6%)
- Use the National Water Commission as the water supply source (14.3%)
- No suggestion offered (57.1%)

On the issue of having specific concerns regarding the project having its own batching plant for the mixing of concrete, 100.0% of interviewees offered a response. Of these individuals, 5.9% expressed uncertainty, 79.6% stated that they had no concerns, while 14.5% indicated that they were concerned about the project having its own concrete batching plant. Concerns expressed were:

- Dust and noise nuisance (40.9%)
- Marine pollution resulting from surface water run-off (9.1%)
- Harmful emissions from the batching plant (18.2%)
- Loss of earning opportunity for existing concrete batching plant (nearby) (40.9%)
- Improper disposal of excess concrete (4.5%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Suggestions put forward to address highlighted concerns were:

- Implement systems to mitigate against harmful emissions/discharge/dust/surface run-off (13.6%)
- Use already existing local concrete batching plant (54.5%)
- Do not build the hotel (4.5%)
- No suggestion offered (27.4%)

In response to whether there was dependence on/use of the proposed site (lands to include the beach area) for any type of activity, all persons interviewed (100.0%) offered a response. Of these respondents, 21.7% of individuals confirmed that they depended on the proposed site while 78.3% stated that they did not depend on the site. The 21.7% of respondents indicated that the proposed site was used for:

- Recreation (to include swimming) (57.6%)
- Fishing (to include boat docking) (48.5%)
- Crab and whelks hunting (3.0%)

Percentages exceeded 100.0% as some respondents offered multiple responses.

On the issue of using the section of the marine environment proposed for the overwater villas for any type of activity, 100.0% of interviewees offered a response. Of these individuals, 2.0% confirmed that they used the area while 98.0% stated that they did not use the overwater villas area for any activity. The 2.0% of respondents indicated that the proposed overwater villas area was used for:

- Fishing (100.0%)

When asked about walking through the site in the past, all survey participants offered a response. Approximately fifty-three percent (53.3%) of respondents stated that they did not walk through the proposed site in the past, while 46.7% indicated that in past years they walked through the site. As it pertained to why individuals walked through the site, respondents indicated:

- to access the beach for recreational purposes (69.0%)
- fishing (38.0%)
- Crab and/or whelks hunting (4.2%)
- Footpath to adjacent villas (1.4%)
- Cattle rearing (1.4%)

Percentages exceeded 100.0% as multiples responses were offered.

When asked, the 46.7% of persons indicating that they walked through the site, stated that they had been walking through the site for:

- Less than a year (7.0%)
- Between one and five years (29.6%)
- Between six and ten years (19.7%)
- Between eleven and fifteen years (7.0%)
- Between sixteen and nineteen years (0.0%)
- More than twenty years (31.0%)
- No timeline stated (5.7%)

Regarding whether persons still walked through the proposed site, all interviewees offered a response (100.0%). Of these respondents, 78.9% of respondents indicated that they were no longer walking through the site, while 21.1% of interviewees indicated that they were still walking through the site. In response to why they were still traversing the site, of the 21.1% of persons confirming that they were still walking through the site, respondents stated:

- For access to the beach (75.9%)
- Fishing (43.8%)
- Crab and/or whelks hunting (6.3%)

Percentages exceeded 100.0% as interviewees offered multiple responses.

When asked if they knew anyone who depends on/uses the proposed site for any type of activity all (100.0%) survey participants responded. Approximately nineteen percent (19.1%) stated that they knew of persons who used the area, while 80.9% of respondents stated that they did not know of anyone who used the proposed location.

The purposes that these persons depended on/used the area for were stated as follows:

- Beach access for recreation (to include swimming) (37.9%)
- Recreation (Beach Party) (6.9%)
- Fishing (58.6%)
- To buy fish (3.4%)
- Animal grazing (3.4%)

Percentages exceeded 100.0% as some respondents stated that the area was used for multiple purposes.

On the issue of whether respondents thought the project would affect their life 100.0% of interviewees offered a response. Just under forty-nine percent (48.7%) of respondents indicated that the project would not affect their life in any way, while 21.1% were not sure if the project would affect their life. Of the 30.2% of persons anticipating some effect on their lives, 2.6% anticipated a negative impact while 26.3% anticipated a positive impact from the project and 1.3% anticipated both a positive and negative impact.

For those anticipating some positive effect, they anticipated:

- Increased opportunity to generate income (14.3%)
- Employment opportunity (83.3%)
- Property appreciation (2.4%)

For those anticipating a negative effect, they anticipated:

- Loss of fishing livelihood (66.7%)
- Loss of beach access (16.7%)
- No further response offered (16.6%)

When asked about possible suggestions to mitigate/address the anticipated negative impact, the following suggestions were offered:

- Allow access for fishing (16.7%)
- Allow beach access for recreation (16.7%)
- No suggestion offered (66.6%)

Regarding whether respondents thought the project would affect their community 100.0% of interviewees offered a response. Just over nineteen percent (19.1%) stated that they were unsure if there would be an impact while 26.3% of individuals interviewed indicated that the project would not have any impact on the community. Approximately fifty-five (54.6%) percent of respondents anticipated that the project would impact their community. Of these respondents, just over fifty-one percent (51.3%) of interviewees anticipated a positive effect, 2.6% anticipated a negative effect and 0.7% anticipated both positive and negative impacts on the community.

For those interviewees anticipating a positive effect on the community, the following were stated:

- employment opportunities will be created (87.3%)
- There will be community/national development (20.3%)
- Property appreciation (1.3%)
- Increased income (2.5%)

Percentages exceeded 100.0% as multiple responses were offered.

For those anticipating a negative effect on the community, the following were stated:

- Increased traffic congestion (20.0%)
- Influx of criminal elements into the community (20.0%)
- Loss of access to the beach (40.0%)
- Loss of fishing area (20.0%)
- Dust pollution (40.0%)

Percentages exceeded 100.0% as multiple negative impacts were anticipated by some respondents.

When asked about possible suggestions to mitigate/address the anticipated negative impact, the following suggestions were offered by respondents:

- Employ local (community) tradesmen (20.0%)
- No suggestions (80.0%)

As it pertained to whether respondents thought the project would affect the environment, 100.0% of persons interviewed offered a response. Just under fifty-three percent (52.6%) of respondents stated that the project would not have an impact on the environment, while 32.9% stated that they were unsure if there would be any impact. Approximately fifteen percent (14.5%) of interviewees anticipated an impact to the environment. Of these respondents, twelve percent (7.9%) anticipated a negative effect while 6.6% anticipated a positive effect on the environment.

For those anticipating a positive effect on the environment, the following were stated:

- Community Development (40.0%)

- Infrastructure upgrades (40.0%)

The remaining 20.0%, while anticipating a positive impact did not offer specific information. It should be noted that those anticipating a positive impact on the environment were anticipating an impact on the physical environment.

For those anticipating a negative effect on the environment, the following were stated:

- Loss of wildlife (fish, turtles) (16.7%)
- Harmful emissions (8.3%)
- Environmental degradation (25.0%)
- Noise and/or dust pollution (50.0%)
- Change in tidal flow (8.3%)
- Improper discharge of sewage effluent into the ocean (25.0%)

Percentages exceeded 100.0% as multiple responses were offered.

When asked about possible suggestions to mitigate/address the anticipated negative impact on the environment, the following suggestions were offered by interviewees:

- Do not develop the property (8.3%)
- Ensure pollution prevention measures are in place (16.7%)

Some respondents (75.0%) offered no suggestion regarding how the anticipated negative impact could be addressed.

As it related to housing 100.0% of interviewees offered responses. Approximately forty-five percent (44.7%) of respondents stated that they owned the house they lived in, 0.0% stated that their residence was leased, 16.4% lived in rented homes, 2.6% lived in government own housing, 0.7% indicated that they squatted in their residence while 34.9% stated that they lived in family-owned homes. Just under one percent (0.7%) stated “other” and further indicated that they were caretakers.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Just over forty percent (40.1%) of respondents stated that they owned the land on which the house is located, 0.7% stated that the land was leased, 5.3% indicated that lands were government owned, 1.3% indicated that they squatted on the land, while 35.5% stated that their homes were built on family land. Approximately seventeen percent (17.1%) stated “other” and indicated that the home they lived in was rented or employer owned, but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 90.1% of interviewees indicated that the walls of their homes was made of concrete and blocks, 7.9% stated wood/board while 2.0% stated that walls were made of both concrete and blocks as well as wood/board. It should be noted that for respondents who indicated that the walls of their homes were made of both materials, this was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 58.6% of respondents indicated that the roof of their homes was metal sheeting, while 36.8% stated concrete. Just under five percent (4.6%) of interviewees stated that their roofs were made of multiple materials, and specified metal sheeting and concrete as the materials. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present 100.0% of respondents offered a response. Approximately ninety-two percent (92.1%) of respondents indicated that their homes had water closets, while 7.9% stated that pit latrine was the toilet facility. No one (0.0%) indicated that their homes did not have a toilet facility.

As it related to what the household used for lighting 100.0% of respondents offered a response. Ninety-eight percent (98.0%) of interviewees stated that electricity was used while 2.0% stated kerosene oil was used for household lighting.

Regarding the type of fuel used mostly for cooking 100.0% of respondents offered a response. Ninety-eight percent (98.0%) of persons interviewed indicated that gas was used mostly, 1.3% stated electricity, while 0.7% stated that they mostly used coal for cooking.

On the issue of the main source of household domestic water supply 100.0% of survey participants offered a response. Just over ninety-three percent (93.3%) of respondents confirmed that their household domestic water supply was the public piped water supply. Two percent (2.0%) of respondents stated that the main source of domestic water was private tank, 0.7% indicated the public standpipe, 0.7% stated private water truck, while 2.6% stated that household water was supplied from a spring or river. Less than one percent (0.7%) of participants stated “other” as the main source for domestic household water supply but offered no further details.

As it pertained to respondents’ having any problems with the domestic water supply 100.0% of interviewees offered a response, and 75.7% of those who responded indicated that there were problems with the water supply while 24.3% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 1.7% stated that the area had no water at all, 4.3% stated that no pipes were run in the area, 93.0% indicated that the water supply was irregular while 2.6% stated that water pressure was low.

Percentages exceeded 100.0% as some respondents stated that they had multiple problems with the domestic water supply.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply, 32.2% stated that rainwater was harvested, 7.8% stated that they bought water, 18.3% collected water from a spring/river. Approximately one percent (0.9%) stated that the water truck supplied water, while 0.0% stated that they used the community standpipe and 46.1% indicated that they stored water in various containers ranging from small containers to large plastic water tanks.

Percentages exceeded 100.0% as some respondents employed multiple strategies to cope with problems related to domestic water supply.

On the issue of access to a residential (fixed line/landline) telephone 100.0% of respondents offered a response. Just over seventy-one percent (71.1%) of interviewees indicated that they did not have access to a residential telephone while 28.9% confirmed that they had access. Of the 71.1% of persons indicating that they did not have a fixed line at their residence 93.5% of these individuals indicated that they owned a mobile phone, while 6.5% stated that they did not own a mobile phone.

As it pertained to respondents' awareness of fixed line telephone service being in their community, 100.0% of respondents offered a response. Approximately six percent (5.9%) of respondents stated that they were not aware of fixed line service being in the community, while 8.6% stated that the community did not have fixed line service. Approximately eighty-six percent (85.5%) of interviewees stated that fixed line telephone service was present in the community.

Regarding the main method of garbage disposal for households 100.0% of respondents offered a response. Approximately ninety-five percent (94.7%) of those interviewed indicated that the public garbage truck was the main garbage disposal method, 0.0% indicated private collection while 4.6% indicated that burning was the main method used to dispose of garbage and 0.7% stated "other" and further indicated that garbage was taken to a community skip for disposal.

Regarding the frequency of collections, of the 94.7% of respondents who indicated that the garbage truck was the main method of garbage disposal, 51.4% indicated that garbage collections were done once per week, 11.1% stated twice per week while 22.2% stated every two weeks as the collection frequency. Just over fifteen percent (15.3%) stated garbage collection was done once per month.

When asked about flooding, 100.0% of respondents offered a response. Of these respondents 98.7% of respondents indicated that their community was not affected by flooding while, 1.3% indicated that they did not know if the community experienced frequent flood events.

Regarding whether there were problems with frequent flooding at or near the proposed site 100.0% of respondents offered a response. Approximately sixty percent (59.9%) of interviewees, stated that the area was not affected by flooding, while 35.5% stated that they did not know if the area was affected, and 4.6% stated that the area was affected by flooding. Of the 4.6% of those stating that there were flooding problems at or near the proposed site, 100.0% stated flooding occurred only on times of heavy rains.

When asked about the frequency of occurrence of rain events causing flooding at or near the proposed site, 14.3% also stated once monthly, and 14.3% also stated once in six months. Approximately twenty-nine percent (28.6%) stated once per year and 42.8% stated that rain events resulting in flooding at or near the proposed site occurred less than once in a year.

Affected areas named were:

- The west side of the property
- The entire property (swampy and prone to waterlogging)
- The existing minor road to access the site and some buildings along the roadway

As it pertained to the depth of flood water at or near the proposed site, 42.9% stated that water levels were less than 0.3 metres (1.0 foot) in depth, while 42.9% stated that water levels ranged between depths of 0.3-1.5m (1.0-5.0ft) and 14.2% stated more than 1.5 metres (5ft).

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately forty-six percent (46.1%) of respondents stated that they did not know if the area was affected while 48.7% stated that the area was not affected by tidal changes and 5.3% indicated that the area was affected by tidal changes.

Regarding whether there was any site nearby considered to be a protected area, historic area, or area of national, historic or environmental importance, 100.0% of interviewees offered a response. Just over twenty-four percent (24.3%) of interviewees stated they did not know of any such area or site, 28.3% stated that no such area was located near to the proposed area while 47.4% indicated that there was an area/site considered to be a protected area or area of historic, national, or environmental importance. The main places named were:

- The Seville Great House and Heritage Park
- The Anchor (in the vicinity of the Infirmary)
- Nearby Mangroves (east of Fantasy Beach)
- Old Church Site at the Infirmary

Compound and Seaview Heights

Two percent (2.0%) of respondents were from the community of Compound and 5.1% were from the Seaview Heights community. These communities are in close proximity and have been merged and discussed together. Fifty-two percent (52.0%) of respondents were male while 48.0% were female.

Age cohort distribution was as follows; 24.0% were 18-25 years of age, 16.0% were 26-33 years, 20.0% were age 34-41 years, 20.0% were age 42-50 years, 20.1% were age 51-60 years. No one interviewed (0.0%) was older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 48.0% indicated that they were self-employed, while 36.0% stated that they were employed (by a third party) and 16.0% stated they were unemployed. No retirees (0.0%) were interviewed. Additionally, 68.0% of interviewees when asked confirmed that they were the head of their household while 32.0% indicated that they were not the household head.

Regarding the number of persons residing in households, twenty-four percent (24.0%) of households had one occupant while 8.0% had two occupants, 12.0% had three occupants and 20.0% had four persons living in the household. Eight percent (8.0%) had five persons living in the household and 28.0% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Forty-eight percent (48.0%) of individuals resided in their communities for all their life, and 28.0% resided in their community more than fifteen years. No one interviewed (0.0%) stated that they lived in their community for between ten and fifteen years; 16.0% resided for between five and ten years. Eight percent (8.0%) resided in their community for between three and five years and no one (0.0%) stated that they resided in the community for under two years.

On the issue of where healthcare was mostly obtained, 32.0% stated the public clinic, 68.0% stated the public hospital and 4.0% stated that healthcare needs were mostly sourced through the private doctor. No (0.0%) interviewee stated the private hospital. As it pertained to the specific healthcare provider, the public hospital most referenced was the St. Ann's Bay Regional Hospital, while the health centre most referenced was the St. Ann's Bay Health Centre. Percentages exceeded 100.0% as some respondents indicated that medical care was sought through multiple healthcare options.

As it related to whether respondents suffered from specific medical conditions, 24.0% of interviewees indicated that they were asthmatic, 12.0% indicated that they suffered from sinusitis, 4.0% confirmed coughing as an ailment. No one interviewed (0.0%) indicated that they suffered from congestion/bronchial problems, chest pains or frequent bouts of diarrhoea as ailments. Sixty-four (64.0%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named. Percentages exceeded 100.0% as some respondents indicated that they suffered from multiple ailments.

Respondents in general, expressed some reluctance to disclose information pertaining to income. Of those interviewed, sixty percent (60.0%) of respondents declined to offer a response relating to their personal weekly income. Four percent (4.0%) of persons indicated that they did not have a weekly income, while 4.0% indicated that their weekly income was under the national minimum wage of $9,000.00 per week. Four percent (4.0%) of interviewees indicated that their weekly income was $9,000.00 per week; 12.0% stated that their weekly income was between $9,001.00 and $12,000.00, while 12.0% stated a weekly income ranging between $12,001.00 and $20,000.00. Four percent (4.0%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00) per week.

Regarding the highest level of education completed, 100.0% of those interviewed offered a response. Of this number no one (0.0%) stated that they did not attend any type of learning institution. Sixteen percent (16.0%) stated they completed primary/all age school, 4.0% stated that they started but did not complete high school, 56.0% completed high school, 0.0% college, 0.0% university and 24.0% HEART/Vocational Training Institution.

As it pertained to education, 36.0% of those interviewed stated that no one in the household was currently attending school while, 64.0% of interviewees indicated someone in the household was attending school. As it related to the school being attended 12.5% stated that the school being attended was infant/basic, 75.0% stated primary/all age and 50.0% stated high school. No one (0.0%) stated college, university, or HEART/a vocational training institute as the school being attended. It should be noted that percentages exceeded one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 72.0% of those offering a response indicated that a recreational space was present while 28.0% stated that no recreational space was present in the community. Recreational spaces named were:

- Seville Heights Community Centre/Playing Field (77.8%)
- Hope Centre (22.2%)

On the issue of respondents' awareness of a company named Richmond Vista Limited, all interviewees (100.0%) offered a response. Of these persons 4.0% indicated that they heard of Richmond Vista Limited while 96.0% stated that they had not heard of that company name. When asked if they had heard of a project called "Secrets Resort and Spa", 100.0% of survey participants offered a response. Twenty-four percent (24.0%) of interviewees stated that they had heard of the project name while 76.0% stated that they had never heard of any project by that name.

Regarding respondents knowing what a desalination plant was, all interviewees (100.0%) offered a response. Sixteen percent (16.0%) of respondents stated that they knew what the term meant while 84.0% indicated that they did not know what a desalination plant was.

On the issue of respondents knowing what an overwater suite/villa was, all interviewees (100.0%) offered a response. Forty percent (40.0%) of respondents stated that they knew what the term meant while 60.0% indicated that they did not know what an overwater suite was.

As it pertained to respondents' awareness of the proposal by Richmond Vista Limited to construct a 715-room hotel development in the Richmond Estate (Priory) area of St. Ann, 100.0% of participants responded. Eight percent (8.0%) of those interviewed stated that they were aware of the project while 92.0% stated that they were not aware of the project.

Of the 8.0% of interviewees confirming awareness of the proposed project:

- 100.0% indicated that they were not aware that the development would include fifteen (15) overwater villas

- 100.0% indicated that they were not aware that the development would include two buildings comprising 700 rooms
- 100.0% indicated that they were not aware that the development would include modifying a section of existing beach
- 100.0% indicated that they were not aware that the development would include constructing a wastewater treatment plant.
- 100.0% indicated that they were not aware that the development would include constructing a seawater desalination plant.
- 100.0% indicated that they were not aware that the development would include constructing a batching plant for concrete mixing.
- 100.0% stated “word of mouth’ as the medium by which they were made aware of the project.

When asked if there have been any problems/issues on the proposed development site, all interviewees (100.0%) offered a response. Eight percent (8.0%) of interviewees stated that they were unaware of the site having problems/issues in the past, while 92.0% of persons stated that there were no problems/issues with the proposed site.

As it related to respondents having any general concerns pertaining to the proposed development project, 96.0% of interviewees indicated that they did not have any concern while 4.0% indicated that they had concerns with the project as proposed.

Concerns highlighted pertained to the following:

- Environmental pollution (to include air, water, and land) (100.0%)

When asked about possible suggestions to address highlighted concerns, the following suggestions were put forward:

Richmond Vista Limited should:

- Convene a community meeting (100.0%)

When asked if there were specific concerns regarding a section of the beach being modified, 100.0% of interviewees offered a response. Of these individuals, 4.0% expressed uncertainty, 92.0% stated that they had no concerns, while 4.0% indicated that they were concerned about a section of the beach being modified. Concerns highlighted were:

- The development may have a negative impact on nearby beaches (e.g., Fantasy Beach) (100.0%)

No suggestion was put forward to address the highlighted concern.

In response to whether there were specific concerns relating to suites/villas being built over water, all (100.0%) survey participants offered a response. Of these respondents, 4.0% expressed uncertainty, 88.0% stated that they had no concerns, while 8.0% indicated that they were concerned about suites being built over water. Concerns expressed were:

- Impact from hurricane and associated storm surge (100.0%)

Although highlighting concerns, none (0.0%) of the interviewees offered suggestions to address them.

As it pertained to respondents having specific concerns relating to the seawater desalination plant, all (100.0%) persons interviewed offered a response. Of these respondents, 88.0% stated that they had no concerns, while 12.0% indicated that they were concerned about the seawater desalination plant. Concerns expressed were:

- The purpose for which the water will be used (will it be safe) (33.3%)
- Lack of information on the desalination process (66.7%)

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- Provide information on the desalination process (33.4%)
- Use the National Water Commission as the water supply source (33.3%)
- No suggestion offered (33.3%)

On the issue of having specific concerns regarding the project having its own batching plant for the mixing of concrete, 100.0% of interviewees offered a response. Of these individuals, 4.0% expressed uncertainty, 92.0% stated that they had no concerns, while 4.0% indicated that they were concerned about the project having its own concrete batching plant. Concerns expressed were:

- Dust and noise nuisance (100.0%)

Although highlighting concerns, none (0.0%) of the interviewees offered suggestions to address them.

In response to whether there was dependence on/use of the proposed site (lands to include the beach area) for any type of activity, all persons interviewed (100.0%) offered a response. Of these respondents, 12.0% of individuals confirmed that they depended on the proposed site while 88.0% stated that they did not depend on the site. The 12.0% of respondents indicated that the proposed site was used for:

- Recreation (to include swimming) (33.3%)
- Fishing (to include boat docking) (66.7%)

On the issue of using the section of the marine environment proposed for the overwater villas for any type of activity, 100.0% of interviewees offered a response. Of these individuals, 8.0% confirmed that they used the area while 92.0% stated that they did not use the overwater villas area for any activity.

The 8.0% of respondents indicated that the proposed overwater villas area was used for:

- Fishing (100.0%)

When asked about walking through the site in the past, all survey participants offered a response. Fifty-six percent (56.0%) of respondents stated that they did not walk through the proposed site in the past, while 44.0% indicated that in past years they walked through the site. As it pertained to why individuals walked through the site, respondents indicated:

- to access the beach for recreational purposes (45.5%)
- fishing (27.3%)
- Crab and/or whelks hunting (9.0%)
- Footpath to adjacent villas (18.2%)

When asked, the 44.0% of persons indicating that they walked through the site, stated that they had been walking through the site for:

- Less than a year (27.3%)
- Between one and five years (36.4%)
- Between six and ten years (0.0%)
- Between eleven and fifteen years (9.1%)
- Between sixteen and nineteen years (9.1%)
- More than twenty years (18.1%)

Regarding whether persons still walked through the proposed site, all interviewees offered a response (100.0%). Of these respondents, 76.0% of respondents indicated that they were no longer walking through the site, while 24.0% of interviewees indicated that they were still walking through the site.

In response to why they were still traversing the site, of the 24.0% of persons confirming that they were still walking through the site, respondents stated:

- For access to the beach (33.3%)
- Fishing (33.3%)
- Crab and/or whelks hunting (16.7%)
- No further response (16.7%)

When asked if they knew anyone who depends on/uses the proposed site for any type of activity all (100.0%) survey participants responded. Sixteen percent (16.0%) stated that they knew of persons who used the area, while 84.0% of respondents stated that they did not know of anyone who used the proposed location.

The purposes that these persons depended on/used the area for were stated as follows:

- Beach access for recreation (to include swimming) (25.0%)
- Fishing (75.0%)

On the issue of whether respondents thought the project would affect their life 100.0% of interviewees offered a response. Thirty-two percent (32.0%) of respondents indicated that the project would not affect their life in any way, while 36.0% were not sure if the project would affect their life. Of the 32.0% of persons anticipating some effect on their lives, 4.0% anticipated a negative impact while 28.0% anticipated a positive impact from the project.

For those anticipating some positive effect, they anticipated:

- Employment opportunity (100.0%)

For those anticipating a negative effect, they anticipated:

- Loss of fishing livelihood (100.0%)

Although highlighting negative impacts, none (0.0%) of the interviewees offered suggestions to address them.

Regarding whether respondents thought the project would affect their community 100.0% of interviewees offered a response. Twelve percent (12.0%) stated that they were unsure if there would be an impact while 32.0% of individuals interviewed indicated that the project would not have any impact on the community. Fifty-six (56.0%) percent of respondents anticipated that the project would impact their community. Of these respondents, fifty-two percent (52.0%) of interviewees anticipated a positive effect, while 4.0% anticipated a negative effect on the community.

For those interviewees anticipating a positive effect on the community, the following were stated:

- employment opportunities will be created (92.3%)
- There will be community/national development (15.4%)

Percentages exceeded 100.0% as multiple responses were offered.

For those anticipating a negative effect on the community, the following were stated:

- Loss of access to the beach (100.0%)
- Loss of fishing area (100.0%)

Percentages exceeded 100.0% as multiple negative impacts were anticipated by some respondents.

Although highlighting negative impacts, none (0.0%) of the interviewees offered suggestions to address them.

As it pertained to whether respondents thought the project would affect the environment, 100.0% of persons interviewed offered a response. Fifty-two percent (52.0%) of respondents stated that the project would not have an impact on the environment, while 36.0% stated that they were unsure if there would be any impact. Twelve percent (12.0%) of interviewees anticipated an impact to the environment. Of these respondents, four percent (4.0%) anticipated a negative effect while 8.0% anticipated a positive effect on the environment.

Although anticipating a positive effect on the environment, none (0.0%) of the respondents offered responses.

Although anticipating a negative effect on the environment, none (0.0%) of the respondents offered responses.

As it related to housing 100.0% of interviewees offered responses. Forty-four percent (44.0%) of respondents stated that they owned the house they lived in, 20.0% lived in government own housing, while 32.0% stated that they lived in family-owned homes. No one interviewed (0.0%) stated that they lived in leased or rented homes or indicated that they squatted in their residence. Four percent (4.0%) stated “other” but offered no further details.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Eight percent (8.0%) of respondents stated that they owned the land on which the house is located, no one (0.0%) stated that the land was leased, 56.0% indicated that lands were government owned, 20.0% indicated that they squatted on the land, while 12.0% stated that their homes were built on family land. Four percent (4.0%) stated “other” but offered no further detail.

Regarding the type of wall that dwellings were made of 16.0% of interviewees indicated that the walls of their homes was made of concrete and blocks, 72.0% stated wood/board while 12.0% stated that walls were made of both concrete and blocks as well as wood/board. It should be noted that for respondents who indicated that the walls of their homes were made of both materials, this was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 80.0% of respondents indicated that the roof of their homes was metal sheeting, while 12.0% stated concrete. Eight percent (8.0%) of interviewees stated that their roofs were made of multiple materials, and specified metal sheeting and concrete as the materials. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present 100.0% of respondents offered a response. Eighty-four percent (84.0%) of respondents indicated that their homes had water closets, while 16.0% stated that pit latrine was the toilet facility. No one (0.0%) indicated that their homes did not have a toilet facility.

As it related to what the household used for lighting 100.0% of respondents offered a response. Ninety-six percent (96.0%) of interviewees stated that electricity was used while 4.0% stated kerosene oil was used for household lighting.

Regarding the type of fuel used mostly for cooking 100.0% of respondents offered a response and further indicated that gas was used mostly for cooking.

On the issue of the main source of household domestic water supply 100.0% of survey participants offered a response. Seventy-six percent (76.0%) of respondents confirmed that their household domestic water supply was the public piped water supply, 16.0% indicated the public standpipe, while 4.0% stated that household water was supplied from a spring or river. Four percent (4.0%) of participants stated “other” as the main source for domestic household water supply and further explained that water was sourced at the” pumphouse”.

As it pertained to respondents’ having any problems with the domestic water supply 100.0% of interviewees offered a response, and 84.0% of those who responded indicated that there were problems with the water supply while 16.0% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 4.7% stated that no pipes were run in the area, while 90.5% indicated that the water supply was irregular. Some respondents (4.8%) did not offer a response although confirming problems with domestic water supply.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply,42.9% stated that rainwater was harvested, 9.5% stated that they bought water, 9.5% collected water from a spring/river. Approximately ten percent (9.5%) stated that they used the community standpipe and 23.8% indicated that they stored water in various containers ranging from small containers to large plastic water tanks. Some respondents (4.8%) did not offer a response.

On the issue of access to a residential (fixed line/landline) telephone 100.0% of respondents offered a response. Eighty-four percent (84.0%) of interviewees indicated that they did not have access to a residential telephone while 16.0% confirmed that they had access. Of the 84.0% of persons indicating that they did not have a fixed line at their residence 90.5% of these individuals indicated that they owned a mobile phone, while 9.5% stated that they did not own a mobile phone.

As it pertained to respondents’ awareness of fixed line telephone service being in their community, 100.0% of respondents offered a response. Twelve percent (12.0%) of respondents stated that they were not aware of fixed line service being in the community, while 64.0% stated that the community did not have fixed line service. Twenty-four percent (24.0%) of interviewees stated that fixed line telephone service was present in the community.

Regarding the main method of garbage disposal for households 100.0% of respondents offered a response. Sixty percent (60.0%) of those interviewed indicated that the public garbage truck was the main garbage disposal method, while 20.0% indicated that burning was the main method used to dispose of garbage and 20.0% stated “other” and further indicated that garbage was taken to a community skip for disposal.

Regarding the frequency of collections, of the 60.0% of respondents who indicated that the garbage truck was the main method of garbage disposal, 66.6% indicated that garbage collections were done once per week, 26.7% stated twice per week while 6.7% stated every two weeks as the collection frequency.

When asked about flooding, 100.0% of respondents offered a response. Of these respondents 96.0% of respondents indicated that their community was not affected by flooding, while 4.0% indicated that they did not know if the community experienced frequent flood events.

Regarding whether there were problems with frequent flooding at or near the proposed site 100.0% of respondents offered a response. Fifty-two percent (52.0%) of interviewees, stated that the area was not affected by flooding, while 40.0% stated that they did not know if the area was affected, and 8.0% stated that the area was affected by flooding. Of the 8.0% of those stating that there were flooding problems at or near the proposed site, 100.0% stated flooding occurred only on times of heavy rains.

When asked about the frequency of occurrence of rain events causing flooding at or near the proposed site, 50.0% stated once in six months and 50.0% stated once per year.

Affected areas named was:

- The entire property (swampy and prone to waterlogging)

As it pertained to the depth of flood water at or near the proposed site, 50.0% stated that water levels were less than 0.3 metres (1.0 foot) in depth, while 50.0% stated that water levels ranged between depths of 0.3-1.5m (1.0-5.0ft).

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Sixty-four percent (64.0%) of respondents stated that they did not know if the area was affected while 28.0% stated that the area was not affected by tidal changes and 8.0% indicated that the area was affected by tidal changes.

Regarding whether there was any site nearby considered to be a protected area, historic area, or area of national, historic or environmental importance, 100.0% of interviewees offered a response. Twenty-eight percent (28.0%) of interviewees stated they did not know of any such area or site, 32.0% stated that no such area was located near to the proposed area while 40.0% indicated that there was an area/site considered to be a protected area or area of historic, national, or environmental importance. The main place named was

- The Seville Great House and Heritage Park

Tanglewood and Hartlands

Four percent (4.0%) of survey participants were from the Hartlands community and 1.4% were from the Tanglewood community. These communities are in close proximity and have been merged and discussed together. It should be noted that the Hartlands community is a small community. As mentioned previously, there was poor participation from the Tanglewood community. Just over sixty-three percent (63.2%) of respondents were male while 36.8% were female.

Age cohort distribution was as follows; no one (0.0%) was 18-25 years of age, 10.5% were 26-33 years, 10.5% were age 34-41 years, 26.3% were age 42-50 years, 21.1% were age 51-60 years and 31.6% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 21.1% indicated that they were self-employed, while 36.8% stated that they were employed (by a third party) and 5.3% stated they were unemployed. Approximately thirty-seven percent (36.8%) of individuals were retired. Additionally, 73.7% of interviewees when asked confirmed that they were the head of their household while 26.3% indicated that they were not the household head.

Regarding the number of persons residing in households, just over twenty-one percent (21.1%) of households had one occupant while 21.1% had two occupants, 15.7% had three occupants and 21.1% had four persons living in the household. Approximately eleven percent (10.5%) had five persons living in the household and 10.5% of households had more than five persons residing.

Approximately five percent (5.3%) of individuals resided in their communities for all their life, and 31.6% resided in their community more than fifteen years. Approximately eleven percent (10.5%) stated that they lived in their community for between ten and fifteen years; 36.8% resided for between five and ten years. Just over five percent (5.3%) resided in their community for between three and five years and 10.5% for under two years.

On the issue of where healthcare was mostly obtained, 36.8% stated the public hospital and 84.2% stated that healthcare needs were mostly sourced through the private doctor. As it pertained to the specific healthcare provider, the public hospital most referenced was the St. Ann's Bay Regional Hospital. Percentages exceeded 100.0% as some respondents indicated that they sought medical care from multiple healthcare providers.

As it related to whether respondents suffered from specific medical conditions, 10.5% of interviewees indicated that they were asthmatic, 10.5% indicated that they suffered from sinusitis. No one interviewed (0.0%) indicated that they suffered from coughing, congestion/bronchial problems, chest pains or frequent bouts of diarrhoea as ailments. Seventy-nine (79.0%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named.

Respondents in general, expressed some reluctance to disclose information pertaining to income. Of those interviewed, approximately sixty-three percent (63.1%) of respondents declined to offer a response relating to their personal weekly income. Approximately five percent (5.3%) of persons indicated that they did not have a weekly income. No one interviewed (0.0%) stated that their weekly income was under the national minimum wage of $9,000.00 per week, was $9,000.00 per week or was between $9,001.00 and $12,000.00. Just under sixteen percent (15.8%) stated a weekly income ranging between $12,001.00 and $20,000.00 while 15.8% also indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00) per week.

Regarding the highest level of education completed, 100.0% of those interviewed offered a response. No one (0.0%) interviewed stated that they did not attend any type of learning institution. Approximately twenty-one percent (21.1%) stated they completed primary/all age school, 31.5% completed high school, 21.1% college, 10.5% university and 15.8% HEART/Vocational Training Institution.

As it pertained to education, 52.6% of those interviewed stated that no one in the household was currently attending school while, 47.4% of interviewees indicated someone in the household was attending school. As it related to the school being attended 11.1% stated that the school being attended was infant/basic, 66.7% stated primary/all age, 22.2% stated high school and 22.2% stated university. No one interviewed (0.0%) stated college or HEART/a vocational training institute, as the school being attended. It should be noted that percentages exceeded one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 15.8% of those offering a response indicated that a recreational space was present while 84.2% stated that no recreational space was present in the community. The recreational space named was:

- Seville Heights Community Centre/Playing Field (100.0%)

On the issue of respondents' awareness of a company named Richmond Vista Limited, all (100.0%) interviewees offered a response and stated that they had not heard of that company name. When asked if they had heard of a project called "Secrets Resort and Spa", 100.0% of survey participants offered a response. Approximately fifty-eight percent (57.9%) of interviewees stated that they had heard of the project name while 42.1% stated that they had never heard of any project by that name.

Regarding respondents knowing what a desalination plant was, all interviewees (100.0%) offered a response. Approximately fifty-eight percent (57.9%) of respondents stated that they knew what the term meant while 42.1% indicated that they did not know what a desalination plant was.

On the issue of respondents knowing what an overwater suite/villa was, all interviewees (100.0%) offered a response Approximately fifty-eight percent (57.9%) of respondents stated that they knew what the term meant while 42.1% indicated that they did not know what an overwater suite was.

As it pertained to respondents' awareness of the proposal by Richmond Vista Limited to construct a 715-room hotel development in the Richmond Estate (Priory) area of St. Ann, 100.0% of participants responded and further stated that they were not aware of the project.

When asked if there have been any problems/issues on the proposed development site, all interviewees (100.0%) offered a response. Just under sixteen percent (15.8%) of interviewees stated that they were unaware of the site having problems/issues in the past, while 84.2% of persons stated that there were no problems/issues with the proposed site.

As it related to respondents having any general concerns pertaining to the proposed development project, 5.3% of those interviewed expressed uncertainty while, 42.1% of interviewees indicated that they did not have any concern while 52.6% indicated that they had concerns with the project as proposed.

Concerns highlighted pertained to the following:

- Increased Traffic congestion (30.0%)
- Loss of beach access (10.0%)
- Increased security risk (influx of criminal elements) (10.0%)
- The impact of the batching plant on the nearby areas (10.0%)
- The lack of public consultation (10.0%)
- Improper sewage disposal (30.0%)
- Loss of mangroves (20.0%)
- Squatting of construction workers (10.0%)
- Loss of marine wildlife (10.0%)
- Environmental pollution (to include air, water, and land) (10.0%)

Percentages exceeded 100.0% as some respondents expressed multiple concerns.

When asked about possible suggestions to address highlighted concerns, the following suggestions were put forward:

- Upgrade the existing traffic corridor (widening, bypass road) (10.0%)
- Develop and implement a traffic management plan (10.0%)
- Engage the constabulary force to assist in regulating traffic flow (10.0%)
- Convene a community meeting (10.0%)
- Do not build on the land (20.0%)
- Build an adequate sewage treatment facility (30.0%)
- Minimise harmful environmental emissions (10.0%)
- Conduct an environmental assessment to determine the development that is best suited (10.0%)

Percentages exceeded 100.0% as multiple responses were offered.

When asked if there were specific concerns regarding a section of the beach being modified, 100.0% of interviewees offered a response. Of these individuals, 52.6% stated that they had no concerns, while 47.4% indicated that they were concerned about a section of the beach being modified. Concerns highlighted were:

- The development may have a negative impact on nearby beaches (e.g., Fantasy Beach) (22.2%)
- Impact on the ecosystem (33.3%)
- Possible damage to the coral reef (22.2%)
- Dislocation of fishers (11.1%)
- Loss of access to beach and shoreline (33.3%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Suggestions put forward to address highlighted concerns were:

- Employ measures to mitigate potential negative impact (11.2%)
- Construct an artificial reef (11.1%)
- Not modify the beach (11.1%)
- Allow for free movement along the beach/shoreline (11.1%)
- Not develop (build) on the project site (11.1%)
- No suggestion offered (44.4%)

In response to whether there were specific concerns relating to suites/villas being built over water, all (100.0%) survey participants offered a response. Of these respondents, 73.7% stated that they had no concerns, while 26.3% indicated that they were concerned about suites being built over water. Concerns expressed were:

- Improper effluent disposal (20.0%)
- Improper solid waste disposal from the over water suites (during operation) (20.0%)
- Impact from hurricane and associated storm surge (20.0%)
- Impact on the coral reef (20.0%)
- Loss of access to the shoreline (20.0%)

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- (During Operation) Sensitise guests on the proper solid waste disposal (20.0%)
- Construct an adequate sewage treatment facility (20.0%)
- Do not build the over water suites (20.0%)
- Build the suites above the storm surge height (20.0%)
- Construct an artificial coral reef (20.0%)
- Allow free movement along the shoreline (40.0%)

Percentages exceeded 100.0% as multiple responses were offered.

As it pertained to respondents having specific concerns relating to the seawater desalination plant, all (100.0%) persons interviewed offered a response. Of these respondents, 10.5% expressed uncertainty, 79.0% stated that they had no concerns, while 10.5% indicated that they were concerned about the seawater desalination plant. Concerns expressed were:

- Negative impact on marine wildlife (50.0%)
- Harmful environmental emissions (50.0%)

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- Mitigate against impact to the ecosystem (50.0%)
- Do not build the desalination plant (50.0%)

On the issue of having specific concerns regarding the project having its own batching plant for the mixing of concrete, 100.0% of interviewees offered a response. Of these individuals, 10.5% expressed uncertainty, 36.8% stated that they had no concerns, while 52.7% indicated that they were concerned about the project having its own concrete batching plant. Concerns expressed were:

- Dust and noise nuisance (50.0%)
- Marine pollution resulting from surface water run-off (20.0%)
- Harmful emissions from the batching plant (20.0%)
- Loss of earning opportunity for existing concrete batching plant (nearby) (10.0%)

Suggestions put forward to address highlighted concerns were:

- Implement systems to mitigate against harmful emissions/discharge/dust/surface run-off (20.0%)
- Do not build the batching plant (10.0%)
- Use already existing local concrete batching plant (20.0%)
- Wet the area (10.0%)
- No suggestion offered (40.0%)

In response to whether there was dependence on/use of the proposed site (lands to include the beach area) for any type of activity, all persons interviewed (100.0%) offered a response. Of these respondents, 15.8% of individuals confirmed that they depended on the proposed site while 84.2% stated that they did not depend on the site. The 15.8% of respondents indicated that the proposed site was used for:

- Recreation (to include swimming) (66.7%)
- Fishing (to include boat docking) (66.7%)

Percentages exceeded 100.0% as some respondents offered multiple responses.

On the issue of using the section of the marine environment proposed for the overwater villas for any type of activity, 100.0% of interviewees offered a response and stated that they did not use the overwater villas area for any activity.

When asked about walking through the site in the past, all survey participants offered a response. Approximately fifty-eight percent (57.9%) of respondents stated that they did not walk through the proposed site in the past, while 42.1% indicated that in past years they walked through the site. As it pertained to why individuals walked through the site, respondents indicated:

- to access the beach for recreational purposes (75.0%)
- fishing (37.5%)

Percentages exceeded 100.0% as multiples responses were offered.

When asked, the 42.1% of persons indicating that they walked through the site, stated that they had been walking through the site for:

- Less than a year (12.5%)
- Between one and five years (25.0%)
- Between six and ten years (25.0%)
- Between eleven and fifteen years (12.5%)
- Between sixteen and nineteen years (0.0%)
- More than twenty years (12.5%)
- No timeline stated (12.5%)

Regarding whether persons still walked through the proposed site, all interviewees offered a response (100.0%). Of these respondents, 78.9% of respondents indicated that they were no longer walking through the site, while 21.1% of interviewees indicated that they were still walking through the site.

In response to why they were still traversing the site, of the 21.1% of persons confirming that they were still walking through the site, respondents stated:

- For access to the beach (75.0%)
- No further response (25.0%)

When asked if they knew anyone who depends on/uses the proposed site for any type of activity all (100.0%) survey participants responded. Approximately sixteen percent (15.8%) stated that they knew of persons who used the area, while 84.2% of respondents stated that they did not know of anyone who used the proposed location. The purposes that these persons depended on/used the area for were stated as follows:

- Fishing (100.0%)

On the issue of whether respondents thought the project would affect their life 100.0% of interviewees offered a response. Just under thirty-two percent (31.6%) of respondents indicated that the project would not affect their life in any way, while 42.1% were not sure if the project would affect their life, while 26.3% anticipated a positive impact from the project. No one interviewed (0.0%) anticipated a negative impact. For those anticipating some positive effect, they anticipated:

- Increased opportunity to generate income (20.0%)
- Employment opportunity (40.0%)
- Property appreciation (20.0%)
- No further response (20.0%)

Regarding whether respondents thought the project would affect their community 100.0% of interviewees offered a response. Just under sixteen percent (15.8%) stated that they were unsure if there would be an impact while 15.8% of individuals interviewed indicated that the project would not have any impact on the community. Approximately sixty-eight (68.4%) percent of respondents anticipated that the project would impact their community. Of these respondents, just under thirty-seven percent (36.8%) of interviewees anticipated a positive effect, 21.1% anticipated a negative effect and 10.5% anticipated both positive and negative impacts on the community.

For those interviewees anticipating a positive effect on the community, the following were stated:

- employment opportunities will be created (88.9%)
- There will be community/national development (11.1%)

For those anticipating a negative effect on the community, the following were stated:

- Increased traffic congestion (33.7%)
- Influx of criminal elements into the community (16.7%)
- Squatting by construction site workers (16.7%)
- Loss of access to the beach (16.7%)
- Loss of fishing area (33.3%)
- Dust pollution (16.7%)
- Beach erosion (16.7%)
- Increased risk of storm surge (16.7%)

Percentages exceeded 100.0% as multiple negative impacts were anticipated by some respondents.

When asked about possible suggestions to mitigate/address the anticipated negative impact, the following suggestions were offered by respondents:

- Employ local (community) tradesmen (16.6%)
- Provide adequate housing solutions for construction workers (16.7%)

- Provide beach access for local (community) residents (16.7%)
- No suggestions (50.0%)

As it pertained to whether respondents thought the project would affect the environment, 100.0% of persons interviewed offered a response. Just under thirty-seven percent (36.9%) of respondents stated that the project would not have an impact on the environment, while 10.5% stated that they were unsure if there would be any impact. Approximately fifty-three percent (52.6%) anticipated a negative effect. No one interviewed (0.0%) anticipated a positive effect on the environment.

For those anticipating a negative effect on the environment, the following were stated:

- Loss of wildlife (fish, turtles) (20.0%)
- Environmental degradation (40.0%)
- Noise and/or dust pollution (20.0%)
- Loss of mangroves (20.0%)
- Change in tidal flow (10.0%)

Percentages exceeded 100.0% as multiple responses were offered.

When asked about possible suggestions to mitigate/address the anticipated negative impact on the environment, the following suggestions were offered by interviewees:

- The government environmental regulatory agency (NEPA) should be engaged to monitor and give project oversight (10.0%)
- Do not develop the property (20.0%)
- Re-establish mangroves post construction (10.0%)
- Ensure pollution prevention measures are in place (10.0%)

Some respondents (50.0%) offered no suggestion regarding how the anticipated negative impact could be addressed.

As it related to housing 100.0% of interviewees offered responses. Approximately thirty-two percent (31.6%) of respondents stated that they owned the house they lived in, 5.3% stated that their residence was leased, 42.1% lived in rented homes. No one interviewed (0.0%) lived in government own housing or indicated that they squatted in their residence. Approximately eleven percent (10.5%) stated that they lived in family-owned homes while 10.5% stated “other” and further indicated that they were caretakers or lived in the homes owned by their employers.

Regarding the land on which dwelling homes were located 100.0% of interviewees offered responses. Just under thirty-two percent (31.6%) of respondents stated that they owned the land on which the house is located, 5.3% stated that the land was leased. None of the survey participants (0.0%) indicated that lands were government owned or that they squatted on the land. Approximately eleven percent (10.5%) stated that their homes were built on family land. Approximately fifty-three (52.6%) stated "other" and indicated that the home they lived in was rented or employer owned, but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of all (100.0%) of interviewees indicated that the walls of their homes was made of concrete and blocks.

Regarding the type of roof that dwellings had, 79.0% of respondents indicated that the roof of their homes was metal sheeting, while 10.5% stated concrete and 10.5% stated wood as the roof material.

As it pertained to the type of toilet facility present 100.0% of respondents offered a response and indicated that their homes had water closets.

As it related to what the household used for lighting 100.0% of respondents offered a response and further stated that electricity was used as the household lighting source.

Regarding the type of fuel used mostly for cooking 100.0% of respondents offered a response. and indicated that gas was used mostly for cooking.

On the issue of the main source of household domestic water supply 100.0% of survey participants offered and all persons confirmed that their household domestic water supply was the public piped water supply.

As it pertained to respondents' having any problems with the domestic water supply 100.0% of interviewees offered a response, and 57.9% of those who responded indicated that there were problems with the water supply while 42.1% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 63.6% indicated that the water supply was irregular while 9.1% stated that water pressure was low. Turbidity was also highlighted as a problem by 27.3% of respondents.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply, 27.3% stated that rainwater was harvested, 18.2% collected water from a spring/river and 54.5% indicated that they stored water in various containers ranging from small containers to large plastic water tanks.

On the issue of access to a residential (fixed line/landline) telephone 100.0% of respondents offered a response. Approximately thirty-two percent (31.6%) of interviewees indicated that they did not have access to a residential telephone while 68.4% confirmed that they had access. Of the 31.6% of persons indicating that they did not have a fixed line at their residence 100.0% of these individuals indicated that they owned a mobile phone.

As it pertained to respondents' awareness of fixed line telephone service being in their community, 100.0% of respondents offered a response. Approximately five percent (5.3%) of respondents stated that they were not aware of fixed line service being in the community, while 94.7% of interviewees stated that fixed line telephone service was present in the community.

Regarding the main method of garbage disposal for households, 100.0% of respondents offered a response. and indicated that the public garbage truck was the main garbage disposal method.

Regarding the frequency of collections, 36.8% indicated that garbage collections were done once per week, 10.6% stated twice per week while 36.8% stated every two weeks as the collection frequency and 15.8% stated garbage collection was done once per month.

When asked about flooding, 100.0% of respondents offered a response and further stated that their community was not affected by flooding.

Regarding whether there were problems with frequent flooding at or near the proposed site 100.0% of respondents offered a response. Approximately fifty-eight percent (57.9%) of interviewees, stated that the area was not affected by flooding, while 31.6% stated that they did not know if the area was affected, and 10.5% stated that the area was affected by flooding. Of the 10% of persons stating that there were flooding problems at or near the proposed site, all respondents (100.0%) stated that flooding occurred only on times of heavy rains.

When asked about the frequency of occurrence of rain events causing flooding at or near the proposed site, 50.0% stated that rain event occurred once weekly and 50.0% also stated once monthly.

No affected areas were named.

As it pertained to the depth of flood water at or near the proposed site, 100.0% stated that water levels ranged between depths of 0.3-1.5m (1.0-5.0ft).

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately forty-two percent (42.1%) of respondents stated that they did not know if the area was affected while 36.8% stated that the area was not affected by tidal changes and 21.1% indicated that the area was affected by tidal changes.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 100.0% of interviewees offered a response. Just under thirty-two percent (31.6%) of interviewees stated they did not know of any such area or site, 26.3% stated that no such area was located near to the proposed area while 42.1% indicated that there was an area/site considered to be a protected area or area of historic, national, or environmental importance.

The main places named were:

- The Seville Great House and Heritage Park
- The Anchor (in the vicinity of the Infirmary)

Hartland Estates, Richmond Estates, Plantation Village

Approximately six percent (6.3%) of survey participants were from the Hartland Estates community, 1.7% were from the Richmond Estates community and less than one percent (0.9%) was from the Plantation Village community. These three communities are gated communities and are in close proximity and have been merged and discussed together. Just over sixty-one percent (61.3%) of respondents were male while 38.7% were female.

Age cohort distribution was as follows; no one (0.0%) was 18-25 years of age, 3.2% were 26-33 years, 12.9% were age 34-41 years, 19.4% were age 42-50 years, 22.6% were age 51-60 years and 41.9% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 29.0% indicated that they were self-employed, while 32.3% stated that they were employed (by a third party) and 3.2% stated they were unemployed. Approximately thirty-six percent (35.5%) of individuals were retired. Additionally, 77.4% of interviewees when asked confirmed that they were the head of their household while 22.6% indicated that they were not the household head.

Regarding the number of persons residing in households, just under twenty-six percent (25.7%) of households had one occupant while 41.9% had two occupants, 6.5% had three occupants and 12.9% had four persons living in the household. Approximately seven percent (6.5%) had five persons living in the household and 6.5% of households had more than five persons residing.

No one interviewed (0.0%) lived in their community for more than fifteen years. This was most likely due to the fact that these gated communities have been established residential areas for less that fifteen years. Approximately ten percent (9.7%) stated that they lived in their community for between ten and fifteen years; 32.3% resided for between five and ten years. Just under forty-two percent (41.9%) resided in their community for between three and five years and 16.1% for under two years.

On the issue of where healthcare was mostly obtained, 12.9% stated the public hospital and 83.9% stated that healthcare needs were mostly sourced through the private doctor. Approximately three percent (3.2%) of interviewees stated the private hospital. As it pertained to the specific healthcare provider, the public hospital most referenced was the St. Ann's Bay Regional Hospital and Hospiten (in Montego Bay) was named at the private hospital.

As it related to whether respondents suffered from specific medical conditions, 9.7% of interviewees indicated that they were asthmatic, 16.1% indicated that they suffered from sinusitis, 3.2% confirmed coughing as an ailment. No one interviewed (0.0%) indicated that they suffered from congestion/bronchial problems, chest pains or frequent bouts of diarrhoea as ailments. Seventy-one (71.0%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named.

Respondents in general, expressed some reluctance to disclose information pertaining to income. Of those interviewed, approximately fifty-two percent (51.7%) of respondents declined to offer a response relating to their personal weekly income. Approximately three percent (3.2%) of persons indicated that they did not have a weekly income, while 3.2% indicated that their weekly income was under the national minimum wage of $9,000.00 per week. No one interviewed (0.0%) indicated that their weekly income was $9,000.00 per week; 9.7% stated that their weekly income was between $9,001.00 and $12,000.00, while 3.2% stated a weekly income ranging between $12,001.00 and $20,000.00. Twenty- nine percent (29.0%) indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00) per week.

Regarding the highest level of education completed, 93.5% of those interviewed offered a response. Of this number no one (0.0%) stated that they did not attend any type of learning institution. Approximately fourteen percent (13.8%) stated they completed primary/all age school, 20.8% completed high school, 31.0% college, 31.0% university and 3.4% HEART/Vocational Training Institution.

As it pertained to education, 73.3% of those interviewed stated that no one in the household was currently attending school while, 26.7% of interviewees indicated someone in the household was attending school. As it related to the school being attended 12.5% stated that the school being attended was infant/basic, 87.5% stated primary/all age and 62.5% stated high school. No one (0.0%) stated that college, university or HEART/a vocational training institute was the school being attended. It should be noted that percentages exceeded one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 48.4% of those offering a response indicated that a recreational space was present while 51.6% stated that no recreational space was present in the community. The recreational space named was:

- Green Space within community (100.0%)

It should be noted that within these gated communities, green spaces form part of the recreational amenities.

On the issue of respondents' awareness of a company named Richmond Vista Limited, all interviewees (100.0%) offered a response. Of these persons 22.6% indicated that they heard of Richmond Vista Limited while 77.4% stated that they had not heard of that company name. When asked if they had heard of a project called "Secrets Resort and Spa", 100.0% of survey participants offered a response. Approximately forty-eight percent (48.4%) of interviewees stated that they had heard of the project name while 51.6% stated that they had never heard of any project by that name.

Regarding respondents knowing what a desalination plant was, all interviewees (100.0%) offered a response. Approximately sixty-five percent (64.5%) of respondents stated that they knew what the term meant while 35.5% indicated that they did not know what a desalination plant was.

On the issue of respondents knowing what an overwater suite/villa was, all interviewees (100.0%) offered a response. Approximately sixty-one percent (61.3%) of respondents stated that they knew what the term meant while 38.7% indicated that they did not know what an overwater suite was.

As it pertained to respondents' awareness of the proposal by Richmond Vista Limited to construct a 715-room hotel development in the Richmond Estate (Priory) area of St. Ann, 100.0% of participants responded. Approximately thirty-two percent (32.3%) of those interviewed stated that they were aware of the project while 67.7% stated that they were not aware of the project.

Of the 32.3% of interviewees confirming awareness of the proposed project:

- 80.0% stated that they were aware that the development would include fifteen (15) overwater villas, while 20.0% indicated that they were not aware
- 80.0% stated that they were aware that the development would include two buildings comprising 700 rooms, while 20.0% indicated that they were not aware
- 100.0% indicated that they were not aware that the development would include modifying a section of existing beach
- 100.0% indicated that they were not aware that the development would include constructing a wastewater treatment plant.
- 50.0% stated that they were aware that the development would include constructing a seawater desalination plant, while 50.0% indicated that they were not aware.
- 100.0% indicated that they were not aware that the development would include constructing a batching plant for concrete mixing.
- 30.0% stated "word of mouth' as the medium by which they were made aware of the project. Seventy percent (70.0%) stated "other" and further explained that they observed activities being undertaken at the project site.

When asked if there have been any problems/issues on the proposed development site, all interviewees (100.0%) offered a response. Just over forty-eight percent (48.4%) of interviewees stated that they were unaware of the site having problems/issues in the past, while 51.6% of persons stated that there were no problems/issues with the proposed site. No one interviewed (0.0%) indicated that there have been problems/issues at the proposed site in the past.

As it related to respondents having any general concerns pertaining to the proposed development project, 3.2% of those interviewed expressed uncertainty while, 42.0% of interviewees indicated that they did not have any concern while 54.8% indicated that they had concerns with the project as proposed. Concerns highlighted pertained to the following:

- Increased Traffic congestion (64.7%)
- Loss of beach access (23.5%)
- Loss of view (17.6%)
- Increased security risk (influx of criminal elements) (5.9%)

- Added strain on existing (public) infrastructure and/or social amenities (healthcare, emergency services) (5.9%)
- The capability of the existing soil type to accommodate the weight of the structures to be built (5.9%)
- Loss of marine wildlife (5.9%)
- Possible relocation/displacement of residents (5.9%)
- Adequate (long term) housing for migrant workers (5.9%)

Percentages exceeded 100.0% as some respondents expressed multiple concerns.

When asked about possible suggestions to address highlighted concerns, the following suggestions were put forward:

- Upgrade the existing traffic corridor (widening, bypass road) (47.1%)
- Leave an area to access the beach (17.6%)
- Reduce the building height (5.9%)
- Engage the constabulary force to assist in regulating traffic flow (11.8%)
- Develop and implement a traffic management plan (5.9%)
- Convene a community meeting (5.9%)
- Upgrade infrastructure to facilitate increased demand (5.9%)
- Do not build on the land (5.9%)
- Create (long term) housing solutions for migrant workers (5.9%)

Percentages exceeded 100.0% as some respondents expressed multiple concerns.

When asked if there were specific concerns regarding a section of the beach being modified, 100.0% of interviewees offered a response. Of these individuals, 9.6% expressed uncertainty, 71.0% stated that they had no concerns, while 19.4% indicated that they were concerned about a section of the beach being modified. Concerns highlighted were:

- The development may have a negative impact on nearby beaches (e.g., Fantasy Beach) (33.3%)
- Impact on the ecosystem (33.3%)
- Loss of access to beach and shoreline (16.7%)
- No further response (16.7%)

Suggestions put forward to address highlighted concerns were:

- Employ measures to mitigate potential negative impact (50.0%)
- Involve the government environmental regulatory agency (NEPA) in project monitoring (16.7%)
- No suggestion offered (33.3%)

In response to whether there were specific concerns relating to suites/villas being built over water, all (100.0%) survey participants offered a response. Of these respondents, 9.7% expressed uncertainty, 61.3% stated that they had no concerns, while 29.0% indicated that they were concerned about suites being built over water.

Concerns expressed were:

- Improper effluent disposal (33.3%)
- Improper solid waste disposal from the over water suites (during operation) (33.3%)
- Impact from hurricane and associated storm surge (11.2%)
- Loss of marine life (22.2%)

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- Ensure oversight by the government environmental regulatory agency (NEPA) (22.2%)
- (During Operation) Sensitise guests on the proper solid waste disposal (22.2%)
- Construct an adequate sewage treatment facility (11.1%)
- Do not build the over water suites (11.1%)
- No suggestion offered (33.4%)

As it pertained to respondents having specific concerns relating to the seawater desalination plant, all (100.0%) persons interviewed offered a response. Of these respondents, 6.4% expressed uncertainty, 71.0% stated that they had no concerns, while 22.6% indicated that they were concerned about the seawater desalination plant. Concerns expressed were:

- The purpose for which the water will be used (will it be safe) (85.7%)
- Lack of information on the desalination process (14.3%)
- Negative impact on marine wildlife (28.6%)
- Handling and disposal of waste (specifically extracted salt) (14.3%)
- Harmful environmental emissions (14.3%)

Percentages exceeded 100.0% as multiple concerns were expressed.

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- Ensure water is good for potable use (42.9%)
- Provide information on the desalination process (42.9%)
- Provide information on potential health and safety risks associated with desalination (42.9%)
- Mitigate against impact to the ecosystem (42.9%)

Percentages exceeded 100.0% as multiple concerns were expressed.

On the issue of having specific concerns regarding the project having its own batching plant for the mixing of concrete, 100.0% of interviewees offered a response. Of these individuals, 6.4% expressed uncertainty, 74.2% stated that they had no concerns, while 19.4% indicated that they were concerned about the project having its own concrete batching plant.

Concerns expressed were:

- Dust and noise nuisance (100.0%)
- Proximity to the ocean (33.3%)
- Marine pollution resulting from surface water run-off (33.3%)
- Harmful emissions from the batching plant (50.0%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Suggestions put forward to address highlighted concerns were:

- Properly hoard the site (33.3%)
- Implement systems to mitigate against harmful emissions/discharge/dust/surface run-off (33.3%)
- Install the wastewater treatment plant first to ensure proper disposal of wastewater from the batching plant (16.7%)
- Install the desalination plant first to ensure that water is adequate and available for concrete mixing (16.7)

In response to whether there was dependence on/use of the proposed site (lands to include the beach area) for any type of activity, all persons interviewed (100.0%) offered a response. Of these respondents, 16.1% of individuals confirmed that they depended on the proposed site while 83.9% stated that they did not depend on the site. The 16.1% of respondents indicated that the proposed site was used for:

- Recreation (to include swimming) (80.0%)
- Fishing (to include boat docking) (40.0%)

Percentages exceeded 100.0% as some respondents offered multiple responses.

On the issue of using the section of the marine environment proposed for the overwater villas for any type of activity, 100.0% of interviewees offered a response. Of these individuals, 6.5% confirmed that they used the area while 93.5% stated that they did not use the overwater villas area for any activity. The 6.5% of respondents indicated that the proposed overwater villas area was used for:

- Fishing (100.0%)

When asked about walking through the site in the past, all survey participants offered a response. Approximately sixty-eight percent (67.7%) of respondents stated that they did not walk through the proposed site in the past, while 32.3% indicated that in past years they walked through the site. As it pertained to why individuals walked through the site, respondents indicated:

- to access the beach for recreational purposes (80.0%)
- fishing (20.0%)

When asked, the 32.3% of persons indicating that they walked through the site, stated that they had been walking through the site for:

- Less than a year (20.0%)
- Between one and five years (0.0%)
- Between six and ten years (20.0%)
- Between eleven and fifteen years (10.0%)
- Between sixteen and nineteen years (0.0%)
- More than twenty years (20.0%)
- No timeline stated (30.0%)

Regarding whether persons still walked through the proposed site, all interviewees offered a response (100.0%). Of these respondents, 83.9% of respondents indicated that they were no longer walking through the site, while 16.1% of interviewees indicated that they were still walking through the site.

In response to why they were still traversing the site, of the 16.1% of persons confirming that they were still walking through the site, respondents stated:

- For access to the beach (100.0%)
- Fishing (20.0%)

Percentages exceeded 100.0% as interviewees offered multiple responses.

When asked if they knew anyone who depends on/uses the proposed site for any type of activity all (100.0%) survey participants responded. Approximately seven percent (6.5%) stated that they knew of persons who used the area, while 93.5% of respondents stated that they did not know of anyone who used the proposed location. The purposes that these persons depended on/used the area for were stated as follows:

- Beach access for recreation (to include swimming) (50.0%)
- Fishing (100.0%)

Percentages exceeded 100.0% as some respondents stated that the area was used for multiple purposes.

On the issue of whether respondents thought the project would affect their life 100.0% of interviewees offered a response. Twenty-nine percent (29.0%) of respondents indicated that the project would not affect their life in any way, while 16.1% were not sure if the project would affect their life. Of the 54.9% of persons anticipating some effect on their lives, 22.6% anticipated a negative impact while 32.3% anticipated a positive impact from the project.

For those anticipating some positive effect, they anticipated:

- Increased opportunity to generate income (20.0%)
- Employment opportunity (50.0%)
- Property appreciation (30.0%)

For those anticipating a negative effect, they anticipated:

- Loss of fishing livelihood (28.6%)
- Increased traffic congestion (57.1%)
- Loss of view (14.3%)

When asked about possible suggestions to mitigate/address the anticipated negative impact, the following suggestions were offered:

- Implement traffic management strategies (42.9%)
- Engage the traffic management of the Jamaica Constabulary Force to monitor traffic flow (14.3%)
- Reduce building heights (14.3%)
- No suggestion offered (28.5%)

Regarding whether respondents thought the project would affect their community 100.0% of interviewees offered a response. Twenty-nine percent (29.0%) stated that they were unsure if there would be an impact while 19.4% of individuals interviewed indicated that the project would not have any impact on the community. Approximately fifty-two (51.6%) percent of respondents anticipated that the project would impact their community. Of these respondents, just over forty-five percent (45.2%) of interviewees anticipated a positive effect, 3.2% anticipated a negative effect and 3.2% anticipated both positive and negative impacts on the community.

For those interviewees anticipating a positive effect on the community, the following were stated:

- employment opportunities will be created (66.7%)
- There will be community/national development (33.3%)
- Property appreciation (20.0%)

Percentages exceeded 100.0% as multiple responses were offered.

For those anticipating a negative effect on the community, the following were stated:

- Influx of criminal elements into the community (50.0%)
- Loss of fishing area (50.0%)

When asked about possible suggestions to mitigate/address the anticipated negative impact, the following suggestions were offered by respondents:

- Screen workers prior to employment (50.0%)
- No suggestions (50.0%)

As it pertained to whether respondents thought the project would affect the environment, 100.0% of persons interviewed offered a response. Just under forty-two percent (41.9%) of respondents stated that the project would not have an impact on the environment, while 32.2% stated that they were unsure if there would be any impact. Approximately twenty-six percent (25.9%) of interviewees anticipated an impact to the environment. Of these respondents, just over nineteen percent (19.4%) anticipated a negative effect while 6.5% anticipated a positive effect on the environment.

For those anticipating a positive effect on the environment, the following were stated:

- Better waste management (50.0%)
- Community Development (50.0%)

It should be noted that those anticipating a positive impact on the environment were anticipating an impact on the physical environment.

For those anticipating a negative effect on the environment, the following were stated:

- Loss of wildlife (fish, turtles) (33.3%)
- Harmful emissions (33.3%)
- Environmental degradation (16.7%)
- Loss of natural landscape (16.7%)

When asked about possible suggestions to mitigate/address the anticipated negative impact on the environment, the following suggestions were offered by interviewees:

- The government environmental regulatory agency (NEPA) should ensure that clean energy solutions are implemented (50.0%)
- The government environmental regulatory agency (NEPA) should be engaged to monitor and give project oversight (33.3%)
- Maintain the natural landscape (16.7%)

As it related to housing 100.0% of interviewees offered responses. Approximately eighty-one percent (80.6%) of respondents stated that they owned the house they lived in, 6.5% lived in rented homes, while 3.2% stated that they lived in family-owned homes. Just under ten percent (9.7%) stated "other" and further indicated that they were caretakers or lived in the homes owned by their employers. No one interviewed (0.0 %) stated that their residence was leased or that they lived in government own housing or indicated that they squatted in their residence.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Approximately eighty-one percent (80.6%) of respondents stated that they owned the land on which the house is located. No one (0.0%) stated that the land was leased, or indicated that lands were government owned, or indicated that they squatted on the land. Just over three percent 3.2% stated that their homes were built on family land. Approximately sixteen percent (16.2%) stated "other" and indicated that the home they lived in was rented or employer owned, but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 100.0% of interviewees indicated that the walls of their homes was made of concrete and blocks.

Regarding the type of roof that dwellings had, 87.10% of respondents indicated that the roof of their homes was metal sheeting, while 3.2% stated concrete. Approximately ten percent (9.7%) stated "other" as the roof material but did not specify the type of roof material.

As it pertained to the type of toilet facility present 100.0% of respondents offered a response and indicated that their homes had water closets.

As it related to what the household used for lighting 100.0% of respondents offered a response. Just under ninety-four percent (93.5%) of interviewees stated that electricity was used while 6.5% stated solar as the household lighting source.

Regarding the type of fuel used mostly for cooking 100.0% of respondents offered a response. Approximately ninety percent (90.3%) of persons interviewed indicated that gas was used mostly, while 9.7% stated electricity.

On the issue of the main source of household domestic water supply 100.0% of survey participants offered a response and further explained that their gated community received water from a private source used to supply the community.

As it pertained to respondents' having any problems with the domestic water supply 100.0% of interviewees offered a response, and 45.2% of those who responded indicated that there were problems with the water supply while 54.8% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 35.7% indicated that the water supply was irregular while 28.6% stated that water pressure was low. Additionally, some respondents indicated that problems with their domestic water supply included:

- High calcium content (hardness) of water (21.4%)
- High chlorine content in water (71%)
- Lack of knowledge on the compliance of potable water with applicable standards (7.1%)
- Turbidity (7.1%)

Percentages exceeded 100.0% as some respondents stated that they had multiple problems with the domestic water supply.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply, 28.6% stated that they bought water. Fifty percent (50.0%) indicated that they stored water in various containers ranging from small containers to large plastic water tanks. Some respondents (21.4%) did not offer a response regarding strategies employed to cope with problems related to domestic water supply.

On the issue of access to a residential (fixed line/landline) telephone 100.0% of respondents offered a response. Just over nineteen percent (19.4%) of interviewees indicated that they did not have access to a residential telephone while 80.6% confirmed that they had access. Of the 19.4% of persons indicating that they did not have a fixed line at their residence 83.3% of these individuals indicated that they owned a mobile phone. Approximately seventeen percent (16.7%) of these respondents offered no response.

As it pertained to respondents' awareness of fixed line telephone service being in their community, 100.0% of respondents offered a response. Approximately three percent (3.2%) stated that the community did not have fixed line service. Just under ninety-seven percent (96.8%) of interviewees stated that fixed line telephone service was present in the community.

Regarding the main method of garbage disposal for households 100.0% of respondents offered a response and further indicated private collection was the main method used to dispose of garbage.

When asked about flooding, 100.0% of respondents offered a response. Of these respondents 90.3% of respondents indicated that their community was not affected by flooding, 6.5% indicated that they did not know if the community was affected, while 3.2% stated that their community experienced frequent flood events. Of the 3.2% of survey participants confirming community flooding all persons (100.0%) stated that flooding occurred only in times of heavy rain.

Regarding the frequency of rain events resulting in community flooding, all (100.0%) respondents stated a frequency of once in three months.

The affected area named was the:

- Section of private dwelling house

As it pertained to the depth of flood water, 100.0% stated that water levels were less than 0.3 metres (1.0 foot) in depth.

Regarding whether there were problems with frequent flooding at or near the proposed site 100.0% of respondents offered a response. Twenty-nine percent (29.0%) of interviewees, stated that the area was not affected by flooding, while 67.8% stated that they did not know if the area was affected, and 3.2% stated that the area was affected by flooding. Of the 3.2% of those stating that there were flooding problems at or near the proposed site, 100.0% stated flooding occurred only on times of heavy rains.

When asked about the frequency of occurrence of rain events causing flooding at or near the proposed site, 100.0% stated once per year.

The affected area named was:

- The Priory Main Road

As it pertained to the depth of flood water at or near the proposed site, 100.0% stated that water levels were less than 0.3 metres (1.0 foot) in depth.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately ninety-four percent (93.5%) of respondents stated that they did not know if the area was affected while 6.5% stated that the area was not affected by tidal changes.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 100.0% of interviewees offered a response. Just over thirty-two percent (32.3%) of interviewees stated they did not know of any such area or site, 12.9% stated that no such area was located near to the proposed area while 54.8% indicated that there was an area/site considered to be a protected area or area of historic, national, or environmental importance.

The main places named were:

- The Seville Great House and Heritage Park
- The Anchor (in the vicinity of the Infirmary)

Banks

Approximately five percent (4.8%) of survey participants were from the Banks community. Just under sixty-five percent (64.7%) of respondents were male while 35.3% were female.

Age cohort distribution was as follows; 29.3% were 18-25 years of age, 11.8% were 26-33 years, 23.5% were age 34-41 years, 11.8% were age 42-50 years, 11.8% were age 51-60 years and 11.8% were older than sixty years of age.

Of those persons interviewed who offered a response (100.0%), 53.0% indicated that they were self-employed, while 17.6% stated that they were employed (by a third party) and 23.5% stated they were unemployed. Approximately six percent (5.9%) of individuals were retired. Additionally, 70.6% of interviewees when asked confirmed that they were the head of their household while 29.4% indicated that they were not the household head.

Regarding the number of persons residing in households, approximately twenty-four percent (23.5%) of households had one occupant while 11.8% had two occupants, 5.9% had three occupants and 29.4% had four persons living in the household. Approximately twenty-four percent (23.5%) had five persons living in the household and 5.9% of households had more than five persons residing.

In general, interviewees resided in their communities over the long term. Just over thirty-five percent (35.2%) of individuals resided in their communities for all their life, and 41.2% resided in their community more than fifteen years. Approximately six percent (5.9%) stated that they lived in their community for between ten and fifteen years; 11.8% resided for between five and ten years. Just under six percent (5.9%) resided in their community for between three and five years. No one interviewed (0.0%) lived in the area for under two years.

On the issue of where healthcare was mostly obtained, 11.8% stated the public clinic, 76.5% stated the public hospital and 29.4% stated that healthcare needs were mostly sourced through the private doctor. As it pertained to the specific healthcare provider, the public hospital most referenced was the St. Ann's Bay Regional Hospital, while the health centre most referenced was the St. Ann's Bay Health Centre. Percentages exceeded 100.0% as some respondents indicated that healthcare was sought through multiple sources.

As it related to whether respondents suffered from specific medical conditions, 17.6% of interviewees indicated that they were asthmatic, while 11.8% indicated that they suffered from sinusitis as an ailment. No one interviewed (0.0%) indicated that they suffered from coughing, congestion/bronchial problems, chest pains or frequent bouts of diarrhoea as ailments. Approximately seventy-one (70.6%) percent of those interviewed indicated that they did not suffer from any of the specific conditions named.

Respondents in general, expressed some reluctance to disclose information pertaining to income. Of those interviewed, approximately fifty-three percent (52.9%) of respondents declined to offer a response relating to their personal weekly income. Approximately twelve percent (11.8%) of persons indicated that they did not have a weekly income, while 5.9% indicated that their weekly income was under the national minimum wage of $9,000.00 per week. No one interviewed (0.0%) indicated that their weekly income was $9,000.00 per week; 17.6% stated that their weekly income was between $9,001.00 and $12,000.00, while 11.8% stated a weekly income ranging between $12,001.00 and $20,000.00. None (0.0%) of the survey participants indicated that their weekly income was in excess of twenty thousand dollars ($20,000.00) per week.

Regarding the highest level of education completed, 100.0% of those interviewed offered a response. None (0.0%) of the persons interviewed stated that they did not attend any type of learning institution. Approximately twelve percent (11.8%) stated they completed primary/all age school, 88.2% completed high school. No one interviewed (0.0%) stated college, university, or HEART/Vocational Training Institution.

As it pertained to education, 52.9% of those interviewed stated that no one in the household was currently attending school while, 47.1% of interviewees indicated someone in the household was attending school. As it related to the school being attended 50.0% stated that the school being attended was infant/basic, 37.5% stated primary/all age, 25.0% stated high school, no one (0.0%) stated college, 12.5% stated university while 12.5% stated that HEART/a vocational training institute was the school being attended. It should be noted that percentages exceeded one hundred as multiple persons from households attend school.

When respondents were asked about the presence of recreational spaces in their community 41.2% of those offering a response indicated that a recreational space was present while 58.8% stated that no recreational space was present in the community. Recreational spaces named were:

- Seville Heights Community Centre/Playing Field (28.6%)
- Lewis Community Centre (71.4%)

On the issue of respondents' awareness of a company named Richmond Vista Limited, all interviewees (100.0%) offered a response. Of these persons 11.8% indicated that they heard of Richmond Vista Limited while 88.2% stated that they had not heard of that company name. When asked if they had heard of a project called "Secrets Resort and Spa", 100.0% of survey participants offered a response. Approximately twenty-nine percent (29.4%) of interviewees stated that they had heard of the project name while 70.6% stated that they had never heard of any project by that name.

Regarding respondents knowing what a desalination plant was, all interviewees (100.0%) offered a response. Approximately six percent (5.9%) of respondents stated that they knew what the term meant while 94.1% indicated that they did not know what a desalination plant was.

On the issue of respondents knowing what an overwater suite/villa was, all interviewees (100.0%) offered a response. Approximately twenty-nine percent (29.4%) of respondents stated that they knew what the term meant while 70.6% indicated that they did not know what an overwater suite was.

As it pertained to respondents' awareness of the proposal by Richmond Vista Limited to construct a 715-room hotel development in the Richmond Estate (Priory) area of St. Ann, 100.0% of participants responded and all persons (100.0%) further stated that they were not aware of the project.

When asked if there have been any problems/issues on the proposed development site, all interviewees (100.0%) offered a response. Just over seventeen percent (17.6%) of interviewees stated that they were unaware of the site having problems/issues in the past, while 82.4% of persons stated that there were no problems/issues with the proposed site. No one interviewed (100.0%) indicated that there were problems/issues at the proposed site in the past.

As it related to respondents having any general concerns pertaining to the proposed development project, 82.4% of interviewees indicated that they did not have any concern while 17.6% indicated that they had concerns with the project as proposed. Concerns highlighted pertained to the following:

- Loss of beach access (33.3%)
- The impact of the batching plant on the nearby areas (33.3%)
- Improper sewage disposal (33.3%)
- The availability of equal work opportunities for locals/community persons (33.3%)

Percentages exceeded 100.0% as some respondents expressed multiple concerns.

When asked about possible suggestions to address highlighted concerns, the following suggestions were put forward:

- Leave an area to access the beach (33.3%)
- Build an adequate sewage treatment facility (33.4%)
- Do not discriminate against local workers (33.3%)

When asked if there were specific concerns regarding a section of the beach being modified, 100.0% of interviewees offered a response. Of these individuals, 5.8% expressed uncertainty, 82.4% stated that they had no concerns, while 11.8% indicated that they were concerned about a section of the beach being modified. Concerns highlighted were:

- Possible damage to the coral reef (50.0%)
- Loss of access to beach and shoreline (50.0%)

Suggestions put forward to address highlighted concerns were:

- Not modify the beach (50.0%)
- Allow for free movement along the beach/shoreline (50.0%)

In response to whether there were specific concerns relating to suites/villas being built over water, all (100.0%) survey participants offered a response. Of these respondents, 88.2% stated that they had no concerns, while 11.8% indicated that they were concerned about suites being built over water. Concern expressed was:

- Loss of marine life (100.0%)

Although expressing concern, respondents (100.0%) did not offer any suggestion to resolve the highlighted concern.

As it pertained to respondents having specific concerns relating to the seawater desalination plant, all (100.0%) persons interviewed offered a response. Of these respondents, 94.1% stated that they had no concerns, while 5.9% indicated that they were concerned about the seawater desalination plant. Concern expressed was:

- Lack of information on the desalination process (100.0%)

To address highlighted concern interviewees suggested that Richmond Vista Limited should:

- Provide information on the desalination process (100.0%)

On the issue of having specific concerns regarding the project having its own batching plant for the mixing of concrete, 100.0% of interviewees offered a response. Of these individuals, 11.8% expressed uncertainty, 64.7% stated that they had no concerns, while 23.5% indicated that they were concerned about the project having its own concrete batching plant. Concerns expressed were:

- Dust and noise nuisance (75.0%)
- Harmful emissions from the batching plant (50.0%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Suggestions put forward to address highlighted concerns were:

- Implement systems to mitigate against harmful emissions/discharge/dust/surface run-off (50.0%)
- Do not build the batching plant (25.0%)
- Use already existing local concrete batching plant (25.0%)
- Educate persons on potential health risks associated with the batching plant operations (25.0%)

Percentages exceeded 100.0% as some respondents offered multiple suggestions.

In response to whether there was dependence on/use of the proposed site (lands to include the beach area) for any type of activity, all persons interviewed (100.0%) offered a response. Of these respondents, 47.1% of individuals confirmed that they depended on the proposed site while 52.9% stated that they did not depend on the site.

The 47.1% of respondents indicated that the proposed site was used for:

- Recreation (to include swimming) (62.5%)
- Fishing (to include boat docking) (50.0%)
- Crab and whelks hunting (12.5%)

Percentages exceeded 100.0% as some respondents offered multiple responses.

On the issue of using the section of the marine environment proposed for the overwater villas for any type of activity, 100.0% of interviewees offered a response. Of these individuals, 11.8% confirmed that they used the area while 88.2% stated that they did not use the overwater villas area for any activity.

The 11.8% of respondents indicated that the proposed overwater villas area was used for:

- Fishing (100.0%)

When asked about walking through the site in the past, all survey participants offered a response. Approximately forty-one percent (41.2%) of respondents stated that they did not walk through the proposed site in the past, while 58.8% indicated that in past years they walked through the site.

As it pertained to why individuals walked through the site, respondents indicated:

- to access the beach for recreational purposes (60.0%)
- fishing (40.0%)
- Crab and/or whelks hunting (10.0%)

Percentages exceeded 100.0% as multiples responses were offered.

When asked, the 58.8% of persons indicating that they walked through the site, stated that they had been walking through the site for:

- Less than a year (0.0%)
- Between one and five years (30.0%)
- Between six and ten years (30.0%)
- Between eleven and fifteen years (10.0%)
- Between sixteen and nineteen years (0.0%)
- More than twenty years (30.0%)

Regarding whether persons still walked through the proposed site, all interviewees offered a response (100.0%). Of these respondents, 58.8% of respondents indicated that they were no longer walking through the site, while 41.2% of interviewees indicated that they were still walking through the site.

In response to why they were still traversing the site, of the 41.5% of persons confirming that they were still walking through the site, respondents stated:

- For access to the beach (57.1%)
- Fishing (28.6%)
- Crab and/or whelks hunting (28.6%)

Percentages exceeded 100.0% as interviewees offered multiple responses.

When asked if they knew anyone who depends on/uses the proposed site for any type of activity all (100.0%) survey participants responded. Approximately twenty-three percent (23.5%) stated that they knew of persons who used the area, while 76.5% of respondents stated that they did not know of anyone who used the proposed location. The purposes that these persons depended on/used the area for were stated as follows:

- Fishing (75.0%)
- Crab and/or whelks hunting (25.0%)

On the issue of whether respondents thought the project would affect their life 100.0% of interviewees offered a response. Just over twenty-nine percent (29.4%) of respondents indicated that the project would not affect their life in any way, while 11.8% were not sure if the project would affect their life. Of the 58.8% of persons anticipating some effect on their lives, 17.6% anticipated a negative impact while 41.2% anticipated a positive impact from the project.

For those anticipating some positive effect, they anticipated:

- Employment opportunity (100.0%)

For those anticipating a negative effect, they anticipated:

- Loss of fishing livelihood (66.7%)
- Loss of beach access (33.3%)

When asked about possible suggestions to mitigate/address the anticipated negative impact, the following suggestions were offered:

- Allow access for fishing (33.3%)
- Allow beach access for recreation (33.4%)
- No suggestion offered (33.3%)

Regarding whether respondents thought the project would affect their community 100.0% of interviewees offered a response. Just over twenty-three percent (23.5%) stated that they were unsure if there would be an impact while 23.5% of individuals interviewed indicated that the project would not have any impact on the community. Fifty-three (53.0%) percent of respondents anticipated that the project would impact their community. Of these respondents, just over forty-seven percent (47.1%) of interviewees anticipated a positive effect, no one (0.0%) anticipated only a negative effect while 5.9% anticipated both positive and negative impacts on the community.

For those interviewees anticipating a positive effect on the community, the following were stated:

- employment opportunities will be created (88.9%)
- There will be community/national development (22.1%)

For those anticipating a negative effect on the community, the following were stated:

- Loss of access to the beach (100.0%)

Although highlighting concerns, none (0.0%) of the interviewees offered suggestions to address them.

As it pertained to whether respondents thought the project would affect the environment, 100.0% of persons interviewed offered a response. Just over thirty-five percent (35.3%) of respondents stated that the project would not have an impact on the environment, while 52.9% stated that they were unsure if there would be any impact. Approximately twelve percent (11.8%) of interviewees anticipated an impact to the environment. Of these respondents, 5.9% anticipated a negative effect while 5.9% anticipated a positive effect on the environment.

For those anticipating a positive effect on the environment, the following was stated:

- Infrastructure upgrades (100.0%)

It should be noted that those anticipating a positive impact on the environment were anticipating an impact on the physical environment. For those anticipating a negative effect on the environment, the following was stated:

- Loss of wildlife (fish, turtles) (100.0%)

Although highlighting negative impact, none (0.0%) of the interviewees offered suggestions to address them.

As it related to housing 100.0% of interviewees offered responses. Approximately thirty-five percent (35.3%) of respondents stated that they owned the house they lived in, 5.9% lived in rented homes, while 58.8% stated that they lived in family-owned homes. No one interviewed (0.0%) stated that their residence was leased, or that they lived in government own housing or that they squatted in their residence.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Just under eighteen percent (17.6%) of respondents stated that they owned the land on which the house is located, no one (0.0%) stated that the land was leased, 5.9% indicated that lands were government owned, 11.8% indicated that they squatted on the land, while 58.8% stated that their homes were built on family land. Approximately six percent (5.9%) stated "other" and indicated that the home they lived in was rented, but there was no arrangement made with respect to the land.

Regarding the type of wall that dwellings were made of 70.6% of interviewees indicated that the walls of their homes was made of concrete and blocks, 23.5% stated wood/board while 5.9% stated that walls were made of both concrete and blocks as well as wood/board. It should be noted that for respondents who indicated that the walls of their homes were made of both materials, this was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 70.6% of respondents indicated that the roof of their homes was metal sheeting, while 23.5% stated concrete as the roof material. Just under six percent (5.9%) of interviewees stated that their roofs were made of multiple materials, and specified metal sheeting and concrete as the materials. This was due to structural additions to increase habitable living space.

As it pertained to the type of toilet facility present 100.0% of respondents offered a response. Approximately sixty-five percent (64.7%) of respondents indicated that their homes had water closets, while 35.3% stated that pit latrine was the toilet facility. No one (0.0%) indicated that their homes did not have a toilet facility.

As it related to what the household used for lighting 100.0% of respondents offered a response and further stated that electricity was used as the household lighting source.

Regarding the type of fuel used mostly for cooking 100.0% of respondents offered a response. Approximately ninety-four percent (94.1%) of persons interviewed indicated that gas was used mostly, while 5.9% stated electricity.

On the issue of the main source of household domestic water supply 100.0% of survey participants offered a response and also confirmed that their household domestic water supply was the public piped water supply.

As it pertained to respondents' having any problems with the domestic water supply 100.0% of interviewees offered a response, and 82.4% of those who responded indicated that there were problems with the water supply while 17.6% indicated that there were no problems with the domestic water supply. For those persons who confirmed that there were problems with the domestic water supply, 85.7% indicated that the water supply was irregular while 14.3% stated that turbidity was the issue.

In response to how persons coped with problems related to domestic/household water supply, of those confirming that there were problems with supply,7.1% stated that rainwater was harvested, 35.7% stated that they used the community standpipe and 42.9% indicated that they stored water in various containers ranging from small containers to large plastic water tanks. Some respondents (14.3%) offered no response.

On the issue of access to a residential (fixed line/landline) telephone 100.0% of respondents offered a response. Just over ninety-four percent (94.1%) of interviewees indicated that they did not have access to a residential telephone while 5.9% confirmed that they had access. Of the 94.1% of persons indicating that they did not have a fixed line at their residence 93.8% of these individuals indicated that they owned a mobile phone, while 6.2% stated that they did not own a mobile phone.

As it pertained to respondents' awareness of fixed line telephone service being in their community, 100.0% of respondents offered a response. Approximately twelve percent (11.8%) of respondents stated that they were not aware of fixed line service being in the community, while 23.5% stated that the community did not have fixed line service. Just under sixty-five percent (64.7%) of interviewees stated that fixed line telephone service was present in the community.

Regarding the main method of garbage disposal for households 100.0% of respondents offered a response. Approximately seventy-seven percent (76.5%) of those interviewed indicated that the public garbage truck was the main garbage disposal method, while 23.5% indicated that burning was the main method used to dispose of garbage. Regarding the frequency of collections, of the 76.5% of respondents who indicated that the garbage truck was the main method of garbage disposal, 53.8% indicated that garbage collections were done once per week, 7.7% stated twice per week, while 38.5% stated garbage collection was done once per month.

When asked about flooding, 100.0% of respondents offered a response and also indicated that their community was not affected by flooding.

Regarding whether there were problems with frequent flooding at or near the proposed site 100.0% of respondents offered a response. Approximately eighty-two percent (82.4%) of interviewees, stated that the area was not affected by flooding, while 11.8% stated that they did not know if the area was affected, and 5.8% stated that the area was affected by flooding. Of the 5.8% of those stating that there were flooding problems at or near the proposed site, 100.0% stated flooding occurred only on times of heavy rains.

When asked about the frequency of occurrence of rain events causing flooding at or near the proposed site, 100.0% stated that rain event occurred once weekly. The entire property was said to be affected (swampy and prone to waterlogging).

As it pertained to the depth of flood water at or near the proposed site, respondents (100.0%) did not offer a response.

On the issue of whether the proposed area was affected by tidal changes such as sea level rise or storm surge 100.0% of interviewees offered a response. Approximately twenty-nine percent (29.4%) of respondents stated that they did not know if the area was affected while 64.8% stated that the area was not affected by tidal changes and 5.8% indicated that the area was affected by tidal changes.

Regarding whether there was any site nearby considered to be a protected area, historic area or area of national, historic or environmental importance, 100.0% of interviewees offered a response. Just over twenty-nine percent (29.4%) of interviewees stated they did not know of any such area or site, 53.0% stated that no such area was located near to the proposed area while 17.6% indicated that there was an area/site considered to be a protected area or area of historic, national, or environmental importance. The main places named were:

- The Seville Great House and Heritage Park
- The Anchor (in the vicinity of the Infirmary)

6.4 FISHERS

6.4.1 Introduction

Questionnaires specifically aimed at fisher folk were administered at the St. Ann's Bay Fishing Beach. Fishers were interviewed on October 15, 2022. It should be noted that despite multiple visits to the proposed project site, the Priory Beach (Fantasy Beach) and the accessible coastline in the general Priory community, no active fisherfolk were encountered in the study area. Therefore, in an effort to obtain feedback from active fisherfolk, surveys were administered at the St. Ann's Bay Fishing Beach, which is the nearest recognised fishing beach to the study area. Six persons were identified as fishers. All persons (100%) interviewed were males and resided in St. Ann's Bay.

Percentages presented are for the total number of persons offering responses; in instances where respondents did not offer an answer to a question, they were not considered part of the analyses.

6.4.2 Results and Findings

Of the six (6) respondents age cohort distribution was as follows; 16.7% were 18-25 years of age, 16.7% were 26-33 years, 50.0% were age 34-41 years and 16.6 % were age 42-50 years. No one (0.0%) 51 years of age or older.

All persons (100.0%) were fishers (fishermen). Fifty percent (50.0%) of fishers indicated that they sold their fish catch directly and 50.0% indicated that they did not sell their fish directly. No fish vendors (0.0%) were encountered. This was due mainly to the fact that the St. Ann's Bay Fishing Beach is a relatively small fishing beach and does not lend itself to providing a viable source of employment for someone to engage in fish vending or fish scaling as a stable means to generate income.

When asked if other members of the household were fishers, 83.3% stated that no other household member was a fisher, while 16.7% of interviewed fishers confirmed that another household member was a fisher. Of the 16.7% of respondents, all persons (100.0%) stated that one other household member was a fisher.

Regarding whether other members in the household were fish vendors, all interviewees (100.0% confirmed that no other member of their household was a fish vendor

On the issue of whether fishing was the main source of employment, all (100.0%) fishers interviewed indicated that they pursued fishing on a full-time basis and were not otherwise employed.

As it pertained to the highest level of education completed, 16.7%) of interviewed fishers stated primary/all age as the highest level of education completed, 66.6% indicated that they completed high school and 16.7% stated HEART/ a vocational training institution.

In general, the fishers encountered, have been fishing for between six and twenty-four years. Approximately seventeen percent (16.7%) of individuals stated that they have been fishers for between six and eleven years, 50.0% stated that they had been engaged in fishing for between twelve and seventeen years while 33.3% have been fishers for between eighteen and twenty-four years.

When fishers were asked where they docked and launched their vessel, 100.0% stated that they used the St. Ann's Bay Fishing Beach.

In relation to where persons fished, 100.0% of respondents indicated that they fished in nearshore areas, 16.7% stated that the fished in Deep Sea within a distance of between 1.6Km and 8.0 Km from shore, while 66.7% stated that the fished in Deep Sea at a distance greater than 8.0 Km from shore. Percentages exceeded 100.0% as multiple responses were offered. It should be noted that fisherfolk fished at different distances from shore based on the types of fish they wanted to harvest or based on prevailing weather conditions. In general, fisherfolk fished in waters extending west to Trelawny and eastwards to St. Mary. Areas named were Ocho Rios, Laughlands, Chukka Cove and Salem.

In response to what fishers used for fishing, it was realised during the survey exercise that the fishers used multiple tools. Approximately thirty-three percent (33.3%) of fishers used lines, 83.3% used spears, 66.7% used nets and 16.7% used fish pots. Percentages exceeded 100.0% as fishers indicated that multiple tools were used for fishing.

As it pertained to the type of vessel used, 66.7% offered a response. Of these respondents 100.0% stated that they used a canoe with an engine for fishing.

Of those respondents who indicated that they used a canoe with an engine for fishing, all interviewees (100.0%) stated that the canoe had one engine. Regarding the engine size, 25.0% of respondents stated the engine size was 15HP, 50.0% stated 40HP and 25.0% stated 50HP as the engine size.

Between two and four persons worked on a fishing vessel. Fifty percent (50.0%) of respondents stated that four persons worked on their vessel, 25.0% stated three persons and 25.0% stated that two persons worked on their vessel.

When fishers were asked how many times per week they went fishing, all interviewees (100.0%) offered a response. Approximately seventeen percent (16.7%) stated three times per week, while 50.0% indicated five times per week. The remaining 33.3% of respondents stated that they went fishing more than five times each week.

As it pertained to the average pound catch of fish harvested on each fishing event, 16.6% of fishers stated that they caught/harvested less than ten pounds of fish, while 16.7% indicated that their catch was on average between eleven and twenty pounds. Fifty percent (50.0%) stated that catch ranged between twenty-one and fifty pounds and 16.7% indicated that average catch for each fishing event exceeded one hundred pounds.

On the issue of how the quality/quantity of fish catch has changed over time, all fishers (100.0%) responded. Fifty percent 50.0% of fishers reported a decrease and 50.0% reported that there was no change in the quality/quantity of fish catch.

As it pertained to whether there was change in the size and/types of fish harvested, all fishers (100.0%) responded. Just over thirty-three percent (33.3%) of fishers stated that there was a decrease while 66.7% indicated that there was no change in the size/types of fish harvested. For those (33.3%) stating that there was a decrease in the size/types of fish harvested, 50.0% attributed the decrease to overfishing. The remaining 50.05 offered no response.

As it pertained to the average weekly income derived from fish sales, 100.0% of interviewees offered a response and further indicated average weekly income from fish sales was in excess of $8,000.00.

Regarding whether respondents observed a change in the income earned from fish sales, 33.3% stated that there was an increase in sales income and 66.7% stated that no change in sales income was observed. For those stating an observed increase in income from fish sales the following reasons were stated:

- Increased cost per pound of fish (50.0%)
- Capital investment and expansion of business (50.0%)

On the issue of respondents' awareness of a company named Richmond Vista Limited, all interviewees (100.0%) offered a response and further stated that they had not heard of that company name. When asked if they had heard of a project called "Secrets Resort and Spa", 100.0% of survey participants offered a response. Fifty percent (50.0%) of interviewees stated that they had heard of the project name while 50.0% stated that they had never heard of any project by that name.

Regarding respondents knowing what a desalination plant was, all interviewees (100.0%) offered a response. Approximately seventeen percent (16.7%) of respondents stated that they knew what the term meant while 83.3% indicated that they did not know what a desalination plant was.

On the issue of respondents knowing what an overwater suite/villa was, all interviewees (100.0%) offered a response. Approximately thirty-three percent (33.3%) of respondents stated that they knew what the term meant while 66.7% indicated that they did not know what an overwater suite was.

As it pertained to respondents' awareness of the proposal by Richmond Vista Limited to construct a 715-room hotel development in the Richmond Estate (Priory) area of St. Ann, 100.0% of participants responded. Approximately seventeen percent (16.7%) of those interviewed stated that they were aware of the project while 83.3% stated that they were not aware of the project (Figure 6-10).

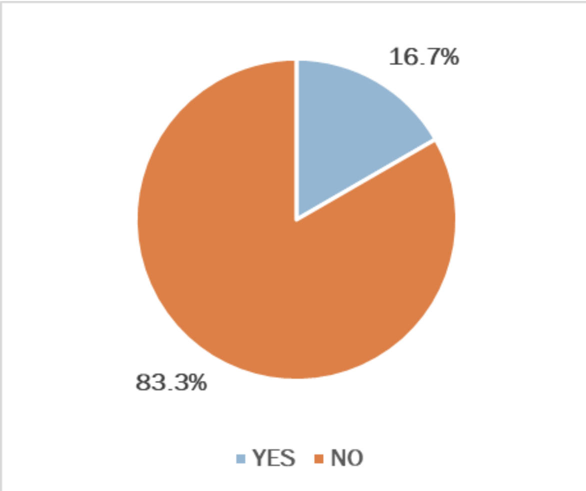


Figure 6-10 Percentage of respondents awareness and unawareness of the 715-room proposed development

Of the 16.7% of interviewees confirming awareness of the proposed project:

- 100.0% indicated that they were not aware that the development would include fifteen (15) overwater villas.
- 100.0% indicated that they were not aware that the development would include two buildings comprising 700 rooms.
- 100.0% indicated that they were not aware that the development would include modifying a section of existing beach.
- 100.0% indicated that they were not aware that the development would include constructing a wastewater treatment plant.
- 100.0% indicated that they were not aware that the development would include constructing a seawater desalination plant.
- 100.0% indicated that they were not aware that the development would include constructing a batching plant for concrete mixing.
- 100.0% stated “word of mouth’ as the medium by which they were made aware of the project.

When asked if there have been any problems/issues on the proposed development site, all interviewees (100.0%) offered a response. Just under seventeen percent (16.7%) of interviewees stated that they were unaware of the site having problems/issues in the past, while 83.3% of persons stated that there were no problems/issues with the proposed site. None (0.0%) of the interviewed fishers indicated that there have been problems/issues at the proposed site in the past.

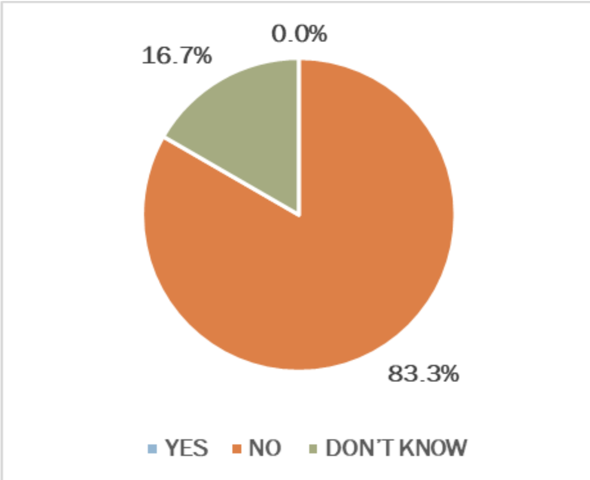


Figure 6-11 Percentage of respondents indicating if there have been problems at the proposed site

As it related to respondents having any general concerns pertaining to the proposed development project, 33.3% of interviewees indicated that they did not have any concern while 66.7% indicated that they had concerns with the project as proposed. Concerns highlighted pertained to the following:

- Loss of marine wildlife (100.0%)

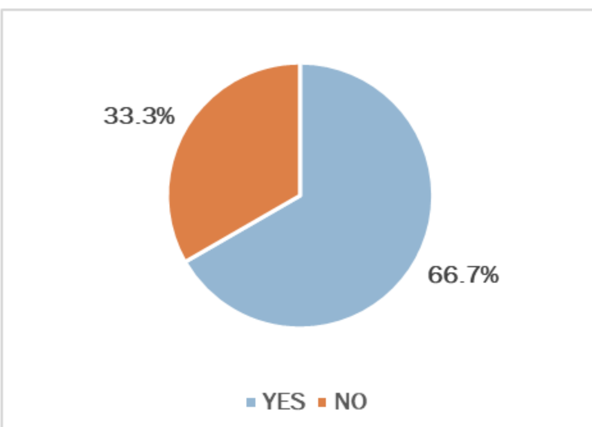


Figure 6-12 Percentage of respondents indicating if there are general concerns about the proposed project

When asked about possible suggestions to address highlighted concerns, the following were put forward for Richmond Vista Limited to undertake:

- Do not disturb the reef (25.0%)
- No suggestion offered (75.0%)

When asked if there were specific concerns regarding a section of the beach being modified, 100.0% of interviewees offered a response. Of these individuals, 16.7% stated that they had no concerns, while 83.3% indicated that they were concerned about a section of the beach being modified. Concerns highlighted were:

- Loss of access to beach and shoreline (40.0%)
- Migration of fish (40.0%)
- Increased turbidity (80.0%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Suggestions put forward to address highlighted concerns were:

- Allow for free movement along the beach/shoreline (20.0%)
- No suggestion offered (80.0%)

In response to whether there were specific concerns relating to suites/villas being built over water, all (100.0%) survey participants offered a response. Of these respondents, 66.7% stated that they had no concerns, while 33.3% indicated that they were concerned about suites being built over water. Concerns expressed were:

- Loss of marine life (50.0%)
- Increased turbidity (50.0%)

To address highlighted concerns interviewees suggested that Richmond Vista Limited should:

- Dredge the seafloor only as necessary (50.0%)
- No suggestion offered (50.0%)

As it pertained to respondents having specific concerns relating to the seawater desalination plant, all (100.0%) persons interviewed offered a response. Of these respondents, 83.3% stated that they had no concerns, while 16.7% indicated that they were concerned about the seawater desalination plant. Concerns expressed were:

- Handling and disposal of waste (specifically extracted salt) (100.0%)
- Harmful environmental emissions (100.0%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Although expressing concerns, none of the respondents (0.0%) offered suggestions to resolve them.

On the issue of having specific concerns regarding the project having its own batching plant for the mixing of concrete, 100.0% of interviewees offered a response. Of these individuals, 66.7% stated that they had no concerns, while 33.3% indicated that they were concerned about the project having its own concrete batching plant. Concerns expressed were:

- Dust and noise nuisance (50.0%)
- Proximity to the ocean (50.0%)
- Marine pollution resulting from surface water run-off (50.0%)
- Harmful emissions from the batching plant (100.0%)

Percentages exceeded 100.0% as multiple concerns were expressed.

Suggestions put forward to address highlighted concerns were:

- Implement systems to mitigate against harmful emissions/discharge/dust/surface run-off (50.0%)
- No suggestion offered (50.0%)

In response to whether there was dependence on/use of the proposed site (lands to include the beach area) for any type of activity, all persons interviewed (100.0%) offered a response. Of these respondents, 66.7% of individuals confirmed that they depended on the proposed site while 33.3% stated that they did not depend on the site. The 66.7% of respondents indicated that the proposed site was used for:

- Fishing (75.0%)
- No further response (25.0%)

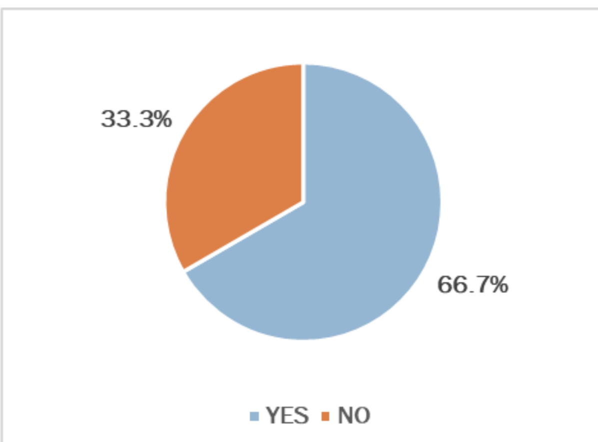


Figure 6-13 Percentage of respondents indicating use/non-use of the proposed site

On the issue of using the section of the marine environment proposed for the overwater villas for any type of activity, 100.0% of interviewees offered a response. Of these individuals, 83.3% confirmed that they used the area while 16.7% stated that they did not use the overwater villas area for any activity. The 83.3% of respondents indicated that the proposed overwater villas area was used for:

- Fishing (60.0%)
- Emergency boat docking (equipment failure/inclement weather/medical emergency) (40.0%)

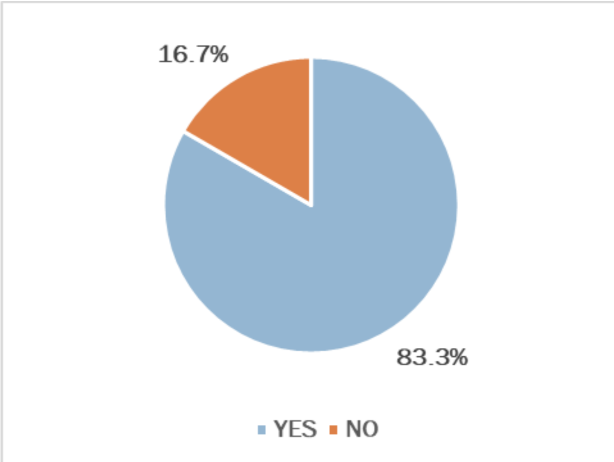


Figure 6-14 Percentage of respondents stating dependence/non-dependence on the marine are of the proposed site

When asked about walking through the site in the past, all survey participants offered a response. Approximately seventeen percent (16.7%) of respondents stated that they did not walk through the proposed site in the past, while 83.3% indicated that in past years they walked through the site. As it pertained to why individuals walked through the site, respondents indicated fishing (100.0%).

When asked, the 83.3% of persons indicating that they walked through the site, stated that they had been walking through the site for:

- Less than a year (0.0%)
- Between one and five years (0.0%)
- Between six and ten years (20.0%)
- Between eleven and fifteen years (60.0%)
- Between sixteen and nineteen years (20.0%)
- More than twenty years (0.0%)

Regarding whether persons still walked through the proposed site, all interviewees offered a response (100.0%). Of these respondents, 16.7% of respondents indicated that they were no longer walking through the site, while 83.3% of interviewees indicated that they were still walking through the site. In response to why they were still traversing the site, of the 83.3% of persons confirming that they were still walking through the site, respondents stated for fishing (100.0%).

When asked if they knew anyone who depends on/uses the proposed site for any type of activity all (100.0%) survey participants responded and further stated that they knew of persons who used the area. Fishing was stated by all respondents (100.0%) as the purposed for which the site was used by others.

On the issue of whether respondents thought the project would affect their life 100.0% of interviewees offered a response. Fifty percent (50.0%) of respondents indicated that the project would not affect their life in any way, while 33.3% were not sure if the project would affect their life and 16.7% anticipated a negative impact from the project (Figure 6-15). None (0.0%) of the fishers interviewed anticipated a positive impact. For those anticipating a negative effect, they anticipated:

- Loss of fishing livelihood (100.0%)
- Loss of beach access (100.0%)

Percentages exceeded 100.0% as multiple responses were offered.

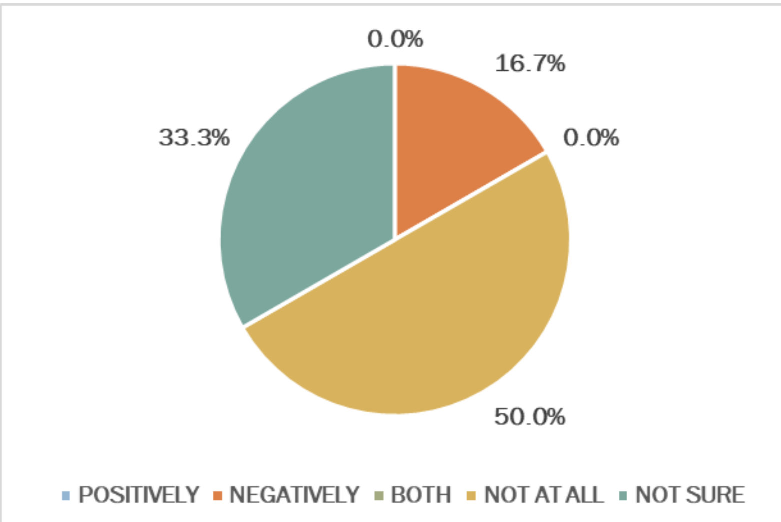


Figure 6-15 Percentage of respondents and the potential impact of the project on respondent's lives/livelihood

When asked about possible suggestions to mitigate/address the anticipated negative impact, the following suggestions were offered:

- Allow access for fishing (100.0%)
- Allow beach access (100.0%)

Percentages exceeded 100.0% as multiple responses were offered.

Regarding whether respondents thought the project would affect their community 100.0% of interviewees offered a response. Just under seventeen percent (16.7%) stated that they were unsure if there would be an impact while 33.3% of interviewed fishers anticipated a positive effect, 50.0% anticipated a negative effect on the community (Figure 6-16).

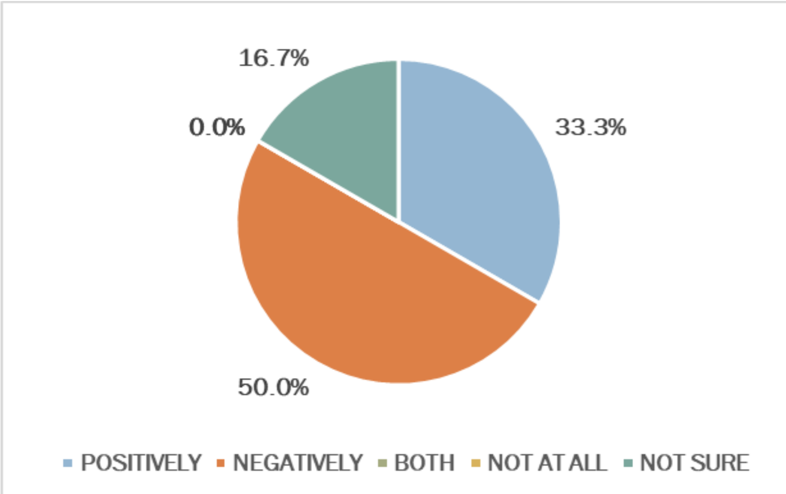


Figure 6-16 Percentage of respondents and the potential impact of the project on the community

For those interviewees anticipating a positive effect on the community, the following were stated:

- employment opportunities will be created (50.0%)
- There will be community/national development (50.0%)
- Increased income (50.0%)

Percentages exceeded 100.0% as multiple responses were offered.

For those anticipating a negative effect on the community, the following were stated:

- Loss of access to the beach (33.3%)
- Loss of fishing area (66.7%)
- Loss of fishing livelihood (66.7%)

Percentages exceeded 100.0% as multiple negative impacts were anticipated by some respondents.

When asked about possible suggestions to mitigate/address the anticipated negative impact, the following suggestions were offered by respondents:

- Compensation for loss (33.3%)
- No suggestions (66.7%)

As it pertained to whether respondents thought the project would affect the environment, 100.0% of persons interviewed offered a response. Just under sixty-seven percent 66.6% stated that they were unsure if there would be any impact, 16.7% anticipated a negative effect while 16.7% anticipated a positive effect on the environment. For those anticipating a positive effect on the environment, the following were stated:

- Infrastructure upgrades (100.0%)

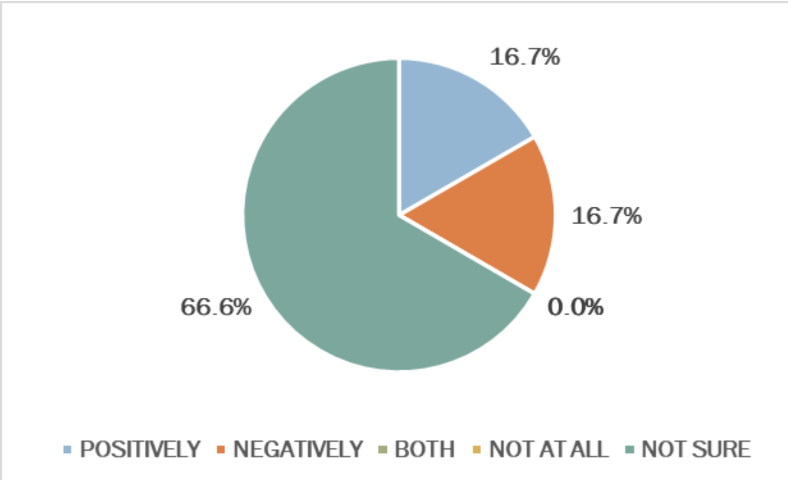


Figure 6-17 Percentage of respondents and the potential impact of the project on the environment

It should be noted that those anticipating a positive impact on the environment were anticipating an impact on the physical environment. For those anticipating a negative effect on the environment, the following were stated:

- Negative Impact on the environment (100.0%)

Although anticipating negative impacts, none of the respondents offered suggestions to resolve them.

6.4.3 General Comments

During the interviews, it was learnt that:

- Spear fishers on returning from sea will at times walk through the site and head to the Priory Main Road to get public transportation to return to St. Ann's Bay. Fishers will take public transportation from St. Ann's Bay to Priory and walk through the site and swim from the beach to go fishing.
- While some boat fishers may not use the proposed area regularly, the area is used as a channel in times of emergency and inclement weather.

6.5 STAKEHOLDERS

6.5.1 Introduction

During the field exercise it was realised that the St. Ann's Bay Infirmary is in proximity to the proposed project site. It was deemed necessary, that special consultation be held with the management of the Infirmary to ascertain potential impacts on the infirmary and its resident population. One interview was conducted with the Matron of the Infirmary on October 10, 2022.

The St. Ann's Bay Infirmary falls under the auspices of the Ministry of Labour and Social Security and is managed at the parish level by the St. Ann Municipal Corporation. At the time of conducting the interview with the Infirmary's Matron, the Infirmary has a staff complement of sixty-eight (68) that caters to a resident population of eighty-three (83) individuals. Information is that that residents suffer from medical conditions which include, hypertension, diabetes, high cholesterol, and mental illness to include delayed mental development. It was highlighted that on average residents of the infirmary live at the facility for more than fifteen years. It was further explained that the Infirmary is not a facility designed to cater only to the aged indigent members in society but is designed to cater to all members of the population who are indigent and unable to care for themselves, thereby resulting in the facility having long-term residents.

The Infirmary does not have its own dedicated recreational space. The communal area of the facility serves as the dining area and recreational area. Information is that in past years the Infirmary had a gazebo that was used by residents, but this gazebo has subsequently deteriorated and is no longer useable.

Although not part of the survey exercise, it was learnt that the Infirmary is desirous of improving its offerings to its residents especially in providing additional spaces dedicated solely for recreational use. The facility is also in need of specialised equipment to better cater to the unique needs of its residents with mobility challenges.

Like the wider Priory area, the Infirmary's water supply is the public piped water supply and there are problems with this supply, specifically irregular water supply. Information is that the facility has a two-day emergency water storage capacity which is used to cope with the water supply issues.

The Infirmary disposes of its garbage through the National Solid Waste Management Authority. Garbage collection for the infirmary is irregular although the collection schedule should be once per week.

6.5.2 Results and Findings

On the issue of awareness, The St. Ann's Bay Infirmary indicated that the organisation had never heard of a company named Richmond Vista Limited. When asked if they had heard of a project called "Secrets Resort and Spa" it was also indicated that they had never heard of any project by that name.

Regarding knowing what a desalination plant was, the representative of the Infirmary stated that they did not know what the term meant.

Regarding knowing what an overwater suite/villa was, the representative of the Infirmary stated that they knew what the term meant.

As it pertained to awareness of the proposal by Richmond Vista Limited to construct a 715-room hotel development in the Richmond Estate (Priory) area of St. Ann, it was stated that the Infirmary was not aware of the project.

When asked if there have been any problems/issues on the proposed development it was stated that the proposed site did not have problems/issues in the past. The St. Ann's Bay Infirmary indicated that they did not have:

- Any general concerns pertaining to the project as proposed
- Specific concerns relating to a section of the beach being modified
- Specific concerns relating to suites/villas being built over water

Regarding the seawater desalination plant the concern was raised regarding whether the quality of the processed water would be safe for consumption, however no suggestion was offered to address the issue.

As it pertained to the concrete batching plant, concerns expressed were:

- Emissions from the batching plant
- Long term health implications from emissions from the batching plant.

When asked about suggestions to address highlighted concerns, the Infirmary representative suggested that:

- Emissions should be managed and minimised

As it pertained to the potential impact of the project on the lives of the residents of the St. Ann's Bay Infirmary, it was expressed that residents' lives would be negatively impacted by:

- Increased noise
- Dust pollution
- Increased risk of disease transmission due to vectors and an overall population increase and tourist presence in the adjacent community.

It was suggested that measures to mitigate and minimise potential impacts should be identified and implemented.

Regarding the potential impact on the community in which the Infirmary is located, it was stated that the community would be positively impacted by the project specifically in the areas of:

- Community development
- Job creation for the unemployed within the community.

No response was offered when asked about how the proposed project could affect the environment.

7.0 IDENTIFICATION AND ASSESSMENT OF POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

7.1 IMPACT MATRICES

Impact matrices for the site preparation/construction and operational phases of the: i) hotel and ii) beach works and overwater rooms were created (Table 7-2 - Table 7-5). Each impact was assessed based on the following criteria, as indicated within each matrix and are grouped as Physical, Biological and Human/ Social (Ogola, 2007):

- **Direction:** - This describes the nature of the potential impact. It can either be positive, negative or no impact of a particular activity (none).
- **Duration:** Environmental impacts have a temporal dimension and needs to be considered in an EIA. Impacts arising at different phases of the project cycle may need to be considered. See Table 7-1 for ranking technique utilised.
- **Magnitude:** This is defined by the severity of each potential impact and indicates whether the impact is irreversible or reversible and estimated potential rate of recovery. The magnitude of an impact cannot be considered large/high if the impact can be successfully mitigated. See Table 7-1 for ranking technique utilised.
- **Extent:** The spatial extent or the zone of influence of the impact should always be determined. An impact can be site-specific and limited to the project area and also within the locality of the proposed project; a regional impact that may extend beyond the local area; and a national impact affecting resources on a national scale which may also in some cases be trans-boundary (international). See Table 7-1 for ranking technique utilised.

It should be noted that the following were also taken into consideration during impact analysis:

- The Consultants' experience,
- Documented impacts from similar projects,
- The data collected,
- Analysis of the processes in the proposed project,
- Information generated from models,
- Concerns raised from stakeholders in the social surveys; and
- Discussions held among the EIA Study team.

Table 7-1 Ranking criteria utilised for duration, magnitude and extent of each potential impact

DURATION	**None (N)** – No temporal effect	**Short (S)** - Impacts lasting 0 – 10 years before recovery occurs. Impact does not persist after the activity ends.	**Medium (M)** - Impacts lasting 10 - 20 years before signs of recovery. Impacts on biological populations are not inter-generational.	**Long (L)** - Impacts are persistent and lasting over 20 years. Impacts on biological populations are over several recruitment cycles or generations of those populations.
MAGNITUDE	**None (N)** - No measurable change in availability of resources or function of systems. No measurable effect on people.	**Small (S)** - Changes in form and/or ecosystem function and/or a resource. The system maintains the ability to support ecosystem/ resource functions with only minor changes in community value and no overall loss/gain and is reversible. Only a small fraction of the local community is affected.	**Medium (M)** - Changes in form and/or ecosystem function and/or a resource. The system's ability to support ecosystem/ resource functions and economic benefit is affected but not lost and is reversible. Only a moderate fraction of the local community is affected.	**Large (L)** - Changes in form and/or ecosystem function and/or a resource. The system's ability to support ecosystem/resource functions and economic benefit is highly affected and irreversible. A large fraction of the local community is affected.
EXTENT	**None** – No spatial effect	**Local (L)** - Isolated effects within project site and its locality.	**Regional (R)** – Extended beyond local area/borders or offsite dispersion pathways.	**National (N)** - Widespread effect affecting the nation (and/or transboundary/international)

Table 7-2 Environmental impact matrix for site preparation and construction phase - Hotel

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Stormwater Runoff and Water Quality	Ground and surface water quality may be prone to increased suspended solids from run-off from construction activities and rainfall events.	X				X	S	M	L
		Stored fuels, lubricants, hazardous substances and the repair and usage of construction equipment have the potential to leak hydraulic fuels, oils, etc and thereby have the potential to compromise water quality	X				X	S	M	L
	Noise	Noise nuisance from construction equipment on surrounding residential communities	X				X	S	S	L
	Air Quality	Dust nuisance from transportation of raw material on surrounding residential communities	X				X	S	S	L
		Fugitive dust effect on construction workers and residential communities	X				X	S	S	L
	Vibration	Effect on occupants of Residential units/villas located at the southern-most boundary	X				X	S	S	L
		Structural Effect on Residential units/villas located at the southern-most boundary	X			X				
		Effect on occupants of Unfinished residential housing located at the western-most boundary	X				X	S	S	L
		Structural effect on Unfinished residential housing located at the western-most boundary	X			X				
Biological	Mangrove	2,098 m² of mangrove near Quadrat 10 to be impacted as a result of reclamation	X				X	L	L	L
		Roystonea princeps may be impacted	X				X	S	S	S
		Loss of carbon storage and sequestration	X				X	L	S	S
	Terrestrial Habitat	Coastal and Grassland Habitat loss	X				X	L	S	S
	Rocky Shore	Species and Habitat Loss	X				X	S	S	S
	Sea Turtles	Habitat loss and displacement	X				X	M	M	M
Natural Hazards	Liquefaction and Geotechnical	Layers of silty sand and silty gravel were found, with the potential of liquefaction in all borings at depths between 5 and 50 ft. (mitigate using deep foundation Auger cast in place piles)	X			X				
Socioeconomic / Cultural	Employment	Creation of direct, indirect and induced jobs	X	X	X			S	M	N
		Employment exclusion/discrimination due to diverse sexual orientations and gender identities	X				X	S	M	R
	Solid Waste	Increased generation of solid waste	X				X	S	S	L
	Wastewater	Contamination of marine environment from accidental spillage from portable toilets		X			X	S	S	L
	Vending and Hygiene	Illnesses resulting from improper food handling practices		X			X	S	M	R
		Visual effect on area		X			X	S	S	L
	Transportation and Traffic	Traffic Flow and delays at intersection of site access road and main road	X				X	S	S	L
		Large units including tankers, and trucks carrying building and operation machine parts will pose challenges because of their sizes and weight.	X				X	S	S	L
	Occupational Health and Safety	Potential for accidental injury of construction workers		X			X	S	L	L
		Fugitive Dust effect on health of construction workers		X			X	S	M	L
	Aesthetics	Decreased aesthetic appeal		X			X	S	S	L
		Trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing.		X			X	S	S	L
	Grievance Mechanism	Inconveniences, health risks and can be a source of nuisance to stakeholders (both internal and external) on site		X			X	S	L	L

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
		Incidences of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination		X			X	S	L	L
	Historical Artefacts	No historical, archaeological features were uncovered. No artefacts were recovered. The possibility exists however that there could be foundations of historical structures or features.		X			X	S	S	L
	Fishers and Maritime Interests	Loss of use of site as access point to sea by spear fishers	X				X	L	M	L
		Loss of use as an area used as a channel for vessels in times of emergency and inclement weather.	X				X	L	M	L

Table 7-3 Environmental impact matrix for operational phase - Hotel

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Drainage and Stormwater	Mixing time of stormwater (freshwater) with seawater		X			X	L	S	L
		Effect on benthos from mixing of stormwater with seawater		X			X	L	S	L
		Potential flooding of areas of the property during extreme rainfall events.		X			X	L	S	L
		Potential flooding of neighbouring properties		X			X	L	S	L
	Hydrodynamics (Operational Wave Heights)	Reduction in wave heights, especially at the north-western beach	X		X			L	M	L
		No change in wave energy within the dredged swimming area	X			X				
		Little to no change in wave energy along the eastern beach and within the overwater suites.	X		X			L	M	L
		Increased circulation due to creating of channel	X		X			L	M	L
	Hydrodynamics (Swell Waves and Sediment Transport)	There were no noticeable downdrift impacts further south or west of the project site.				X				
		Protected beaches appear to remain stable				X				
		Swell waves encourage water circulation between the two beaches	X		X			L	M	L
		Currents reduced in the lee of the proposed structures	X		X			L	M	L
		Breakwater reduces the wave energy entering the swimming beach significantly at the north-eastern beach.	X		X			L	M	L
		Sand accretion is occurring along the eastern beach and north-eastern shorelines	X		X			L	M	L
		No noticeable downdrift changes along the neighbouring properties as a result of currents or waves				X				
		There is sediment movement within the dredged wading area	X		X			L	M	L
	Circulation	Changes in current speed and direction are localized along the eastern beach causing a slight increase in current speeds to improve water circulation	X		X			L	M	L
Biological	Sea Turtles	Operational activities, lighting and other barriers may discourage and or prevent turtle nesting and foraging activities	X				X	L	M	M
	Rocky Shore and Intertidal Communities	Species expected to recolonise rocky shore and permanent structure with intertidal area.	X		X					
Natural Hazards	Hurricane Waves and Storm Surge	Potential of flooding to the property from storm surge as well as damage due to high energy waves from 50-yr storm event (mitigative structures to protect property for the 50-yr storm event)		X			X	L	S	L
Socioeconomic / Cultural	Employment	Creation of direct, indirect and induced jobs	X	X	X			L	L	N
		increase of persons with training in the hospitality sector.	X	X	X			L	L	N
		Employment exclusion/discrimination due to diverse sexual orientations and gender identities	X				X	L	M	R
	Solid Waste	Increased generation of solid waste	X				X	L	S	L
	Health and Safety	Workers and guests may become ill or have accidents. In addition, disasters such as earthquakes, floods, storm surge and fires are real possibilities.		X			X	L	L	N

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Drainage and Stormwater	Mixing time of stormwater (freshwater) with seawater		X			X	L	S	L
		Effect on benthos from mixing of stormwater with seawater		X			X	L	S	L
		Potential flooding of areas of the property during extreme rainfall events.		X			X	L	S	L
		Potential flooding of neighbouring properties		X			X	L	S	L
	Hydrodynamics (Operational Wave Heights)	Reduction in wave heights, especially at the north-western beach	X		X			L	M	L
		No change in wave energy within the dredged swimming area	X			X				
		Little to no change in wave energy along the eastern beach and within the overwater suites.	X		X			L	M	L
		Increased circulation due to creating of channel	X		X			L	M	L
	Hydrodynamics (Swell Waves and Sediment Transport)	There were no noticeable downdrift impacts further south or west of the project site.				X				
		Protected beaches appear to remain stable				X				
		Swell waves encourage water circulation between the two beaches	X		X			L	M	L
		Currents reduced in the lee of the proposed structures	X		X			L	M	L
		Breakwater reduces the wave energy entering the swimming beach significantly at the north-eastern beach.	X		X			L	M	L
		Sand accretion is occurring along the eastern beach and north-eastern shorelines	X		X			L	M	L
		No noticeable downdrift changes along the neighbouring properties as a result of currents or waves				X				
		There is sediment movement within the dredged wading area	X		X			L	M	L
	Circulation	Changes in current speed and direction are localized along the eastern beach causing a slight increase in current speeds to improve water circulation	X		X			L	M	L
	Traffic	Delays for traffic coming from the St. Ann's Bay Road. Motorists needing to turn left onto the hotel's main entrance from Laughlands Road and right from out of the hotel's entrance unto Laughlands Road		X			X	L	S	L
		Due to the significant increase in traffic volume in 10 years, the proposed signalized intersection would eventually lose its effectiveness		X			X	L	S	L
	Tourism	Improvement of the tourism product of the country	X		X			L	M	N
	Grievance Mechanism	Incidences of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination	X				X	L	L	L
	Fishers and Maritime Interests	Loss of use of site as access point to sea by spear fishers	X				X	L	M	L
		Loss of use as an area used as a channel for vessels in times of emergency and inclement weather.	X				X	L	M	L

Table 7-4 Environmental impact matrix for site preparation and construction phase – Beach Works and Overwater Structures

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Water Quality	Sedimentation of marine environment from beach works, sand (nourishment), boulders	X				X	S	M	L
		Pollution of marine environment from fuel, lubricants, hazardous substances from construction equipment	X				X	S	M	L
		Sedimentation from temporary construction pad needed for coastal structures	X				X	S	M	L
	Marine Excavation and Dredging	Increased suspended solids, turbidity, BOD and the reduction in light penetration and dissolved oxygen in the water column	X				X	S	M	L
		Suspension of heavy metals from the substrate	X				X	S	M	L
		Affect sensitive coastal ecological habitats	X				X	S	L	L
		Dredge spoil disposal from land may affect coastal water quality	X				X	S	M	L
	Noise	Noise nuisance from construction equipment on surrounding residential communities	X				X	S	S	L
Biological	Rocky Shore	Habitat and Species loss	X				X	S	S	S
		Smothering of habitat and filter feeding organisms	X				X	S	S	S
	Coral Community	Smothering of sensitive nearby coral and reduced light from sedimentation	X				X	M	S	S
		Species loss- not suitable for relocation	X				X	M	M	M
		Species loss during relocation	X				X	S	M	M
		Damage to colonies near work area or relocation areas	X				X	S	S	S
	Other Benthic Communities	Habitat Loss (loss of breeding, foraging and nursery areas) and Fragmentation	X				X	L	M	M
		Species Loss	X				X	L	M	M
		Smothering of species and habitat / clogging of gills and filter feeding appendages	X				X	M	S	S
		Damage during construction and relocation activities	X				X	S	S	S
	Seagrass	Habitat Loss and Fragmentation	X				X	L	L	L
		Species loss	X				X	L	L	L
		Smothering of seagrass blades and epiphytes from sedimentation	X				X	S	S	S
		Reduced light penetration and resulting decrease in photosynthesis	X				X	M	S	S
		Mechanical abrasion from construction activities moorings and anchors	X				X	S	S	S
		Loss of stored carbon and loss of further carbon sequestration	X				X	L	M	M
	Sea Turtles	Temporary disturbance/displacement from construction activity, lights and noise	X				X	S	M	L
		Impeded beach access for nesting	X				X	L	L	L
Socioeconomic / Cultural	Maritime Traffic	Impact on fishing and other maritime activities	X				X	L	S	L
		Accident potential is also increased due to presence of vessels, structures and equipment at sea.	X				X	S	L	L
	Health and Safety	Potential for accidental injury of construction workers	X				X	S	L	L
	Aesthetics	Decreased aesthetic appeal	X				X	S	S	L

Table 7-5 Environmental impact matrix for operational phase - Beach Works and Overwater Structures

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Biological	Reef and Seagrass Community	Pilings and Hard structures (groynes, breakwaters, jetty) will provide of ecological volume and substrate for colonization and recruitment	X		X			L	M	L
		Shading from sea rooms (seagrass)	X				X	L	M	L
		Trampling of beds and other benthic species	X				X	L	M	M
		Habitat Fragmentation	X				X	L	M	S
	Fish	Hard structures (groynes, breakwaters, jetty) will act as Fish Aggregation Devices (FADs)		X	X			L	S	L
	Sea Turtles	Alteration of food source from seagrass bed modification		X			X	L	S	L
		Hard structures block or act as deterrent from going ashore to nest		X			X	L	S	L
		Noise and lighting act as deterrent from going ashore to nest		X			X	L	S	L
Natural Hazards	Hurricane Waves	Increase in static water level and potential for extreme flooding		X		X				
Human/Social	Maritime Traffic	Maritime activities affected by presence of searooms		X			X	L	S	L
		Accident potential due to possibility of collision with searoom structures		X			X	L	M	L
	Aesthetics	Improvement of the aesthetic appeal of the hotel	X		X			L	M	N
	Health and Safety	Workers and guests may become ill or have accidents. In addition, disasters such as storm surge and fires are real possibilities		X			X	L	L	N
	Tourism	Improvement of the tourism product of both the hotel and the country	X		X			L	L	N

7.2 SITE CLEARANCE/ CONSTRUCTION - HOTEL

7.2.1 Physical

7.2.1.1 Stormwater Runoff and Water Quality

Raw materials, for example marl used in the construction of the proposed hotel, will be stored on site or at a staging area; ground and surface water quality may be prone to increased suspended solids from run-off from construction activities and rainfall events.

Stored fuels, lubricants, hazardous substances and the repair and usage of construction equipment have the potential to leak hydraulic fuels, oils, etc and thereby have the potential to compromise water quality as well.

Recommended Mitigation

i. The project site will put in sediment control measures such as turbidity barriers/silt screens and should be erected around the active work area to prevent the dispersion of sediments and contaminants throughout the water column.
ii. A central area will be designated for the storage of raw materials. This area should be lined in order to prevent the leakage of chemicals into the sediment.
iii. Fine grained materials (sand, marl, etc.) will be stockpiled away from drainage channels and low berms will be placed around the piles which themselves will be covered with tarpaulin to prevent them from being eroded and washed away. Silt fences may also be utilized to prevent siltation.
iv. Stoppage of works during adverse weather conditions
v. Raw materials that generate dust should be covered or wetted frequently to prevent them from becoming air or waterborne.
vi. Raw material and equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff.
vii. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by bunds to contain the volume being stored in case of accidental spillage.
viii. Refuelling of boats should only be done at anchor out at sea if the sea conditions are calm, otherwise, all refuelling should be done when docked at land. Appropriate refuelling equipment (such as funnels) and techniques should always be used.
ix. Appropriate minor spill response equipment (for containment and clean- up) will kept on site, including oil absorbent pads and disposal bags.
x. In terms of transporting equipment, the paths of the planned roadways will be used, rather than creating temporary pathways just for equipment access.
xi. Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway.

xii. Vehicle refuelling facilities must be situated on impermeable surfaces served by an oil trap, run-off collection system. Sediment basins and oil water separators should be constructed to intercept storm water before it is discharged.

7.2.1.2 Noise

Site clearance necessitates the use of heavy equipment to carry out the job, including bulldozers, backhoes, jackhammers, etc. These activities and required equipment possess the potential to have a direct negative impact on the noise climate.

Construction noise can result in short-term impacts of varying duration and magnitude. The construction noise levels are a function of the scale of the project, the phase of the construction, the condition of the equipment and its operating cycles, the number of pieces of construction equipment operating concurrently. To gain a general insight into potential construction noise impacts that may result from the project, the typical noise levels associated with various types of construction equipment are identified in Table 7-6.

Table 7-6 Typical construction equipment noise levels

Type of Equipment	Typical Sound Level at 50 ft. (dBA Leq.)
Dump Truck	88
Portable Air Compressor	81
Concrete Mixer (Truck)	85
Jackhammer	88
Scraper	88
Bulldozer	87
Paver	89
Generator	76
Piledriver	101
Rock Drill	98
Pump	76
Pneumatic Tools	85
Backhoe	85

Adapted from - Route 101A Widening and Improvements, City of Nashua Hillsborough County, New Hampshire; McFarland-Johnson, Inc. May 30, 2007

Recommended Mitigation

i. Use equipment that has low noise emissions as stated by the manufacturers.
ii. Use equipment that is properly fitted with noise reduction devices such as mufflers.
iii. Operate noise-generating equipment during regular working hours (e.g., 7 am – 7 pm) to reduce the potential of creating a noise nuisance during the night.
iv. Phase the use of noise generating equipment near the eastern boundary (near neighbours)
v. Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.

7.2.1.3 Air Quality

Site preparation comprises various activities such as excavation and land clearing (digging, loading and removal of material by trucks), as well as the storage of raw materials (for example sand and marl) that may potentially have a two-fold direct negative impact on air quality. The first impact is air pollution generated from the construction equipment and transportation of materials. The second is fugitive dust from the proposed construction areas and raw materials stored on or transported to site (potential for materials to become airborne). Fugitive dust has the potential to affect the health of construction workers, the resident population and the vegetation.

Recommended Mitigation

i. Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.
ii. Minimize cleared areas to those that are needed to be used.
iii. Cover or wet construction materials such as marl to prevent a dust nuisance.
iv. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.
v. Ensure material stockpiles and construction debris are stored away from the roadway
vi. Consultation with Stakeholders to inform them of the work schedule and activities and to get their feedback.
vii. Use of properly serviced and maintained equipment to reduce air emissions.

7.2.1.4 Vibration

Various governmental agencies have criteria regarding architectural and structural damage, as well as annoyance and acceptability of vibration. In general, most of the criteria specify that for a Peak Particle Velocity (PPV) less than approximately 3.048 mms^{-1} (0.12 inches per second), the potential for architectural damage due to vibration is unlikely. A PPV of approximately 3.048 mms^{-1} (0.12 inches per second) to 12.7 mms^{-1} (0.50 inches per second) there is potential for architectural damage due to vibration, and for a PPV greater than approximately 12.7 mms^{-1} (0.50 inches per second) the potential for architectural damage due to vibration is very likely.

Vibrations from various types of equipment have been measured by the Federal Transit Administration (FTA) in the United States. The data in Table 7-7 provides a reasonable estimate for a wide range of soil conditions and were obtained from measurements on several projects including the Central Artery/Tunnel Project in Boston and from several published sources including the FTA Manual and Dowding's Textbook. To predict the vibration at a receptor from the operation of the equipment listed in Table 7-7, the following equation is used:

$$\mathbf{PPV_{equipment} = PPV_{ref}\ (100/D_{rec})^{n}}$$

Where:

PPV_{ref} = reference PPV at 100 ft.
D_{rec} = distance from equipment to the receiver in ft.
n = 1.1 (the value related to the attenuation rate through ground)

Table 7-7 Equipment Vibration Emission Levels

Equipment Description	Vibration Type Steady or transient	Ref PPV at 100 ft.
Auger Drill Rig	Steady	0.011125
Backhoe	Steady	0.011
Bar Bender	Steady	N/A
Boring Jack Power Unit	Steady	N/A
Chain Saw	Steady	N/A
Compactor	Steady	0.03
Compressor	Steady	N/A
Concrete Mixer	Steady	0.01
Concrete Pump	Steady	0.01
Concrete Saw	Steady	N/A
Crane	Steady	0.001
Dozer	Steady	0.011
Dump Truck	Steady	0.01
Excavator	Steady	0.011
Flat Bed Truck	Steady	0.01
Front End Loader	Steady	0.011
Generator	Steady	N/A
Gradall	Steady	0.011
Grader	Steady	0.011
Horizontal Boring Hydraulic Jack	Steady	0.003
Hydra Break Ram	Transient	0.05
Impact Pile Driver	Transient	0.2
Insitu Soil Sampling Rig	Steady	0.011125
Jackhammer	Steady	0.003
Mounted Hammer hoe ram	Transient	0.18975
Paver	Steady	0.01
Pickup Truck	Steady	0.01
Pneumatic Tools	Steady	N/A
Scraper	Steady	0.000375
Slurry Trenching Machine	Steady	0.002125
Soil Mix Drill Rig	Steady	0.011125
Tractor	Steady	0.01
Tunnel Boring Machine (rock)	Steady	0.0058
Tunnel Boring Machine (soil)	Steady	0.003
Vibratory Pile Driver	Steady	0.14
Vibratory Roller (large)	Steady	0.059
Vibratory Roller (small)	Steady	0.022
Welder	Steady	N/A
Concrete Batch Plant	Steady	N/A
Pumps	Steady	N/A
Blasting	Transient	0.75
Clam Shovel	Transient	0.02525
Rock Drill	Steady	0.011125
3-ton truck at 35 mph	Steady	0.0002

Construction activities can result in various degrees of ground vibration; this is dependent on the type of equipment used and the methodologies employed. Vibration has the potential to interfere with persons normal routines/activities. This can become more acute if the surrounding community has no understanding of the extent and duration of the construction. This can lead to misunderstandings if the contractor is insensitive although they may believe they are in compliance with the required conditions/ordinances.

The closest receptors to the proposed development are: Residential units/villas located at the southern-most boundary and; Unfinished residential housing located at the western-most boundary of the project area.

The vibration impact was predicted on these structures with the use of ten (10) primary pieces of construction equipment/activities. Construction vibration impact readings are displayed in Table 7-8.

Results show that persons occupying the Residential units/villas located at the southern-most boundary located 12 m away would be annoyed from continuous vibrations from the majority of the construction activities/equipment. However, the vibratory pile driver and the vibratory roller have the highest vibration emission of all the equipment listed. Vibration from this equipment is considered unacceptable for people exposed to it continuously (see

Table 7-9 for descriptive effects for different levels of vibration). From a building standpoint, there is no effect from vibration emissions from most of the construction equipment, however the vibratory roller and pile driver both have the potential to cause damage to weak or sensitive structures.

Persons occupying the unfinished residential housing located at the western-most boundary of the project area located 16 m away, similar to the previous scenario, would be annoyed from continuous vibrations from the majority of the construction activities/equipment. However, the vibratory pile driver and the vibratory roller have the highest vibration emission of all the equipment listed. Vibration from this equipment is considered unacceptable for people exposed to it continuously. From a building standpoint, there is no effect from vibration emissions from the majority of the construction equipment, however the vibratory roller and pile driver both have the potential to cause damage to weak or sensitive structures.

Table 7-8 Predicted vibration levels at closest receptors in PPV mm/sec

	RECEPTOR VIBRATION (PPV mm/sec)	
CONSTRUCTION EQUIPMENT	Residential units/villas located at the southern-most boundary (12 m)	Unfinished residential housing located at the western-most boundary (16 m)
Pile Driver (Vibratory)	9.85	7.18
Vibratory Roller	4.15	3.03
Bulldozer	0.77	0.56
Excavator	0.77	0.56
Jack Hammer	0.21	0.15
Backhoe	0.77	0.56
Loaded Dump Truck	0.70	0.51
Frontend Loader	0.77	0.56
Grader	0.77	0.56
Paver	0.70	0.51

The effects of construction vibration (both on humans and buildings) is summarized in

Table 7-9.

Table 7-9 Effects of Construction Vibration

PEAK PARTICLE VELOCITY (mm/sec)	EFFECTS ON HUMANS	EFFECTS ON BUILDINGS
< 0.127	Imperceptible	No effect on buildings
0.127 – 0.381	Barely perceptible	No effect on buildings
0.508 – 1.27	Level at which continuous vibrations begin to annoy in buildings	No effect on buildings
2.54 – 12.7	Vibrations considered unacceptable for people exposed to continuous or long-term vibration.	Minimal potential for damage to weak or sensitive structures
12.7 – 25.4	Vibrations considered bothersome by most people, however tolerable if short-term in length	Threshold at which there is a risk of architectural damage to buildings with plastered ceilings and walls. Some risk to ancient monuments and ruins.
25.4 – 50.8	Vibrations considered unpleasant by most people	U.S. Bureau of Mines data indicates that blasting vibration in this range will not harm most buildings. Most construction vibration limits are in this range.
>76.2	Vibration is unpleasant	Potential for architectural damage and possible minor structural damage

Recommended Mitigation

i. Sequence of operations:
   - Phase earth-moving and ground-impacting operations so as not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately.
   - Avoid night-time activities. People are more aware of vibration during the night-time hours.

ii. Avoid impact pile driving where possible in vibration-sensitive areas. Drilled piles or vibratory pile driving causes lower vibration.

iii. Have regular meetings or devise a communication strategy to inform the surrounding residents and businesses of construction activities.

7.2.2 Biological

7.2.2.1 Grasslands and Coastal Habitat

This community is disturbed and modified, as a result the impacts of habitat and species loss is expected to be minimal. *Roystonea princeps*, is classified as Near Threatened on the IUCN Red List for Threatened Species and therefore requires conservation.

Mitigation

Plants should be preserved and utilized as part of the Landscape Plan or relocated to a suitable area prior to any site clearance or construction activities.

7.2.2.2 Mangrove Community

Based on latest development plan footprint, mangroves near the Q10 sample site are likely to be reclaimed (based on their location) for maximizing the development space. The proposed project will impact an area of 2,098 m^2 and thus potentially displace 671 dwarf mangrove trees and seedlings (*impacted area x mean tree density*). These trees are dwarfed, sparse, young to middle aged and have not attained the expected or significant height or other ecological parameters, nor have the roots been able to extend. These mangroves are not likely to have any significant carbon deposits or rich soil organics due to the low productivity of the trees. The loss of storage carbon and sequestration is expected to be minimal.

Mitigation

- Mangrove rehabilitation of the 671 impacted trees and seedlings will be conducted on the project property. This will be incorporated as part of the Landscape Plan.
- An application for a wetland modification permit will be submitted to NEPA.
- Water from the roadway will naturally move northeast towards the southern “wetland” area, so development plans should consider this as a key drainage point.
- The cluster of mangroves (Q9) on the south-eastern end should be retained if possible and shoreline revetment plans incorporate them into the design. They are ideal for erosion control and privacy and can be expanded with proper planning and designing.
- Dwarfed mangroves near Q 13 and 14 should be conserved if possible. These are located outside of the development footprint.

7.2.2.3 Rocky Shore

Site preparation and construction activities may result in the habitat and species loss. The impact is expected to be minimal.

No recommended mitigation.

7.2.2.4 Sea Turtles

Site preparation and construction activities may result in the temporary displacement of any sea turtles that utilize the general area for nesting. Displacement may occur as a result of barriers and equipment being utilized, this may prevent/limit access to various habitats and pathways (fragmentation).

Nesting turtles maybe particularly sensitive to varying and increased noise (Wendy E.D Piniak, 2016). Studies carried show that turtle have auditory cues however the impact of noise on their ecology is not fully known. Lighting used during any night-time construction activities has the potential to interfere with nesting and navigation of some species.

Vibration can potentially affect sea turtle eggs in a few ways. Sea turtle eggs are sensitive to external disturbances, including vibrations, and excessive disturbance can cause damage to the developing embryos or even lead to their death.

One way that vibration can affect sea turtle eggs is by altering the temperature and moisture levels of the sand surrounding the eggs. Vibrations from heavy machinery or nearby construction can cause the sand to compact, which can reduce airflow and make it more difficult for the eggs to receive oxygen. This can increase the temperature and humidity levels within the nest, potentially leading to developmental abnormalities or death of the embryos.

Vibration can also disrupt the orientation of the eggs within the nest. Sea turtles lay their eggs in a carefully constructed nest, with the eggs positioned in a specific way to ensure proper development. Vibrations can cause the eggs to shift position or even become dislodged from the nest, which can also lead to developmental abnormalities or death of the embryos. Relocation was suggested as vibrations from site works have the potential to cause egg mortality

Finally, vibrations can also affect the behaviour of sea turtle hatchlings as they emerge from the nest. Emerging hatchlings typically use the vibrations of the sand to orient themselves and find their way to the ocean. If the sand is overly compacted due to vibrations, hatchlings may have difficulty navigating their way to the ocean, increasing their vulnerability to predators or other threats.

Overall, excessive vibrations can have negative effects on sea turtle eggs and hatchlings, potentially leading to developmental abnormalities, death, or other adverse outcomes. It is important to minimize disturbances in sea turtle nesting areas to ensure the survival and success of these vulnerable animals.

(Saba, 2007) found that vibration caused changes in the temperature and moisture levels of the sand surrounding the eggs, which in turn led to developmental abnormalities and reduced hatching success.

(Gray, 2014)found that increased vibration led to changes in temperature and oxygen levels in the nest, which affected embryonic development and reduced hatching success.

(Coyne, 2007), found that beach nourishment resulted in increased levels of vibration and compaction in the sand, which reduced hatching success and led to a higher proportion of deformed hatchlings.

Recommended Mitigation

i. Attempts should be made to schedule the majority of the construction period outside of turtle nesting season (May – October).
ii. All staff and workers should be sensitized to the sensitive ecosystems and species in the area, in particular turtles. The site should be inspected daily for any signs of turtle activity. If a nest is suspected or found;
    a. The nest should cordoned off and remain undisturbed until it is hatched in approximately 60 days.
    b. All activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs if the nest is located in a highly vulnerable area.
iii. The stakeholders, proponents and the NEPA should develop clear lines of reporting and communication in the event that action needs to be taken.

iv. Silt screens should be used to prevent sedimentation but should be removed promptly along with any other construction debris and material upon completion.
v. Night-time activities should be limited or avoided when possible. No lights should be pointed out to sea which may cause confusion and disorientation of turtles or any other species that maybe affected by lunar activity.
vi. Fixtures in direct line-of-sight from the beach should be shielded down-light only fixtures or recessed fixtures having low wattage "bug" type bulbs and non-reflective interior surfaces.
vii. Fixtures mounted as low in elevation as possible through use of low-mounted wall fixtures, low bollards and ground level fixtures.
viii. Floodlights, up-lights or spotlights for decorative and accent purposes that are directly visible from the beach, or which indirectly or cumulatively illuminate the beach shall not be used.
ix. For high intensity lighting applications such as providing security and similar applications shielded low-pressure sodium vapour lamps and fixtures shall be used.

7.2.3 Natural Hazards

7.2.3.1 Liquefaction and Geotechnical

Liquefaction potential of the subsurface soils was estimated using the N values of the soil samples obtained in the borings and the measured content of fines. Based on the calculations, layers of silty sand and silty gravel were found, with the potential of liquefaction in all borings at depths between 1.5 m – 15.2m (5 - 50 ft). The soil profile uncovered by the borings indicates the presence of a weak cementation, high void ratio and fragmented coral reef in all of the test boring locations.

Mitigation

The supporting of the structures using deep foundations is recommended. These piles should penetrate up to 23.5 meters deep and achieve a satisfactory skin friction capacity. For this project, end bearing capacity is not emphasized due to the heterogeneous nature of the soil formation where cavities and voids can be found at final depths.

Auger cast in place piles of 40 and 60 cm diameter drilled down to 23.5 m depth are proposed. Piles shall have a minimum separation of three (3) diameter between centres. For the allowable axial and lateral capacities, please see Table 7-10. Contour maps with the allowable axial capacities for the 40 cm and 60 cm piles diameter are presented in Figure 7-1 and Figure 7-2.

Detailed information on allowable axial and lateral loads for auger cast in place piles can be found in the full Geotechnical Report (Horizon Construction Jamaica Ltd., 2022).

Table 7-10 Recommended Axial and Lateral Loads for CFA Piles

Boring No.	Dia. [m]	Depth [m]	Allowable Axial [ton]	Allowable Lateral [ton]	Reinforcement GR 60
BH01	0.40	23.5	140		
BH01	0.60	23.5	220		
BH02	0.40	23.5	130		
BH02	0.60	23.5	200		
BH04	0.40	23.5	130		
BH04	0.60	23.5	200		
BH07	0.40	23.5	105	6.5	6 No. 6 Rebars
BH07	0.60	23.5	160	12.0	12 No. 6 Rebars
BH08	0.40	23.5	145		
BH08	0.60	23.5	220		
BH11	0.40	23.5	125		
BH11	0.60	23.5	195		
BH25	0.40	23.5	115		
BH25	0.60	23.5	185		
BH29	0.40	23.5	105	6.5	6 No. 6 Rebars
BH29	0.60	23.5	160	12.0	12 No. 6 Rebars
BH41	0.40	23.5	145		
BH41	0.60	23.5	225		
BH45	0.40	23.5	130		
BH45	0.60	23.5	200		

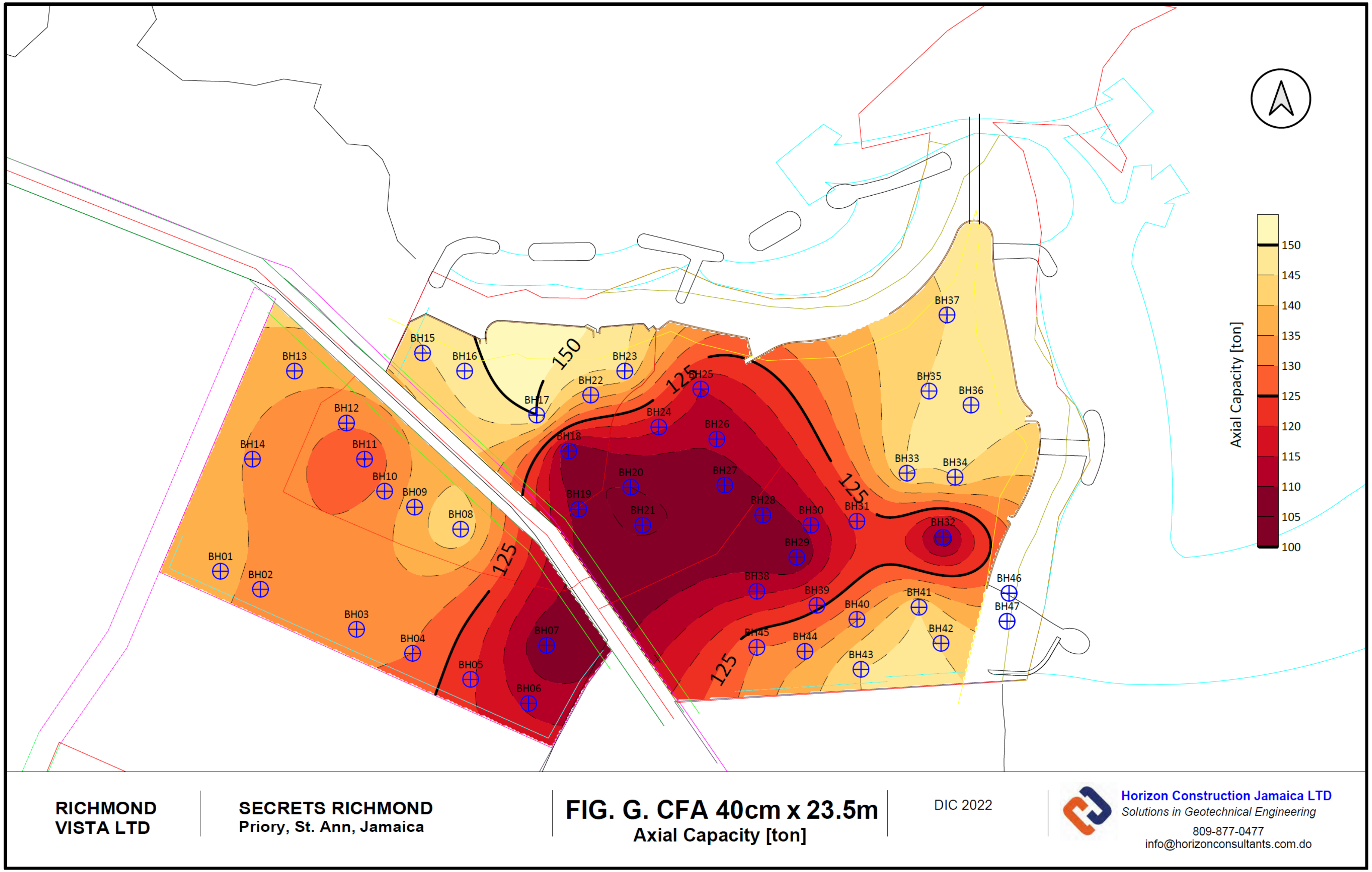


Figure 7-1 Contour maps with the allowable axial capacities for the 40 cm piles diameter

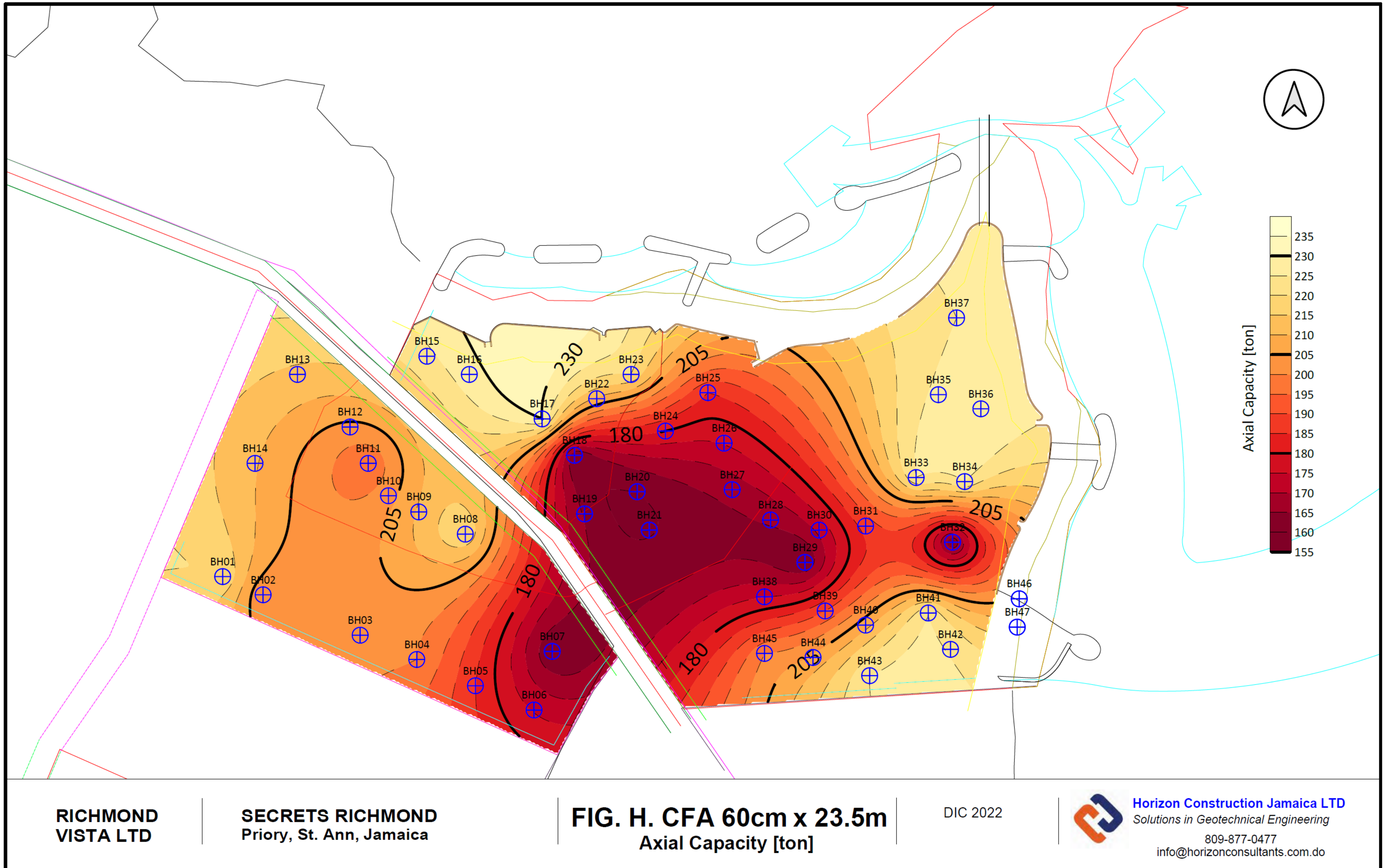


Figure 7-2 Contour maps with the allowable axial capacities for the 60 cm piles diameter

Fluid mortar shall be pumped using the "tremie" methodology through the augers, filling the hole from the tip as the augers are withdrawn. The tip of the auger shall be at all times submerged into the fresh mortar during the pumping process. The drill rig must be equipped with instrumentation to continuously record the drilling and pumping key variables to ensure the construction of a sound pile. The Continuous Recording System must record the pressure of mortar and the volume injected continuously, and the operator must adjust the rate of withdrawal of the auger to ensure that positive pressure in the mortar is maintained at all times and that the volume injected exceeds the theoretical volume.

Fluid mortar shall have a compressive strength f'c = 280 Kg/cm2, with at least 11-inch slump and maximum aggregate size of 4 mm (sand) with no gravel. It is recommended that Pile Integrity Tests PIT (ASTM D5882) be conducted to a minimum of 25% of the total amount of the production piles and Dynamic Load Tests with PDA (ASTM D4945) to at least 3% of the total of piles. An experienced geotechnical engineer shall supervise the construction of these piles.

7.2.4 Socioeconomic/Cultural

7.2.4.1 Employment

The work force for the site will at peak time be approximately 1,000 trade men and labourers and during construction. This should create approximately 3,800 indirect and induced jobs during construction. This represents a significant level of employment within the study area and has the potential to be a significant positive impact.

It is important to try to source potential workers from nearby communities to strengthen community relations. In addition, diverse sexual orientations and gender identities may have the effect of excluding people from potential employment opportunities which prevents them from taking advantage of the opportunities available to other members of the community.

Mitigation

It is important that the Developer:

- Anticipates and prevent adverse risks and impacts based on gender, sexual orientation, and gender identity, and when avoidance is not possible, to mitigate and compensate for such impacts.
- Achieves inclusion in project-derived benefits of people of all genders, sexual orientations, and gender identities.
- Implement measures to prevent Sexual and Gender Based Violence (SGBV), including sexual harassment, exploitation and abuse; and when incidents of SGBV occur, to respond promptly.

7.2.4.2 Solid Waste Generation and Disposal

During this construction phase of the proposed project, solid waste generation may occur mainly from general construction activities including site clearance and excavation.

The USEPA estimates from surveys of non-residential construction that the average rate of solid waste generation is 22.95 Kg/square metre (or 1.6 to 8.5 lb/ft^2 (5.05 lb/ft^2))[6]. With an estimated 81,544.15 m^2 (877,733.93 ft^2) of building floor area, then the estimated construction solid waste is 2,010.57 tonnes. Figure 7-3 and Table 7-11 shows the typical breakdown of this waste.

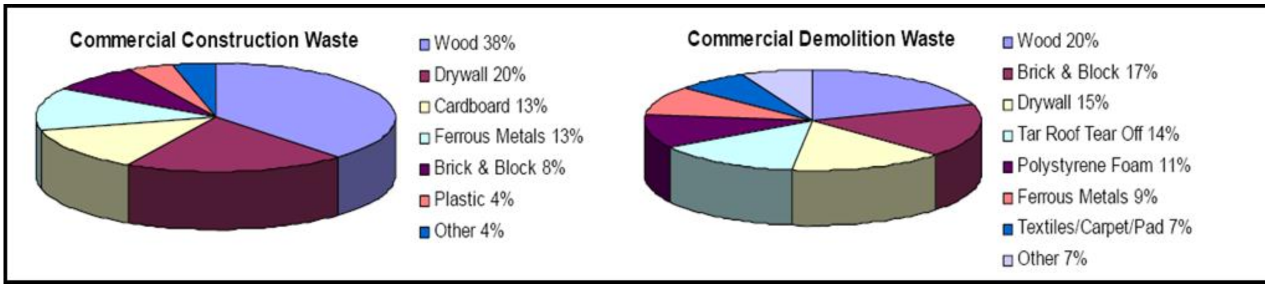


Figure 7-3 Composition of construction and demolition waste [7]

Table 7-11 Estimated construction solid waste generation

BUILDING SIZE		**877,733.93 ft2**	**877,733.93 ft2**		
GENERATION RATE		**LOW 1.6 lb/ft^2**	**HIGH 8.5 lb/ft^2**		
MATERIAL	**COMPOSITION (%)**	**LBS**	**LBS**	**LOW TONNES**	**HIGH TONNES**
Wood	38	533,662.23	2,835,080.59	242.065	1285.97
Drywall	20	280,874.86	1,492,147.68	127.403	676.8263
Cardboard	13	182,568.66	969,895.99	82.8117	439.9371
Ferrous	13	182,568.66	969,895.99	82.8117	439.9371
Brick/Block	8	112,349.94	596,859.07	50.961	270.7305
Plastic	4	56,174.97	298,429.54	25.4805	135.3653
Other	4	56,174.97	298,429.54	25.4805	135.3653
TOTAL	100	1,404,374.29	7,460,738.41	637.013	3384.131
AVERAGE		4,432,556.35		**2,010.57**	

Recommended Mitigation

i. A Solid Waste Management Plan will be done and is to be approved by the National Environment and Planning Agency (NEPA) and the National Solid Waste Management Authority (NSWMA).

[6] Estimating 2003 Building Construction and Demolition Material, USEPA

[7] "Construction and Demolition Waste Management Toolkit," WasteCap Wisconsin, June 2005

ii. Skips and bins should be strategically placed within the campsite and construction site.
iii. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour.
iv. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling.
v. Disposal of the contents of the skips and bins should be done at an approved disposal site
vi. A ticketing system will be developed between both the Permittee and the Solid Waste Contractor to ensure effective management of waste and verification of disposal at the correct site.

7.2.4.3 Wastewater Generation and Disposal

With every construction site comes the need to provide construction workers with sanitary conveniences. Portable toilets and the disposal of same have the potential to contaminate the marine environment in the event of accidental spillage.

Mitigation

i. Provision and maintenance of portable sanitary conveniences for the construction workers for control of sewage waste by a licenced contractor. A ratio of approximately 25 workers per chemical toilet should be used.
ii. Portable toilets should be located approximately 25 metres from the high water mark, away from the shoreline to avoid discharge into the marine environment in the event of accidental spillage.

7.2.4.4 Vending and Food Hygiene

The establishment of a construction site may cause a proliferation of “cook shops” (food vendors) to provide the construction workers with meals. Improper food preparation and the failure to practice proper hygiene can result in certain pathogens entering the food supply and cause food borne illness. Food borne illness often presents itself as flu likes symptoms such as nausea, vomiting, diarrhoea or fever. This will also have a negative visual effect on the proposed construction site.

Mitigation

i. Provision of adequate supply of potable water.
ii. The monitoring of the various “cook shops” by public health authorities and the construction management team, to ensure proper hygiene is being followed.
iii. The provision of areas to adequately wash hands and utensils.
iv. Support the St Ann Municipal Corporation to ensure an orderly layout of vending areas.

7.2.4.5 Traffic

Traffic Volumes

During the construction phase, it was estimated that the project would result in approximately 25 trips during the AM peak hour, with 20% of them being within the Heavy Vehicle (HV) category. The trips were then distributed using a 2%, 41%, 9%, and 49% distribution between the Infirmary Road (North), Northeast (Laughlands), South (Bamboo Main Road) and Southwest (St. Ann's Bay) respectively. Analysis of the Construction Phase conditions took into account the scenarios of including a signalized intersection at the proposed main entrance of the site. The use of the existing service entrance was considered to alleviate some of the expected impact on the Main Road intersection. The ratio used between these roads was 8:2 between proposed main intersection and existing intersection respectively.

Proposed Main Entrance (Unsignalized)

Analysis of the during construction phase at the proposed main intersection by the Shazz Service Station, with the insertion of an unsignalized intersection, revealed an increase in delays to traffic moving in all directions. Motorists travelling along the main road experience a delay of up to 25.4 seconds. By introducing this intersection, the Level of Service has been generally decreased, but retains reasonable level of delays experienced by motorists (Figure 7-4, Table 7-12).

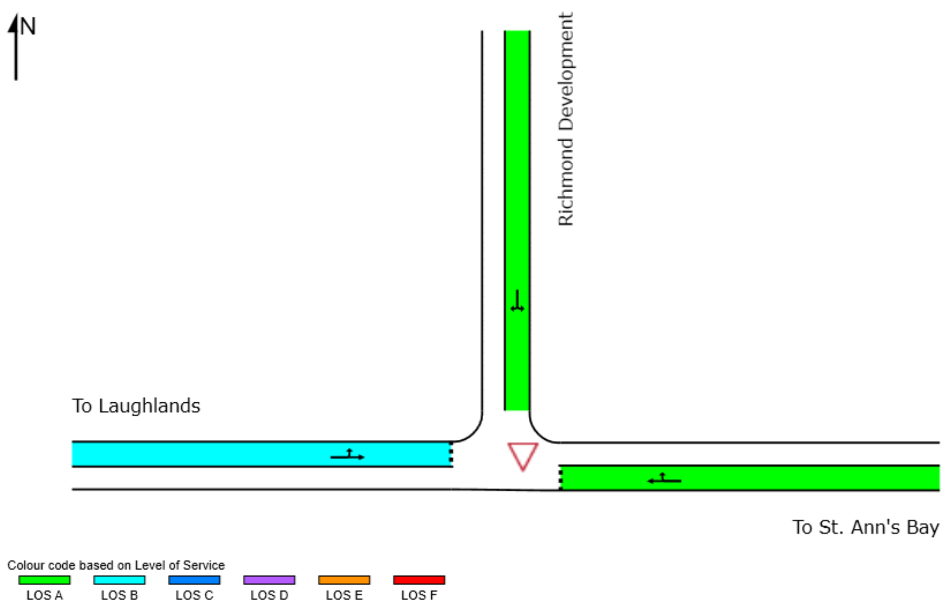


Figure 7-4 Showing the Level of Service of the unsignalized proposed intersection

Table 7-12 Showing the movement performance at the proposed intersection for the AM peak Hour during the Construction scenario (unsignalized)

Movement Performance - Vehicles												
Mov	Turn	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Aver. No.	Average
ID		Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Cycles	Speed
		veh/h	%	v/c	sec		veh	m				km/h
East: To St. Ann's Bay												
5	T1	723	13	0.55	4.3	LOS A	3.6	28.2	0.05	0.51	0.05	54.8
6	R2	10	20	0.55	25.4	LOS D	3.6	28.2	0.05	0.51	0.05	53
Approach		733	13	0.55	4.6	LOS A	3.6	28.2	0.05	0.51	0.05	54.8
North: Richmond Development												
7	L2	4	50	0.01	6.1	LOS A	0	0	0	0.59	0	51.6
9	R2	4	50	0.01	6.1	LOS A	0	0	0	0.59	0	51.9
Approach		8	50	0.01	6.1	NA	0	0	0	0.59	0	51.7
West: To Laughlands												
10	L2	10	20	0.82	10	LOS A	13	96.3	0.79	1.27	1.8	49.4
11	T1	816	7	0.82	12.2	LOS B	13	96.3	0.79	1.27	1.8	50
Approach		826	7.1	0.82	12.1	LOS B	13	96.3	0.79	1.27	1.8	50
All Vehicles		1567	10	0.82	8.6	NA	13	96.3	0.44	0.91	0.97	52.1

Proposed Main Entrance (Signalized)

Construction trip generation was estimated from both observations and reference to previous studies. Civil works such as filling, and excavation are expected to generate the most significant heavy vehicle traffic. Likewise, workers coming to and going from the site in the morning and evening sessions are also expected to generate significant traffic. A review of previous studies is summarized in the table below. Based on experience with construction of similarly sized resorts, it was assumed that the number of deliveries that will be made during the peak hour is five (5), five (5) entering and five (5) leaving. This will be controlled by the construction team who will coordinate the deliveries mostly to off peak hours to minimize the impact on traffic and safety. The estimated values for light class motor vehicles are 20 arriving in the morning peak, 4 leaving and the same arriving in the midday peak and 25 leaving in the evening peak.

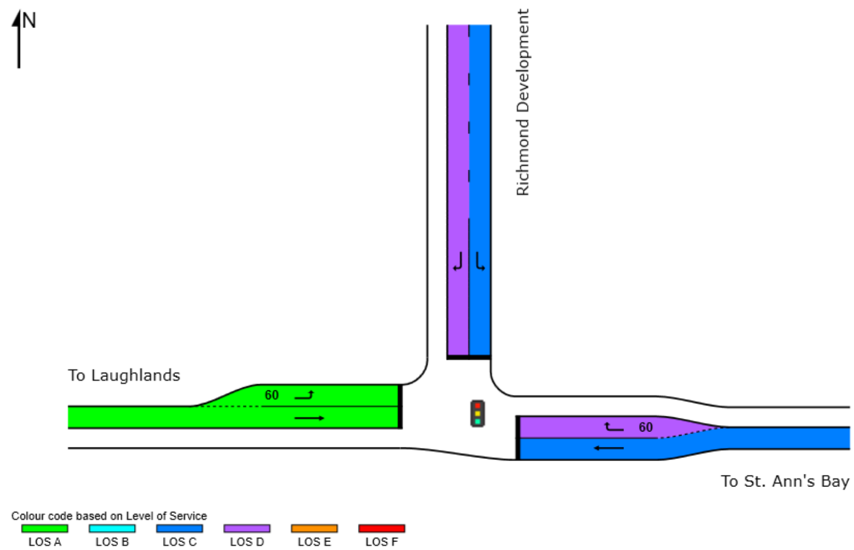


Figure 7-5 Showing Level of Service of proposed signalized intersection (Shazz Service Station)

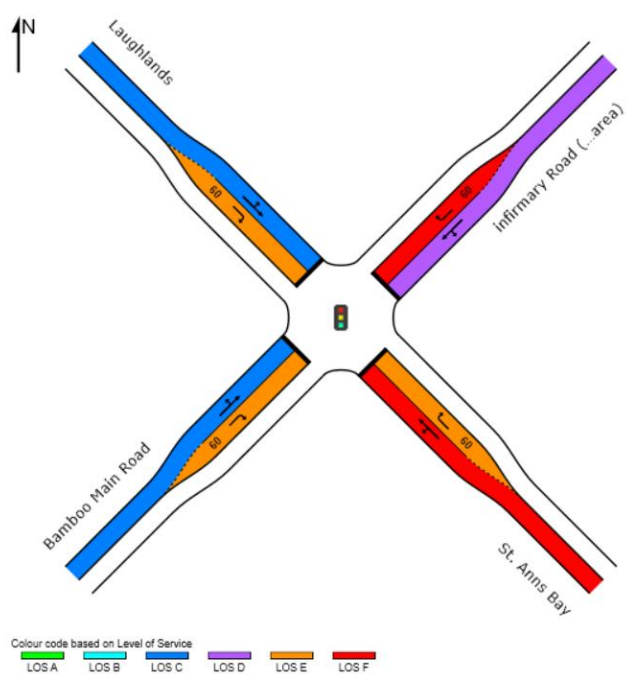


Figure 7-6 Showing Level of Service of existing Bamboo/A1 Highway intersection

Table 7-13 Showing the movement performance at the proposed Richmond Intersection for the AM peak Hour during the Construction scenario (signalized)

Mov ID	Turn	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
East: To St. Ann's Bay												
5	T1	723	13.1	0.873	24.4	LOS C	27.6	215.2	0.95	0.89	0.98	44.3
6	R2	10	20.0	0.084	47.7	LOS D	0.4	3.3	0.94	0.67	0.94	34.7
Approach		733	13.2	0.873	24.7	LOS C	27.6	215.2	0.95	0.88	0.98	44.2
North: Richmond Development												
7	L2	4	50.0	0.020	24.0	LOS C	0.1	0.8	0.86	0.63	0.86	42.8
9	R2	4	50.0	0.040	47.9	LOS D	0.2	1.6	0.93	0.64	0.93	32.3
Approach		8	50.0	0.040	35.9	LOS D	0.2	1.6	0.90	0.64	0.90	37.2
West: To Laughlands												
10	L2	10	20.0	0.008	7.9	LOS A	0.1	0.7	0.22	0.60	0.22	51.2
11	T1	816	7.0	0.761	7.9	LOS A	13.0	96.4	0.81	0.73	0.81	53.9
Approach		826	7.1	0.761	7.9	LOS A	13.0	96.4	0.80	0.72	0.80	53.8
All Vehicles		1567	10.2	0.873	15.9	LOS B	27.6	215.2	0.87	0.80	0.89	48.7

Table 7-14 Showing the movement performance at the Bamboo/Laughlands Intersection for the AM peak Hour during the Construction scenario (signalized)

Mov ID	Turn	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
SouthEast: St. Anns Bay												
21	L2	98	3.1	1.021	110.5	LOS F	79.1	610.7	1.00	1.34	1.58	18.1
22	T1	723	13.1	1.021	105.9	LOS F	79.1	610.7	1.00	1.34	1.58	19.7
23	R2	16	6.3	0.072	68.9	LOS E	1.0	7.7	0.89	0.69	0.89	25.5
Approach		837	11.8	1.021	105.7	LOS F	79.1	610.7	1.00	1.32	1.56	19.6
NorthEast: infirmary Road (to project area)												
24	L2	18	5.6	0.076	41.0	LOS D	0.8	6.1	0.87	0.69	0.87	35.3
25	T1	1	0.0	0.076	35.4	LOS D	0.8	6.1	0.87	0.69	0.87	36.0
26	R2	4	25.0	0.063	86.1	LOS F	0.3	2.5	0.97	0.64	0.97	26.2
Approach		23	8.7	0.076	48.6	LOS D	0.8	6.1	0.89	0.68	0.89	33.1
NorthWest: Laughlands												
27	L2	4	25.0	0.870	37.5	LOS D	35.7	265.2	0.94	0.98	1.11	39.7
28	T1	806	7.1	0.870	31.6	LOS C	35.7	265.2	0.94	0.98	1.11	41.2
29	R2	3	0.0	0.009	61.2	LOS E	0.2	1.3	0.83	0.63	0.83	31.4
Approach		813	7.1	0.870	31.8	LOS C	35.7	265.2	0.93	0.98	1.11	41.1
SouthWest: Bamboo Main Road												
30	L2	32	18.8	0.072	31.6	LOS C	1.3	10.2	0.74	0.70	0.74	40.3
31	T1	1	0.0	0.072	25.8	LOS C	1.3	10.2	0.74	0.70	0.74	39.7
32	R2	201	4.0	0.835	78.0	LOS E	14.7	106.3	1.00	0.83	1.00	25.9
Approach		234	6.0	0.835	71.5	LOS E	14.7	106.3	0.96	0.81	0.96	27.4

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
All Vehicles		1907	9.1	1.021	69.3	LOS E	79.1	610.7	0.97	1.10	1.29	26.7

Proposed Main Entrance (Signalized with Lane Improvement)

Another scenario considered was the main road with improvements, namely an additional lane to allow for higher volume of traffic movement. In this scenario, the increase in the number of lanes results in improvements experienced by motorists using the intersection due to higher volume of traffic flow when comparing to the effects if the number of lanes remain as they presently exist. The average delay is improved as the maximum delay is 32 seconds experienced by motorists turning into the development, compared to 48 seconds without road corridor improvement (Figure 7-7, Table 7-15).

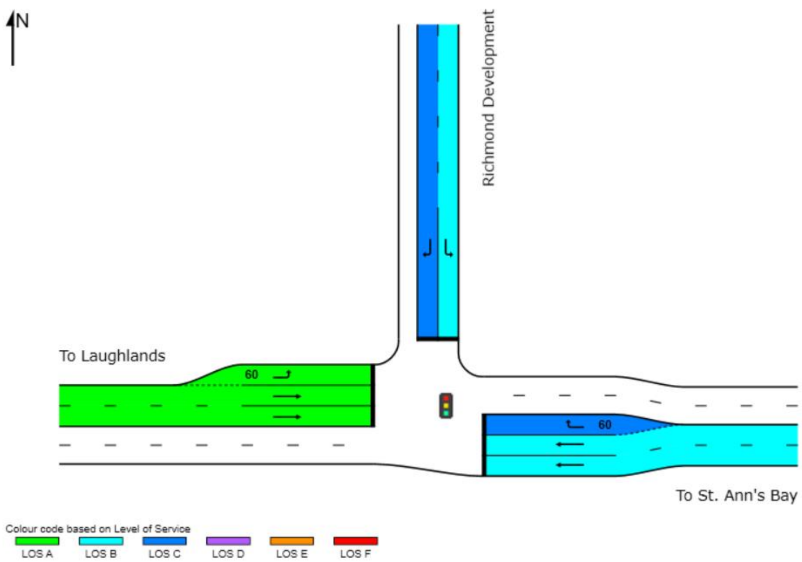


Figure 7-7 Showing Level of Service of proposed signalized intersection (Shazz Service Station) w/Lane Improvements

Table 7-15 Showing the movement performance at the Bamboo/Laughlands Intersection for the AM peak Hour during the Construction scenario (signalized) w/ Lane Improvements

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
East: To St. Ann's Bay												
5	T1	723	13.1	0.504	14.8	LOS B	7.7	59.6	0.79	0.67	0.79	49.5
6	R2	10	20.0	0.057	32.0	LOS C	0.3	2.1	0.90	0.67	0.90	40.1
Approach		733	13.2	0.504	15.0	LOS B	7.7	59.6	0.79	0.67	0.79	49.3

North: Richmond Development												
7	L2	4	50.0	0.013	16.2	LOS B	0.0	0.5	0.79	0.63	0.79	46.5
9	R2	4	50.0	0.027	32.2	LOS C	0.1	1.0	0.90	0.64	0.90	37.8
Approach		8	50.0	0.027	24.2	LOS C	0.1	1.0	0.85	0.63	0.85	42.0
West: To Laughlands												
10	L2	10	20.0	0.009	8.9	LOS A	0.1	0.7	0.33	0.61	0.33	50.5
11	T1	816	7.0	0.603	8.8	LOS A	4.9	36.2	0.85	0.72	0.85	53.2
Approach		826	7.1	0.603	8.8	LOS A	4.9	36.2	0.84	0.72	0.84	53.2
All Vehicles		1567	10.2	0.603	11.8	LOS B	7.7	59.6	0.82	0.70	0.82	51.2

Existing Bamboo Intersection

With the insertion of a signalized intersection and the appropriate short lanes for the proposed main entrance, there was an increase in delays when compared to the unsignalized, where delays in the high flow volume directions did not exceed 43.4 seconds. By introducing an additional intersection, it must be noted that the overall time to traverse the segment of roadway to increase dramatically. However, the negative impacts of not having a controlled intersection far exceed the signalized delays (Figure 7-8, Table 7-16).

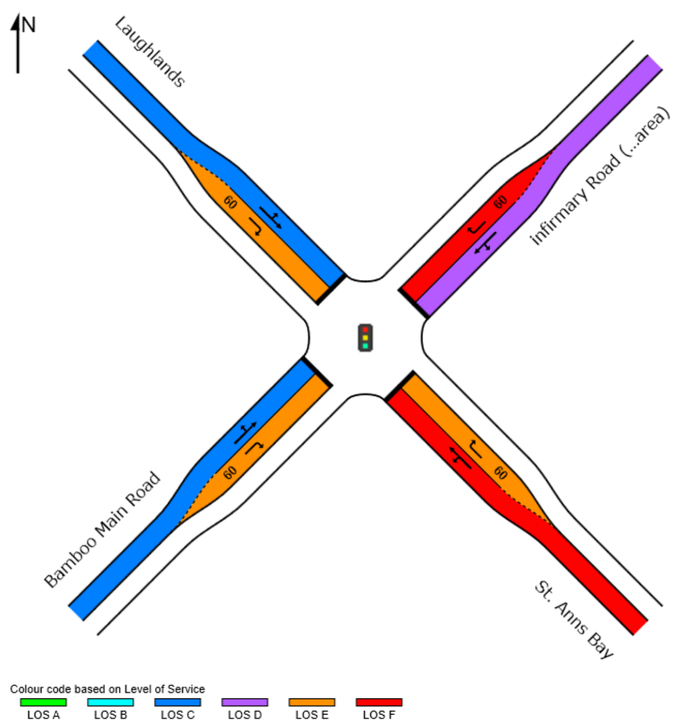


Figure 7-8 Showing Level of Service of existing signalized intersection (Bamboo)

Table 7-16 Showing the movement performance at the proposed intersection for the AM peak Hour during the Construction scenario (signalized)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
East: To St. Ann's Bay												
5	T1	723	13.1	0.873	24.4	LOS C	27.6	215.2	0.95	0.89	0.98	44.3
6	R2	10	20.0	0.084	47.7	LOS D	0.4	3.3	0.94	0.67	0.94	34.7
Approach		733	13.2	0.873	24.7	LOS C	27.6	215.2	0.95	0.88	0.98	44.2
North: Richmond Development												
7	L2	4	50.0	0.020	24.0	LOS C	0.1	0.8	0.86	0.63	0.86	42.8
9	R2	4	50.0	0.040	47.9	LOS D	0.2	1.6	0.93	0.64	0.93	32.3
Approach		8	50.0	0.040	35.9	LOS D	0.2	1.6	0.90	0.64	0.90	37.2
West: To Laughlands												
10	L2	10	20.0	0.008	7.9	LOS A	0.1	0.7	0.22	0.60	0.22	51.2
11	T1	816	7.0	0.761	7.9	LOS A	13.0	96.4	0.81	0.73	0.81	53.9
Approach		826	7.1	0.761	7.9	LOS A	13.0	96.4	0.80	0.72	0.80	53.8
All Vehicles		1567	10.2	0.873	15.9	LOS B	27.6	215.2	0.87	0.80	0.89	48.7

Summary

During the construction phase, the model depicted minimal impact on the flows experienced at the observed intersections compared to the conditions before construction. Delays remained relatively consistent however a few fell to a lower LOS classification. To allow for satisfactory level of performance significant physical alterations in the form of the construction of a signalized intersection and the creation of more would have to be made to accommodate this.

Based in the model, there is a lower impact on the traffic flow to use an unsignalized lane during the construction phase as the addition of this results in significant levels of the delays. However, post construction, this may be deemed a necessary requirement for the safe passage of motor vehicles unto and off the development.

Table 7-17 and Table 7-18 below give the summarized data.

Table 7-17 Summary of Bamboo/Laughlands Intersection Scenarios

Bamboo/ Laughlands	Fr St. Ann's Bay						Fr Infirmary Road						Fr Laughlands						Fr Bamboo Main Road					
Intersection	Left		Straight		Right		Left		Straight		Right		Left		Straight		Right		Left		Straight		Right	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Existing Conditions	160.2	F	155.6	F	69.8	E	40.2	D	34.6	C	83.4	F	30.2	C	24.1	C	55.7	E	30.1	C	24.3	C	77.1	E
Construction Phase	110.5	F	105.9	F	68.9	E	41.0	D	35.4	D	86.1	F	37.5	D	31.6	C	61.2	E	31.6	C	25.8	C	78.0	E

Table 7-18 Summary of Proposed Main Gate Intersection Scenarios

Proposed Main Gate Intersection	Fr St. Ann's Bay				From Hotel Main Gate				Fr Laughlands			
	Straight		Right		Left		Right		Left		Straight	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Construction Phase unsignalized	4.3	A	25.4	D	6.1	A	6.1	A	10.0	A	12.2	B
Construction Phase signalized	24.4	C	47.7	D	24.0	C	47.9	D	7.9	A	7.9	A

Traffic Management

The sequence of construction is expected to include the following activities (amongst others) within its framework:

1. Site Preparation
   a. Hoarding
   b. Clearance/Earthwork
2. Coastal works
3. Installation of Machinery and equipment
4. Buildings
   a. Concrete Works
   b. MEP
   c. Finishing Works etc.
5. Roadworks

As such, it is expected that the development process will generate varying patterns of vehicle flow and movement throughout construction. In some instances, such as site preparation, it can be expected that there will be large volumes of continuous heavy type vehicle traffic to accommodate for earth movement demands amongst other requirements. Similar types of movements can be expected in stages that include concrete transport and the movement of boulders and rubble.

In other instances, the expected impact of high-volume movements is diminished, and concerns are shifted to the accommodation of slow-moving vehicles. This is usually experienced in scenarios that require the use of oversized trucks to move equipment. This type of delivery requires more room for manoeuvring and often includes the usage of multiple lanes and wider turning radii.

Stages such as MEP installations and finishing works that usually run concurrently, generally tend to have high labour and human capital demand. As such it can be expected that higher volumes of light vehicle traffic can be expected, especially in sites where there may be a myriad of sub-contractors working together.

RECOMMENDED MITIGATION

The following mitigation measures will be implemented to minimize traffic:

- To minimize the negative impacts that the construction flows could have on the background traffic, events such as the delivery of materials and equipment can be scheduled during off-peak hours. (Outside the regions of 7:00-9:30 AM and 3:00-6:00 PM).
- Accommodations should be made to allow for prompt entry to the site area, by the implementation of a short lane and a deep enough ingress to prevent queueing from bleeding in main lanes.
- Movements such as oversized truck movements will also need to communicate with the NWA and authorities within the parish for the requisite approval and planning
- Signs should be placed to warn oncoming motorists of the hazards generated by the site such as but not limited to slow-moving vehicles and open trenches.

- Implementation of speed decrease signs or flashing amber signals to prompt road users to slow upon approach to the site entry.

Overweight Vehicles

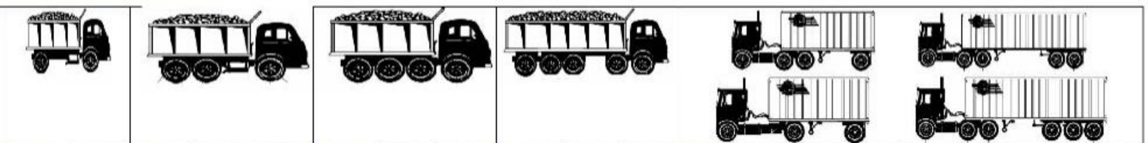
Large units including tankers, and trucks carrying building and operation machine parts will pose challenges because of their sizes and weight.

RECOMMENDED MITIGATION

All trucks are expected to adhere to the National Works Agency standards as per the expected loads per vehicle axle. (Figure 7-9). Special permits will be requested from the NWA as required two weeks in advance.

SPECIAL PERMIT REQUIREMENTS vehicles exceeding Permit Column data can be issued ith a Special Permit once the vehicle does not exceed the relevant column etc

Maximum Allowable



	Permit	MAX Limit	Permit	MAX Limit	MAX Limit	Permit	MAX Limit	MAX Limit	Permit	MAX Limit	MAX Limit	Permit	MAX Limit	MAX Limit	MAX Limit	MAX Limit	MAX Limit	MAX Limit	MAX Limit
Overall Height (m)	3.6	4.15	3.6	4.15	4.15	3.6	4.15	4.15	3.6	4.15	4.15	3.6	4.15	4.15	4.15	4.15	4.15	4.15	4.15
Gross Weight (tons)	12.2	15	12.2	20	25	12.2	30	35	12.2	30	35	12.2	25	30	35	40	45	50	55
Length (m)	9.14	12.8	9.14	12.8	12.8	9.14	12.8	12.8	9.14	12.8	12.8	12.8	17.3	17.3	17.3	17.3	17.3	17.3	17.3
Width (m)	2.44	2.70	2.44	2.70	2.70	2.44	2.75	2.75	2.44	2.75	2.75	2.44	2.75	2.75	2.75	2.75	2.75	2.75	2.75
No. of Axles	2	2	3	3	3	4	4	4	5	5	5	3	3	4	4	5	5	6	6
No. of Tires	6	6	8	8	10	12	12	14	16	16	12	10	10	12	14	16	18	20	22

Please note that

1. Maximum allowable dual tire axle load is **10 tonnes** except super singles/ flotation
2. Maximum allowable single tire axle load is **5 tonnes** except super singles/ flotation
3. maximum allowances **must not exceed manufacturer ratings**, specifications for **vehicles and tires** etc
4. Special permits are required for tucks that exceed one or more of the following criteria:

   a. ***Overall Length of 9.14m (rigid) or 12.8 m (articulated/trailer)***
   b. ***Overall width of 2.44 m,***
   c. ***Gross weight of 12,273 kg,***
   d. ***overhang of 50% of wheelbase,***
   e. ***height of 3.6 m from ground***

Figure 7-9 National Works Agency weight limit requirements for heavy vehicles

7.2.4.6 Health and Safety

Construction activities have the potential for accidental injury, whether major or minor. For example, construction works may entail workers being suspended at heights in the process and this has the potential for increased construction accidents. Fugitive dust has the potential to affect the health of construction workers. This may also include fire safety, safe access routes, clearly defined pedestrian pathways, electrical hazards, eye hazards and radiation hazards. In addition, disasters such as earthquakes, floods and hurricanes are real possibilities.

Recommended Mitigation

i. Ensure that there is an ambulance and requisite staff onsite for any eventualities.
ii. The provision of lifelines, personal safety nets or safety belts and scaffolding for the construction workers (if necessary)
iii. Ensuring that workers wear personal protective equipment (hard hats, reflective vests, safety shoes, eye protection etc.)
iv. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.
v. Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.
vi. There should be onsite first aid kits and arrangement for a local nurse and/or doctor to be on call for the construction site.
vii. Make prior arrangements with staff at the St. Ann’s Bay hospital and/or health centre to accommodate any eventualities. There is a doctor’s office in proximity to the site which could also be explored.
viii. Make prior arrangements with the St. Ann’s Bay police and fire stations (Freeport) to accommodate any eventualities.
ix. Material Safety Data Sheets (MSDS) should be stored onsite.
x. A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers.
xi. Trench Excavation
    - A trench 1.2m or more in depth must have a means of egress (ladders/ stairways/ramps) and should be located at 8m intervals.
    - Excavated materials must be stored 0.6m or more from the open trench (not to be measured from the crown of the spoil).
    - Spoil should be placed so that the channels rainwater and other runoff water away from the excavation.
    - Take precautions regarding Tension Cracks
        - Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench.
        - Sliding or sloughing may occur as a result of tension cracks. [8]
xii. Ensure that construction safety nets (catch nets) are installed that will catch personnel, debris, and small tools
xiii. Designing and implementing an Emergency Response Plan (ERP) in the event of any emergency. This should include:
    - Hurricane

[8] Worker Health and Safety Guidelines as per OSHA #510 Construction Industry Standard 29 CFR Part 1926.

- Earthquake
- Flooding
- Fire
- Civil Unrest and Riots
- Bomb Threats and Acts of Sabotage
- Acts of Terrorism and Armed Attacks
- Petroleum and Hazardous Material Stockpiling
- Security and Safety Information
- Medical Emergency Information
- Technological Emergencies

7.2.4.7 Aesthetics

Construction activities may decrease the aesthetic appeal of the area; however, this will be for a short-term period during construction. In particular, trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing and in the process, affecting the conditions of other vehicles traversing the main road.

Recommended Mitigation

- Good housekeeping activities and adherence to other mitigative measures.
- An area of gravel should be placed on site (just before exiting onto the main road) to help remove mud/marl from truck wheels.
- A wheel wash area on site (just before exiting onto the main road) should be implemented to rid wheels of as much mud/marl as possible.

7.2.4.8 Grievance Mechanisms

Construction activities often causes inconveniences, health risks and can be a source of nuisance to stakeholders (both internal and external) on site and in the general area. Incidences of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination may also occur.

Recommended Mitigation

With the aim of establishing and maintaining a harmonious relationship between the stakeholders (both internal and external) and the Project, a Claims and Complaints Absolution Program will be implemented, whose general objective is to create a system that allows timely response to complaints from residents who are perceived to be affected or harmed by any aspect of the Project. A Grievance Redress Mechanism (GRM) to include reports of allegations of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination will be formulated.

7.2.4.9 Historical Artefacts

As observed to date the property is still in ruinate and very few historical remnants are within the 1-kilometre radius of this site. The possibility exists however that there could be foundations of historical structures or features. It should be noted that the Jamaica National Heritage Trust Sites and Monument Record has shown several prehistoric sites in the vicinity, namely at Llandovery, Cranbrook, Richmond Hill, Southfield, Seville, Drax Hall and Little River. The possibility of a Taíno site on the Richmond Estate cannot be ruled out.

Recommended Mitigation

Care should be taken during construction activities. Any vestiges of cultural material unearthed on should be collected and examined. It should be noted that in case archaeological features are found within the project area, the JNHT will evaluate and record the features and collect any such cultural material found.

7.2.4.10 Fishers and Maritime Interests

Stakeholder consultations conducted revealed that spear fishers would take public transportation from St. Ann's Bay to Priory and walk through the proposed project area and swim from the beach to go fishing. In addition, spear fishers, on returning from sea, would walk through the proposed project site toward the Priory Main Road to get public transportation to return to St. Ann's Bay.

While some boat fishers may not use the proposed area regularly, the area is used as a channel in times of emergency and inclement weather.

Recommended Mitigation

- Coordinate with the Tourism Enhancement Fund and the National Fisheries Authority to ensure that the proposed upgrading to the official fishing beach at Priory have the requisite infrastructure to accommodate the displaced fishers.

7.3 OPERATION - HOTEL

7.3.1 Physical

7.3.1.1 Drainage and Stormwater

The impacts of storm water generated by the property and from the wider catchment area discharging into the sea, at three (3) locations was analysed. As previously discussed, the design intent is to have the generated stormwater from the wider catchment being collected by a covered "U" channel along the southern boundary and discharge into the sea. While runoff generated from within the site boundary flow into several infiltration wells across the site. During extreme events where the wells may not sufficiently manage the flows, overflow pipes were designed to take any excess flow and discharges into the sea. We modelled a scenario that assumed the wells do not function properly, and that storm water flows into the sea directly, along with the flows from the wider catchment. The goal is to determine how long it takes for fresh water to mix with seawater so that the effects of fresh water on the ecosystem are kept to a minimum. Figure 7-10 shows the location of the three (3) outfalls, and the numerical modelling assumptions were as follows.

1. The model was run with tides only (i.e., no wind or wave inputs, which would increase the mixing of the fresh water with sea water).
2. The model ran for a simulation day to reach steady state before the freshwater flow began.

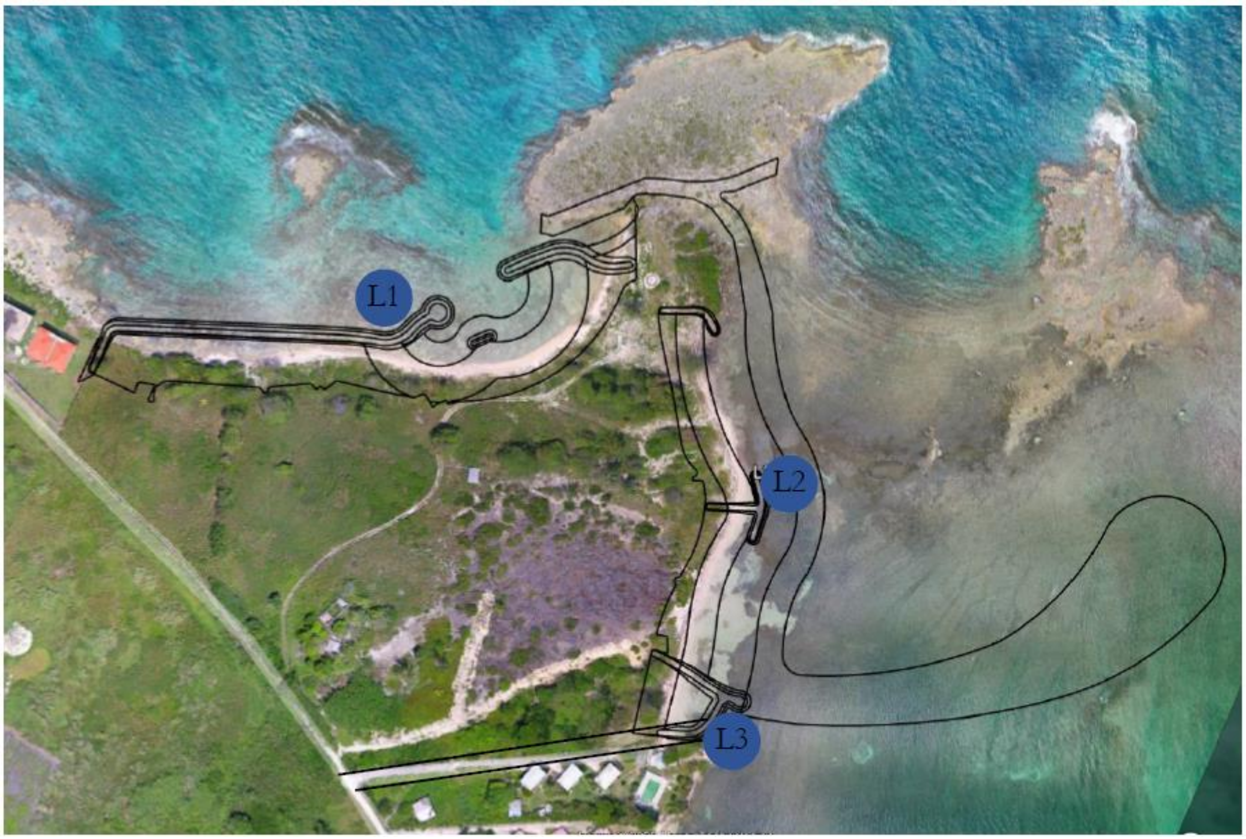


Figure 7-10 Locations of the storm water outfalls

Figure 7-11 shows the results over 48 hours from the peak flow. After 24 hours, most of the freshwater was mixed in with the seawater along the western section of the property (location 1), and for the outfall located at the eastern T-groyne (location 2) the freshwater fully mixed with seawater. After 48 hours, majority of the fresh water from location 3 (box drain) was mixed in with the seawater. The salinity concentration along the shoreline ranges between 8 to 28 ppt. While this is within acceptable limits it should be noted that the model did not include wind and wave impacts on the mixing of the fresh water. It is believed that with the additional impacts of wind and waves the mixing of freshwater with the seawater will be faster than what is shown in the models. These extreme stormwater flow conditions are rare and, when they occur, the time it takes for the environment to get back to ambient conditions should not have an adverse impact on the benthic ecosystem.

Other potential drainage impacts include; Flooding of neighbouring properties if slopes and grades are not maintained; blockage of drains from debris, sediments etc. which may result in inundation of areas of the property during extreme rainfall events.

Recommended Mitigation

- The site should be well graded to facilitate proper drainage in a northern direction towards the coast and into the infiltration network.
- The slopes and graded of the wider catchment towards the proposed covered "U" channel should be maintain, to capture runoff from the wider catchment area and safely discharge into the sea to mitigate flooding of the neighbouring property.
- The external and internal drainage system should be implemented as designed.
- Regular maintenance of the drainage system to keep it free from sediments, debris, and trash must be undertaken.

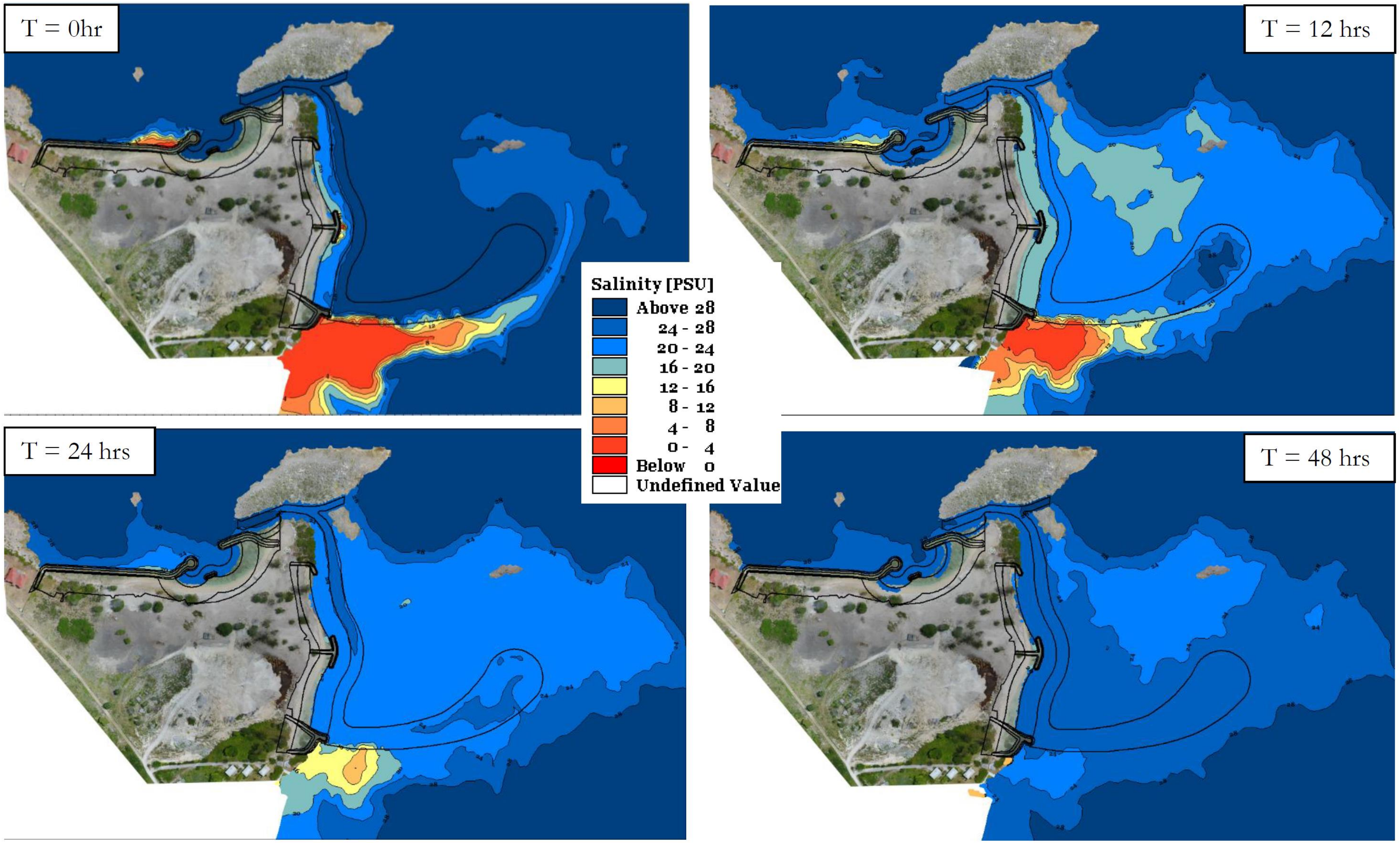


Figure 7-11 Model showing mixing of storm water outflow into the marine environment

7.3.1.2 Hydrodynamics

Computer simulated beach response modelling was performed using various wave conditions to assess the effectiveness of the proposed protective structures on the stability of the beach in front of the project site, as well as to investigate if the impacts are local or if they impact adjacent properties. MIKE 21 was used to evaluate the impacts of operational (seas and swell) waves, hydrodynamics, and sediment transport for both the existing conditions ("do nothing" scenario) and the proposed beach concept described above. The modelling results were used to forecast what would happen in the short and long term if the proposed solution was implemented.

Operational Waves

The proposed concept's goal is to create a stable beach environment with optimal circulation by allowing enough wave energy into the foreshore under average day-to-day conditions while also protecting the sand used to create the beach under less frequent wave conditions. The magnitude of the proposed coastal layout's impact on wave heights was determined using daily wave conditions derived from a statistical analysis of 42 years of ERA5 daily wave conditions.

Figure 7-12 shows the difference plot of the extreme operational wave height after the proposed shoreline enhancement and protective structures are implemented. The followed are observed:

- Along the eastern section of the property, the model shows a reduction in wave heights ranging between 0.1 to 0.3m.
- There is no change in wave energy within the dredged swimming area because the energy is broken down due to the shallow waters within this area.
- Where the proposed channel has been created, wave heights have increased, allowing more wave energy to enter the channel and encourage water circulation within the proposed channel.
- The major changes are at the north-western end, where the perched beach and groynes are proposed. The model predicts a significant reduction in wave energy along this shoreline as wave heights decrease to 0.1 to 0.4m.

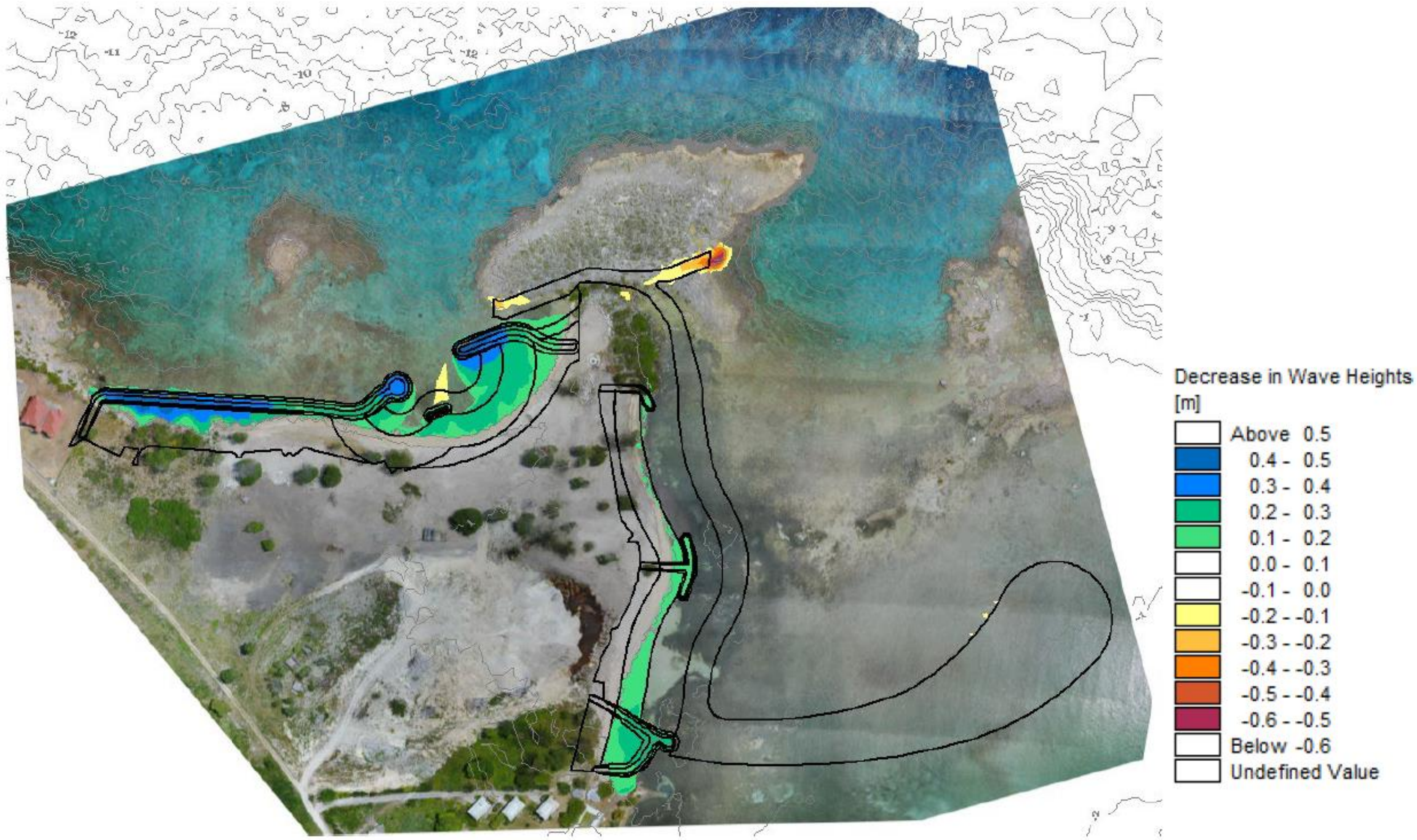


Figure 7-12 Difference plot for the extreme operational wave heights along the beach front with the proposed design

Figure 7-13 depicts a side-by-side comparison of mean annual wave heights (top) and extreme operational wave heights (exceeded 12 hours per year for 42 years) (bottom), as well as comparisons between existing conditions (left) and the proposed beach concept (right). Overall, the findings indicate that:

- The structures on the western beach significantly reduce wave heights at both the 50th and 99.86th percentiles.
- The impacts on wave heights are limited to the project site's foreshore and are expected to have little impact on neighbouring properties.
- Aside from a minor reduction in wave heights at the southern end of the beach, the proposed swimming area (dredged area) shows little to no change in wave energy along the eastern beach and within the overwater suites.

RECOMMENDED MITIGATION

None Required

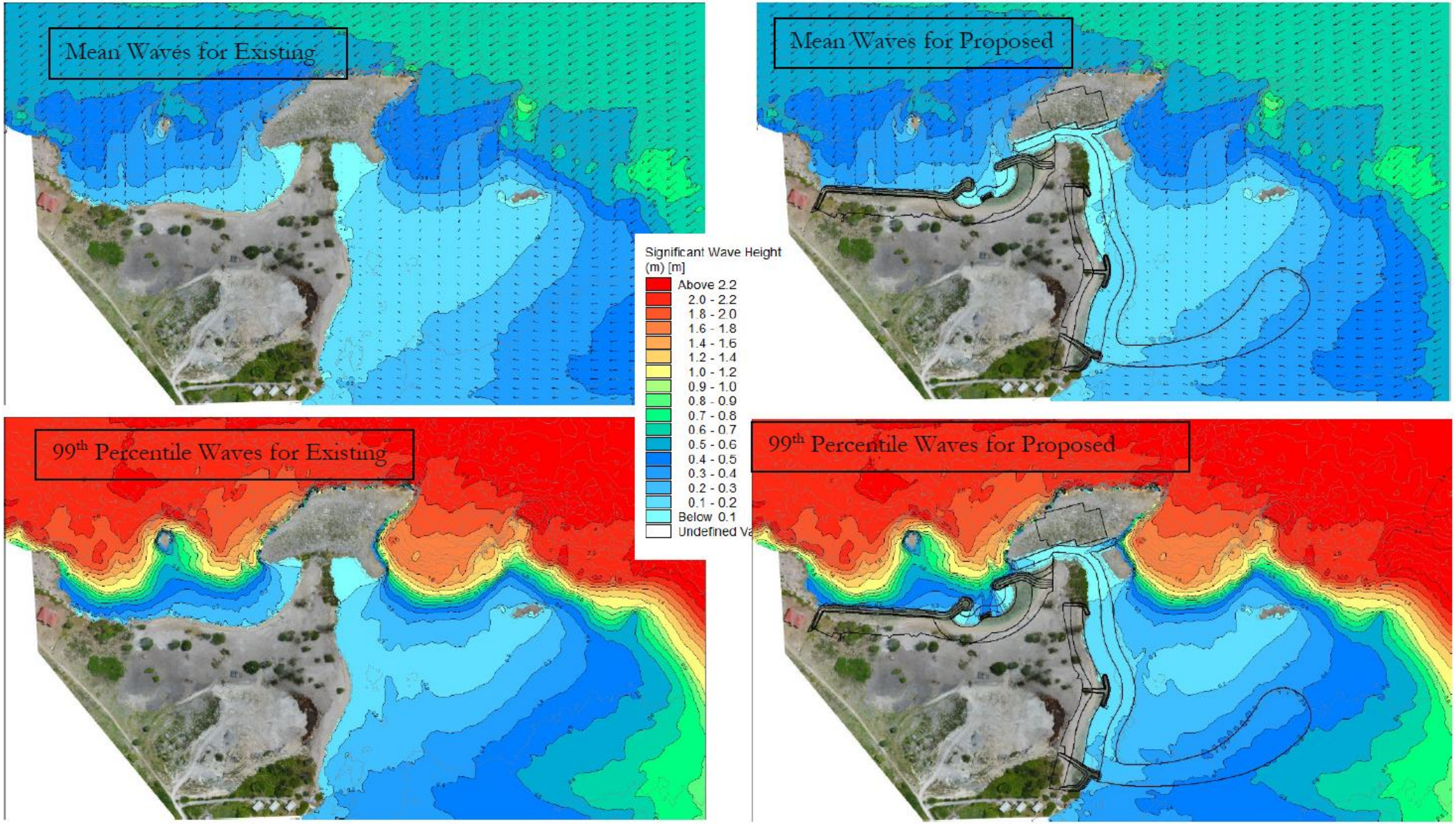


Figure 7-13 Comparisons of incident wave height with the existing configuration (left) and proposed concept (right), under the mean annual wave height (top) and the extreme operational wave height (bottom)

Swell Waves

A typical swell event coming from the northwest to northeast (April 2003) was used to quantify the range of coastal related short-term impacts resulting from the implementation of the proposed beach enhancements. Figure 7-14 (top) depicts the wave heights and wave period time series, as well as the direction, while the bottom figure depicts the swell event's wave height rose plot. The time series and rose plot show high wave energy approaching the shoreline from the north to the northeast as wave heights and periods increased in tandem, indicating a swell event approaching the shoreline.

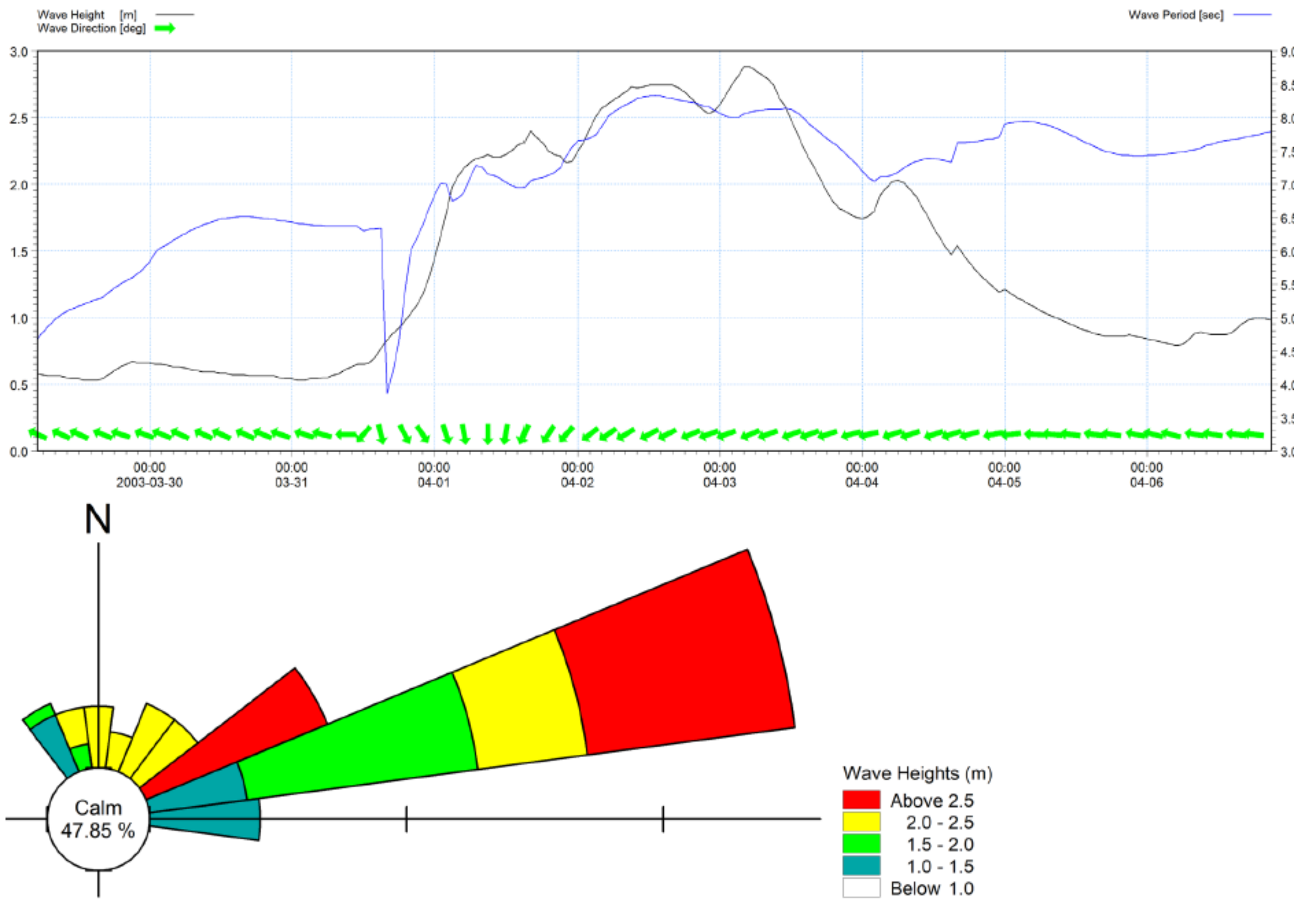


Figure 7-14 April 2003 swell event showing time series (top) and wave rose plot (bottom)

The significant wave heights and directions, as well as the current speeds and directions, were plotted at the peak of the swell event on April 2nd, 2003, at 12:30pm. The existing and proposed conditions with the shoreline enhancement layout in place were compared. Comparisons were made between the existing and proposed conditions with the shoreline enhancement layout in place. Results are plotted in Figure 7-15 and Figure 7-16.

The following are observed:

- There were no noticeable downdrift impacts further south or west of the project site.
- When exposed to the swell waves, the protected beaches appear to remain stable.
- The wave-induced currents that occur within the water sports channel are what is desired to encourage water circulation between the two beaches.
- Currents
  - Localized impacts in the lee of the protective structures.
  - Currents reduced in the lee of the proposed structures by 0.1m/s in some areas.
  - No noticeable downdrift changes.
- Waves
  - The breakwater reduces the wave energy entering the swimming beach significantly at the north-eastern beach.
  - No noticeable downdrift changes stood out.
- Sediment Transport
  - Sand accretion is occurring along the eastern beach and north-eastern shorelines.
  - No noticeable downdrift changes along the neighbouring properties.
  - Under swell conditions, there is sediment movement within the dredged wading area

RECOMMENDED MITIGATION

None Required

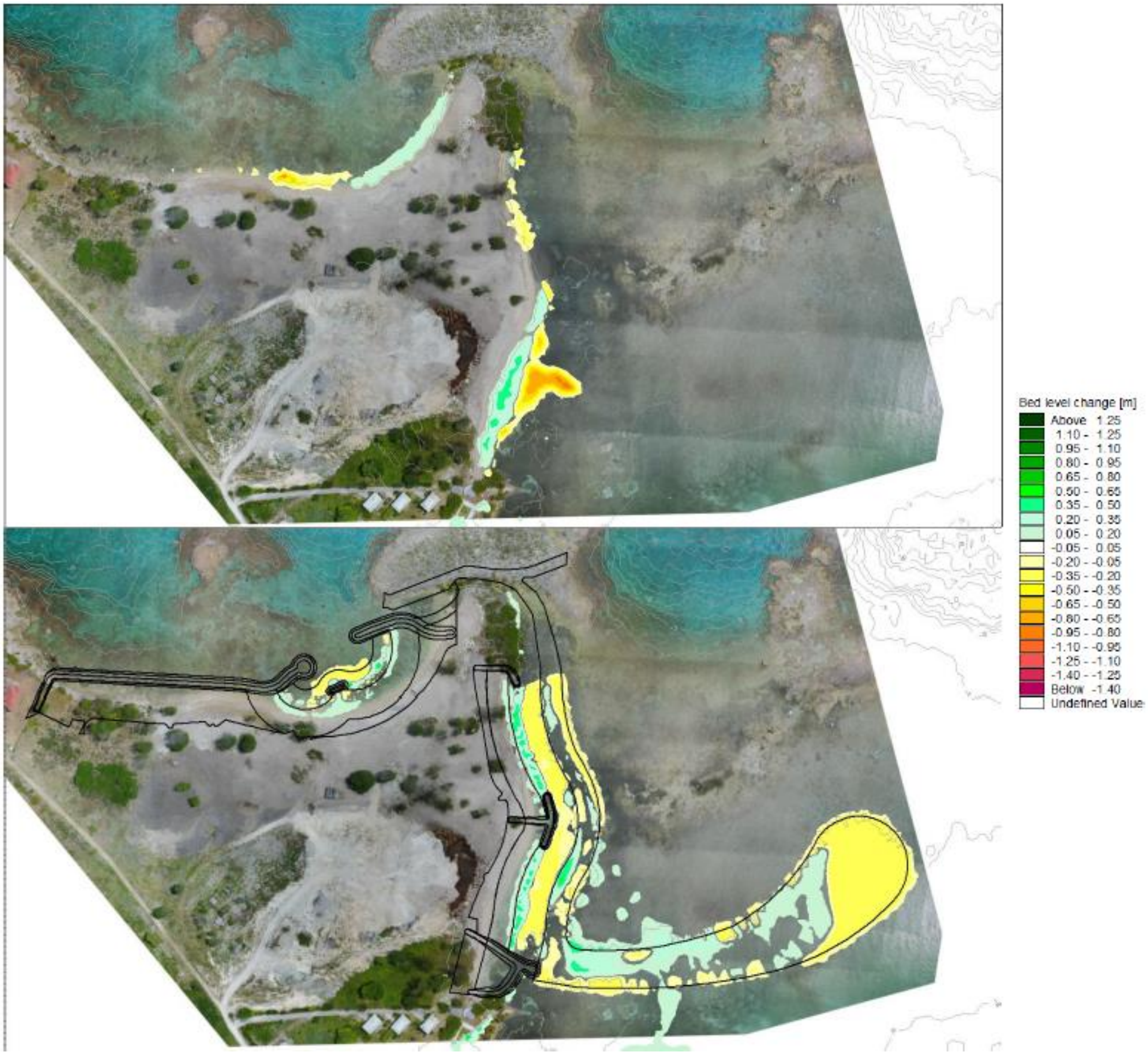


Figure 7-15 Simulated bed level change at the end of April 2003 swell event. Existing (top), proposed (bottom)

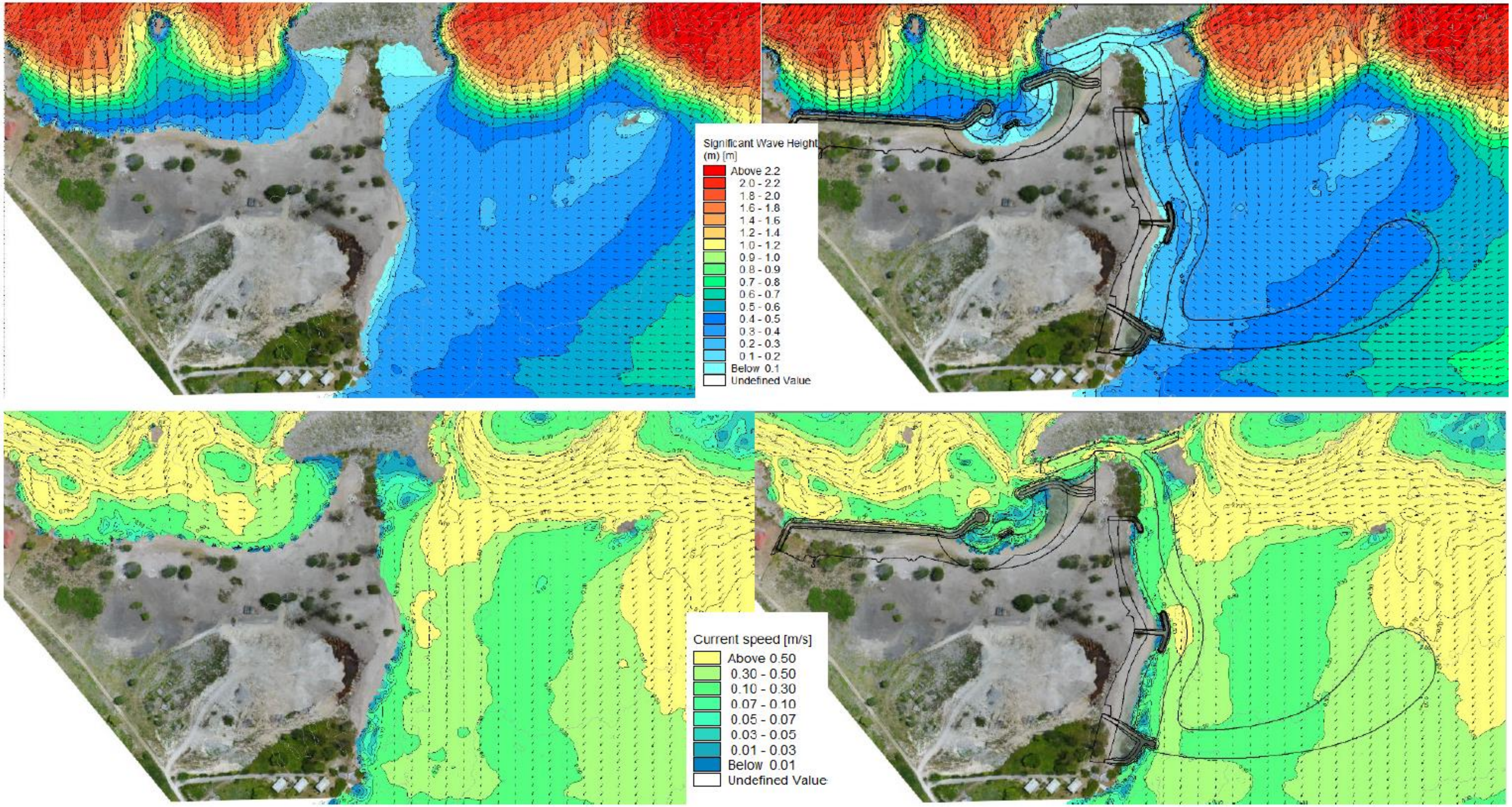


Figure 7-16 Wave height/direction (top) and Current speed/direction (bottom), at the peak of April 2013 swell event. Existing (left), proposed (right)

Circulation

Maintaining adequate circulation is a critical design consideration for any shoreline enhancement project. This helps to keep the water quality healthy and reduces algae growth. The baseline hydrodynamic conditions can be deduced from the health of the benthic organisms, which indicate that the area has adequate water exchange and oxygenation under the current scenario.

This section investigates the predicted changes in current speeds and directions that may occur as a result of the proposed shoreline enhancement implementation. The magnitude of the proposed concept's impacts was determined using a 17-day simulation period that included neap and spring tidal cycles.

Figure 7-17 shows current speeds and directions at six arbitrary locations along the shoreline over a 17-day simulation period, with a side-by-side comparison of the existing condition and the proposed beach concept.

Current roses indicate that currents along the eastern beach generally move in a north-south direction parallel to the shoreline. The proposed layout and dredged wading area changes the current directions in line with the shape of the channel when compared to the existing conditions. The current speeds along the eastern beach are slightly higher than the existing, implying that the flushing channel shows some improvement in water circulation. In the existing and proposed layout, at the most southerly rose plot (near the adjacent property) there does not appear to be a change in current speed and direction. Changes in current speed and direction are localized along the eastern beach, with slight changes in current direction and a slight increase in current speeds to improve water circulation.

The changes in current direction are more pronounced along the western beach, which is protected by two groynes and a breakwater.

Under the existing layout, currents move unidirectionally to the northeast at the north-eastern beach. The proposed layout shows currents moving in both directions, though the current speeds for both conditions are very slow due to the sheltering of the peninsula and the proposed structures. The most western rose plot is located at the adjacent property and shows the current speed and direction. The model results show little change in direction and magnitude under both existing and proposed conditions in the rose plots, indicating that the impacts on current speed and direction are localised to the northern beaches.

RECOMMENDED MITIGATION

None Required

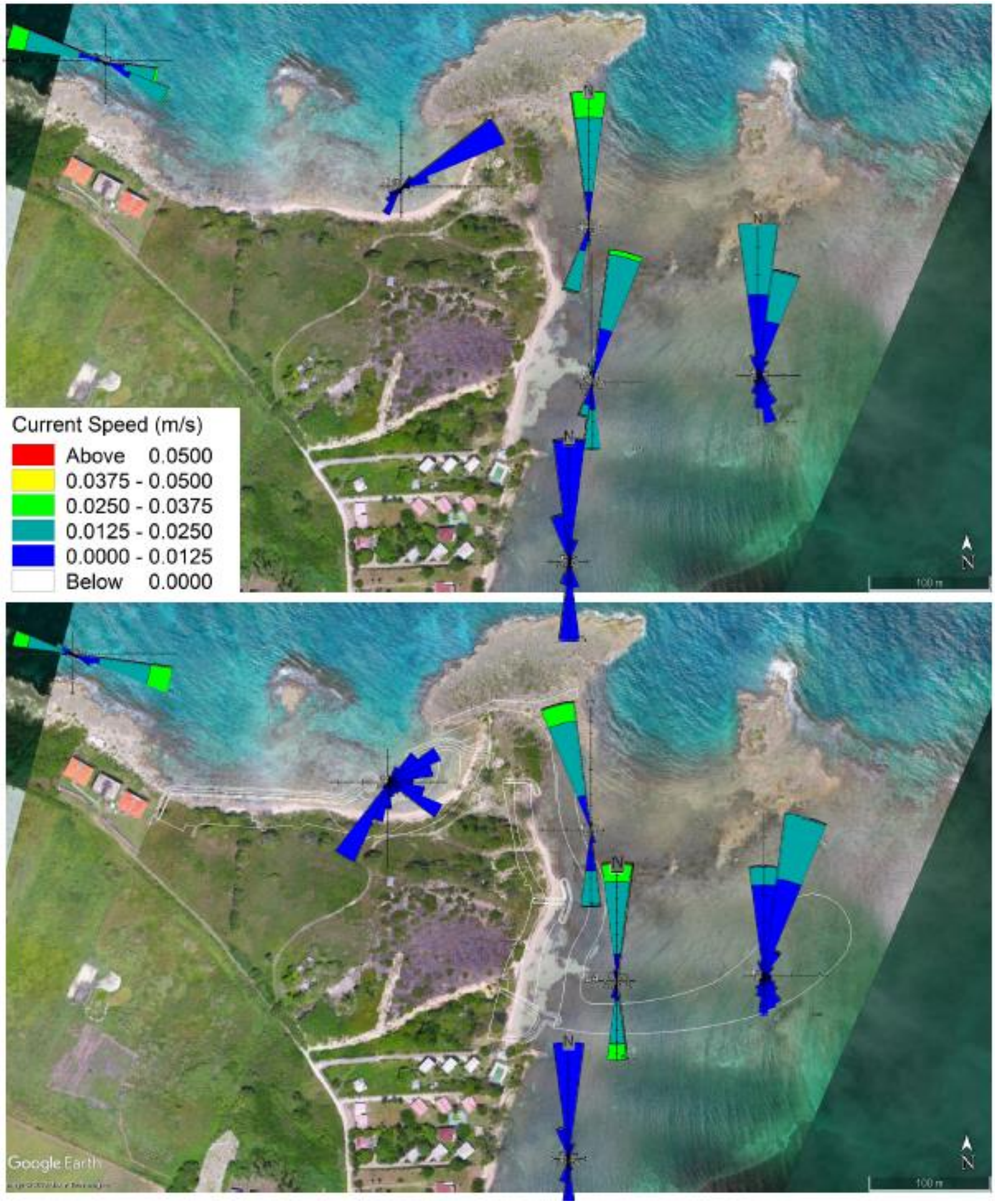


Figure 7-17 Current patterns over the 17-day simulation period with side-by-side comparison between existing (top) and proposed (bottom)

7.3.2 Biological

7.3.2.1 Rocky Shore

Species are expected to recolonise suitable areas on the rocky shore.

No recommended mitigation

7.3.2.2 Sea Turtles

Operational activities, obstructions and lighting may impact turtle nesting and foraging activity.

Recommended Mitigation

I. All staff and workers should be sensitized to the sensitive ecosystems and species in the area, in particular turtles. The beaches should be inspected daily for any signs of turtle activity. If a nest is suspected or found;
   a. The nest should cordoned off and remain undisturbed until it is hatched in approximately 60 days.
   b. All activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs if the nest is located in a highly vulnerable area.
II. Turtle-friendly lighting and light positioning (if any) should also be placed on the searooms. Hotel operators should also educate their guests on sea turtle conservation and the correct actions to take if a sea turtle is observed nesting on the beach.
III. The Hotel should also develop a Sea Turtle Monitoring programme which would include tagging and hatchling release. This could add to their attraction offerings (turtle watching).

7.3.3 Natural Hazards

7.3.3.1 Hurricane Waves and Storm Surge

Hurricanes have the potential to cause flooding to the property from storm surge as well as damage due to high energy waves. Storm surge levels are related to the increase in sea level due to the low-pressure system caused by a hurricane. The hurricane simulations with sea level rise projections for climate change indicated a 50-year inundation level of 2.4 to 2.6m.

Recommended Mitigation

Based on this, a minimum ground elevation of +2.8m is proposed and a minimum floor elevation of +3.0m. By increasing the ground level (also to facilitate drainage) the development is protected from hurricane-related flooding as shown in Figure 7-18 and Figure 7-19. In addition, a wall around the entire development is proposed as a solid method of protection against erosion from waves accompanying the surge.

The following are noted:

- Under 50-year hurricane conditions, the proposed structures around the beaches will be inundated. The structures are not intended to protect the beach during these extreme conditions; rather, they will be designed to withstand these extreme conditions so that they can function under normal operational conditions after the storm has passed.
- The perimeter wall and raised elevation of the property will protect the resort from flooding up to the 50-year hurricane event.

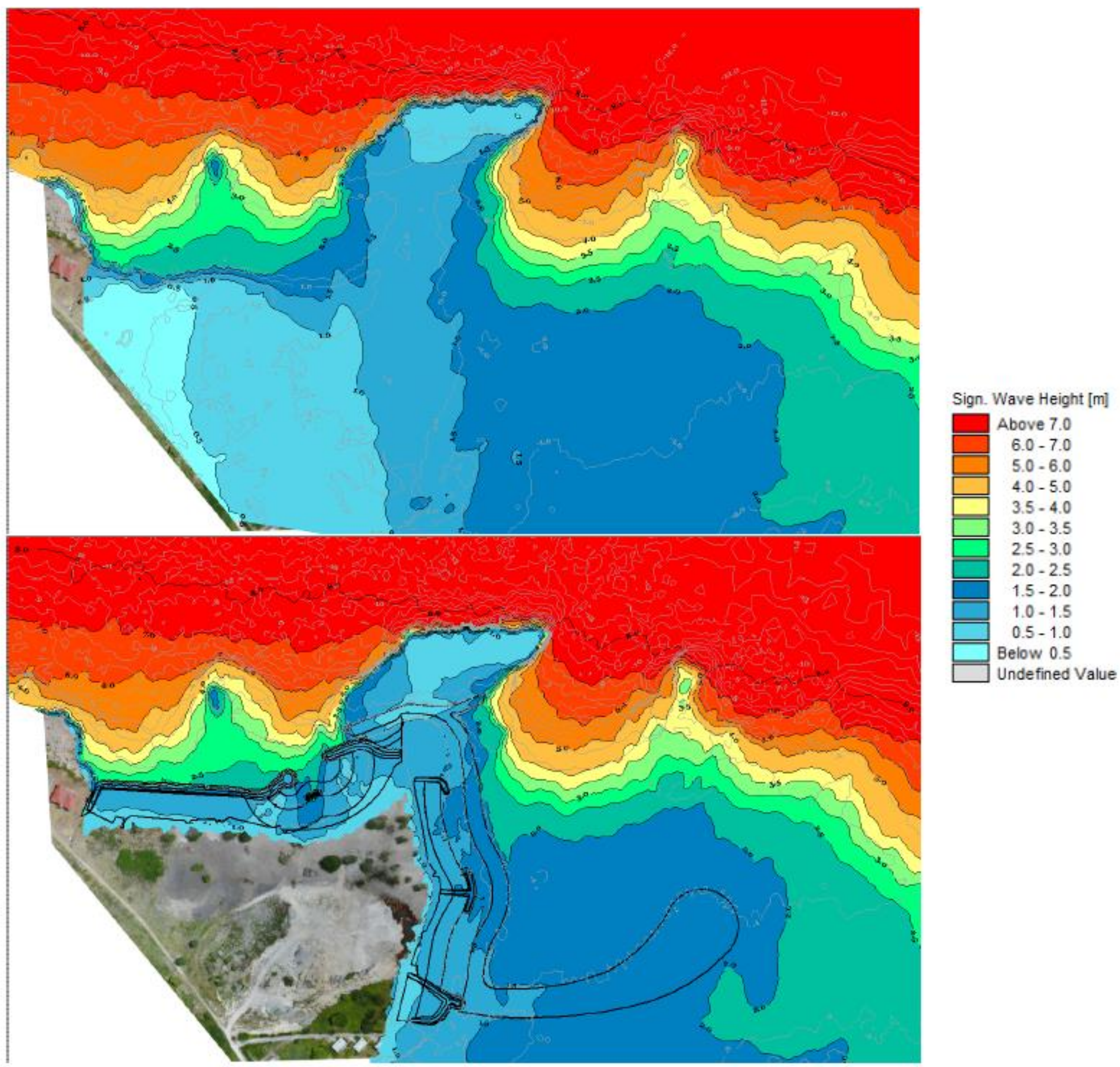


Figure 7-18 Significant wave heights under the 1 in 50-year event with no structures in place (top) and with structures in place (bottom)

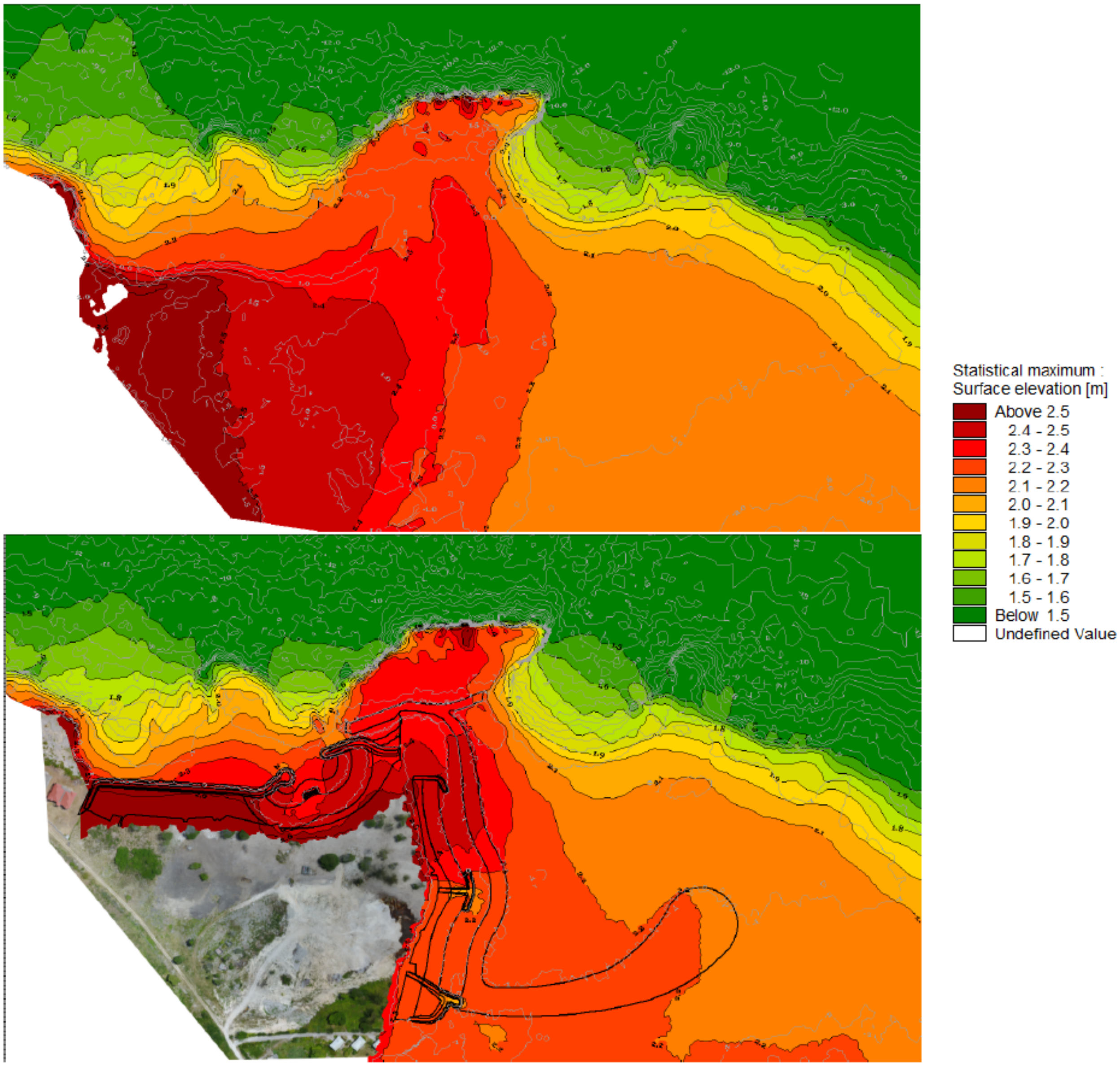


Figure 7-19 Static storm surge levels (50-year event) with no structures in place (top) and with structures in place (bottom)

7.3.4 Socioeconomic/Cultural

7.3.4.1 Employment

Once fully operational, the hotel expects to employ approximately 1,600 persons (Phase I – 670 pers. and Phase II – 930 pers). This should create approximately 6,080 indirect and induced jobs. To the extent practicable, the Client will utilise local skills and labour for the operation of the hotel. This has the potential to be a significant positive impact.

Persons engaged in this phase will require training, which will result in an increase of persons with training in the hospitality sector.

In addition, diverse sexual orientations and gender identities may have the effect of excluding people from potential employment opportunities which prevents them from taking advantage of the opportunities available to other members of the community.

Mitigation

It is important that the Hotelier:

- Anticipates and prevent adverse risks and impacts based on gender, sexual orientation, and gender identity, and when avoidance is not possible, to mitigate and compensate for such impacts.
- Achieves inclusion in project-derived benefits of people of all genders, sexual orientations, and gender identities.
- Implement measures to prevent Sexual and Gender Based Violence (SGBV), including sexual harassment, exploitation and abuse; and when incidents of SGBV occur, to respond promptly.

7.3.4.2 Water Supply and Consumption

Potable water for the development will be supplied via the hotel's desalination plant (approximately 2,700 m^3/day).

Even though potable water will be sourced via the hotel's own desalination plant, it is recommended that various storage and conversation measures be put in place at the hotel such as:

i. Low flow fixtures
ii. Dual flush toilets
iii. Faucets fitted with aerators
iv. Electronic spigots and flush valves

In addition to design and infrastructural measures for the reduction of water consumption, the hotel should also ensure operational measures are employed in order to manage the use of this resource. Summarized in Table 7-19 below is a list of recommended operational strategies for the reduction of water consumption:

Table 7-19 Operational strategies for reduced water consumption

Departments	*Operating Procedures*
Housekeeping	• Do not leave the tap running while cleaning, using buckets for holding water instead • Make sure that all faucets do not leak and are in good repair • Report immediately any leaking or dripping faucet or toilet

Departments	*Operating Procedures*
	• Give guests the option of changing linen and towels every two or three days • Use only the minimum required amount of detergent in the laundry • Reuse rinse-water in the first cycle of washing of the next load • Separate the laundry's hot-water system from the guest room hotel-water system if possible • Hotel guests can be given politely written cards as to how to conserve water in their bathrooms, for example to shut off water during tooth brushing, shaving, and other unnecessary periods • Keep utility bills to track the consumption of water • Purchase and use water-saving equipment always • Establish an effective employee training program about water conservation
Food and Beverage	• Do not leave faucets running • Wash food products in buckets, bowls or containers • Use dishwasher with sufficient loads • Make regular inspections of dishwasher pumps for water leakage • Do not use water to defrost or thaw frozen food products, defrost in refrigerator • Report immediately any leaking and dripping faucet • Install infrared-activated faucets and toilets in restaurant rest rooms • Track the consumption of water by regular monitoring utility bills • Establish an effective employee training program about water conservation
Maintenance	• Recover waste pool water for reuse • Make regular inspections of circulating pumps for water leakage • Report immediately any pool or faucet leakage • Purchase and use water-saving pool equipment • Track the consumption of water by regular monitoring utility bills • Establish an effective employee-training program about pool water conservation • Consult pool specialists about effective maintenance of swimming pool

7.3.4.3 Solid Waste Generation and Disposal

The operation of the development has the potential of significantly increasing the solid waste in the area.

Mitigation

viii. Provision of solid waste storage bins and skips.

ix. Provision of adequately designed bins and skips to prevent access by vermin.
x. Monitor beach garbage.
xi. Contracting a private contractor to collect solid waste in a timely fashion to prevent a build-up.
xii. Ensure that the solid waste collected is disposed in an approved disposal site
xiii. Waste sorting (plastics, papers, glass, organic waste etc.) should be facilitated and integrated into the development.
xiv. A ticketing system will be developed between both the Permittee and the Solid Waste Contractor to ensure effective management of waste and verification of disposal at the correct site.

7.3.4.4 Health and Safety

The operation of the proposed development will involve workers and guests who may become ill or have accidents. In addition, disasters such as earthquakes, floods, storm surge and fires are real possibilities.

Mitigation

iv. Have first aid kits located in various sections of the development
v. Design and implement an emergency response plan.
vi. Arrange mutual assistance and make prior arrangements with:
    a. Health care facilities (St. Ann's Bay Hospital) and associated doctors and nurses to accommodate any eventualities.
    b. St. Ann's Bay Fire Station
    c. St. Ann's Bay Police Station

7.3.4.5 Traffic

Trip Generation

Operational traffic volumes were determined using ITE Trip Generation Manual: 10^{th} edition. The manual provides an estimate of trips generated per unit based on the general land usage of a development. It was advised by the NWA that the ITE's rates generally tend to be more conservative for usage in Jamaica (Figure 7-20).

Resort Hotel
(330)

Vehicle Trip Ends vs:	**Rooms**
On a:	**Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m.**
Setting/Location:	**General Urban/Suburban**
Number of Studies:	6
Avg. Num. of Rooms:	524
Directional Distribution:	72% entering, 28% exiting

Vehicle Trip Generation per Room

Average Rate	Range of Rates	Standard Deviation
0.32	0.24 - 0.41	0.08

Figure 7-20 Vehicle Trip Generation per Room for Resort Hotel

As expected, the majority of the trips generated from guests will be via shuttle. A such the trip generation rate for resort hotel was used, however was scaled down to 0.24 for this assessment. The trip volume, for the 715 rooms, generated approximately 172 trips/hour for the peak operating case. These volumes were however adjusted to reflect the trips terminating and originating from the site. The volumes were also adjusted to account for the fact that a number of the trips produced or terminated by the development would have been associated with origins within the development footprint. It was also assumed that 95% of the traffic would be Light Vehicular traffic. This inference was based on traffic type volumes determined from the existing traffic counts.

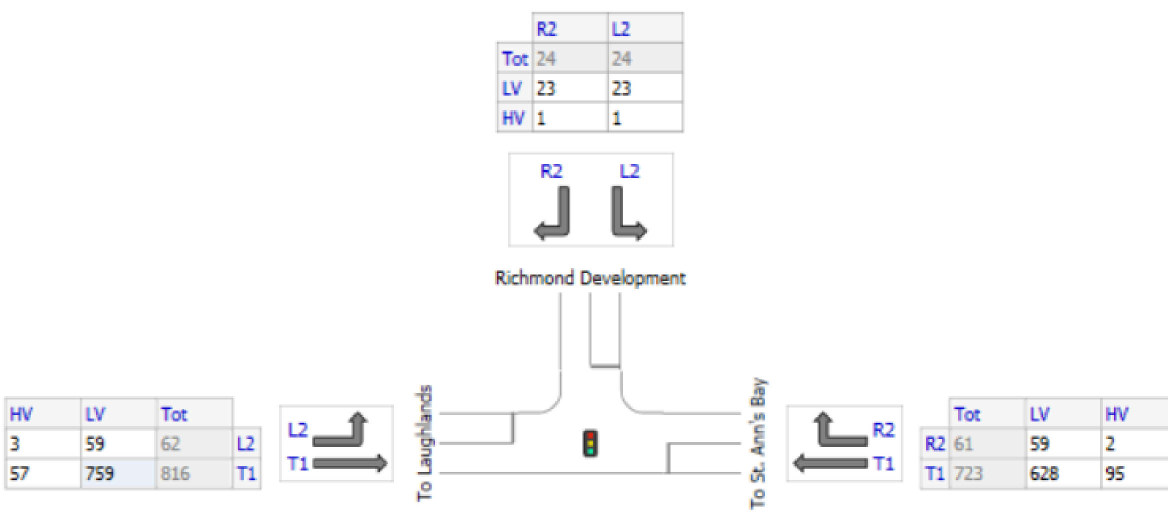


Figure 7-21 Showing the Traffic flow diagram from trip generation for the proposed main entrance

Proposed Main Entrance Signalized

The overall impact of the operational phase was expected to be quite significant due to the number of hotel rooms and jobs to be generated by the development. The main and most significant loss of performance however was noticed for traffic coming from the St. Ann's Bay Road. Motorists needing to turn left onto the hotel's main entrance from Laughlands Road and right from out of the hotel's entrance unto Laughlands Road wait approximately 24.6 seconds longer than any other lane and persons traveling from the hotel's direction of the highway would have a 10.1 second longer delay on average.

An increase in the degree of saturation means that volume of vehicles making that left turn exceeds the approaching the available capacity of the signal cycle and as such the quantity of vehicles was approaching a volume that the signal could not handle in a signal cycle.

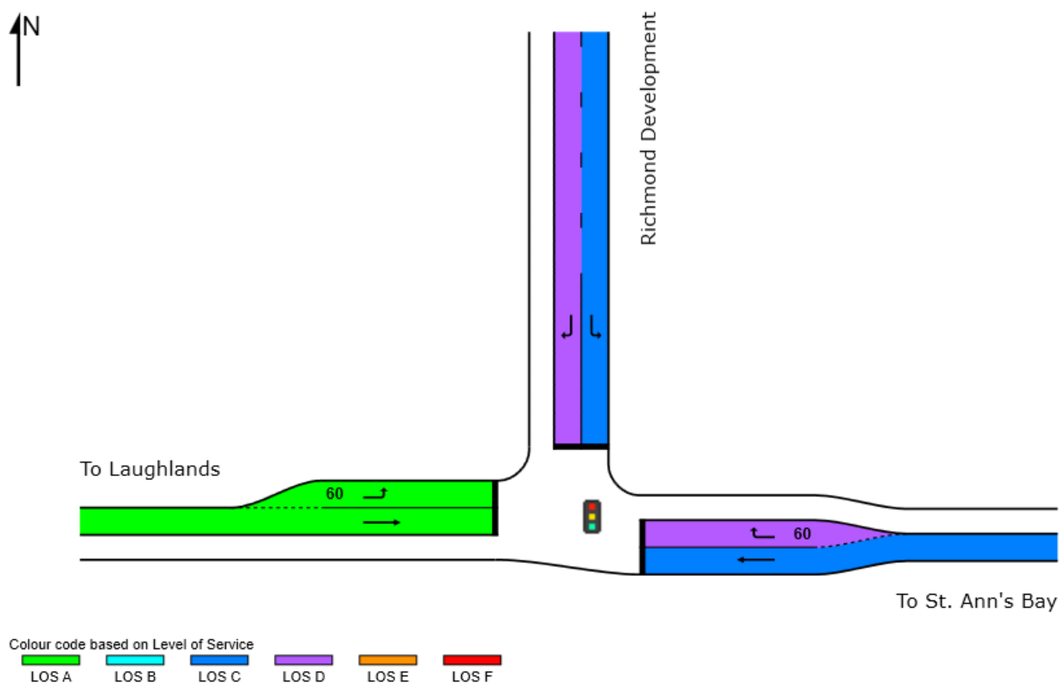


Figure 7-22 Showing Level of Service Recorded at the Proposed Main Gate Intersection

Table 7-20 Movement performance at the Propose Main Gate Intersection for the AM peak during the operational phase

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
East: To St. Ann's Bay												
5	T1	723	13.1	0.878	23.8	LOS C	27.3	212.4	0.93	0.87	0.97	44.7
6	R2	51	3.9	0.330	47.8	LOS D	2.1	15.0	0.95	0.74	0.95	33.0
Approach		774	12.5	0.878	25.4	LOS C	27.3	212.4	0.93	0.86	0.97	43.8

Movement Performance - Vehicles													
Mov ID	Turn	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total	HV				Vehicles	Distance				
		veh/h	%	v/c	sec		veh	m				km/h
North: Richmond Development												
7	L2	20	5.0	0.070	23.2	LOS C	0.4	2.9	0.86	0.69	0.86	42.5
9	R2	20	5.0	0.152	47.9	LOS D	0.8	5.9	0.95	0.70	0.95	34.8
Approach		40	5.0	0.152	35.5	LOS D	0.8	5.9	0.90	0.69	0.90	38.0
West: To Laughlands												
10	L2	52	5.8	0.037	8.0	LOS A	0.5	3.6	0.24	0.62	0.24	52.4
11	T1	816	7.0	0.777	8.4	LOS A	13.6	100.7	0.83	0.75	0.83	53.5
Approach		868	6.9	0.777	8.3	LOS A	13.6	100.7	0.79	0.74	0.79	53.5
All Vehicles		1682	9.5	0.878	16.8	LOS B	27.3	212.4	0.86	0.79	0.88	48.1

Proposed Main Entrance Signalized with Corridor Improvements

Another scenario considered was the main road with improvements, namely an additional lane to allow for higher volume of traffic movement. In this scenario, the increase in the number of lanes results in improvements experienced by motorists using the intersection due to higher volume of traffic flow when comparing to the effects if the number of lanes remain as they presently exist. The average delay is improved as the maximum delay is 33 seconds experienced by motorists turning into the development, compared to 48 seconds without road corridor improvement.

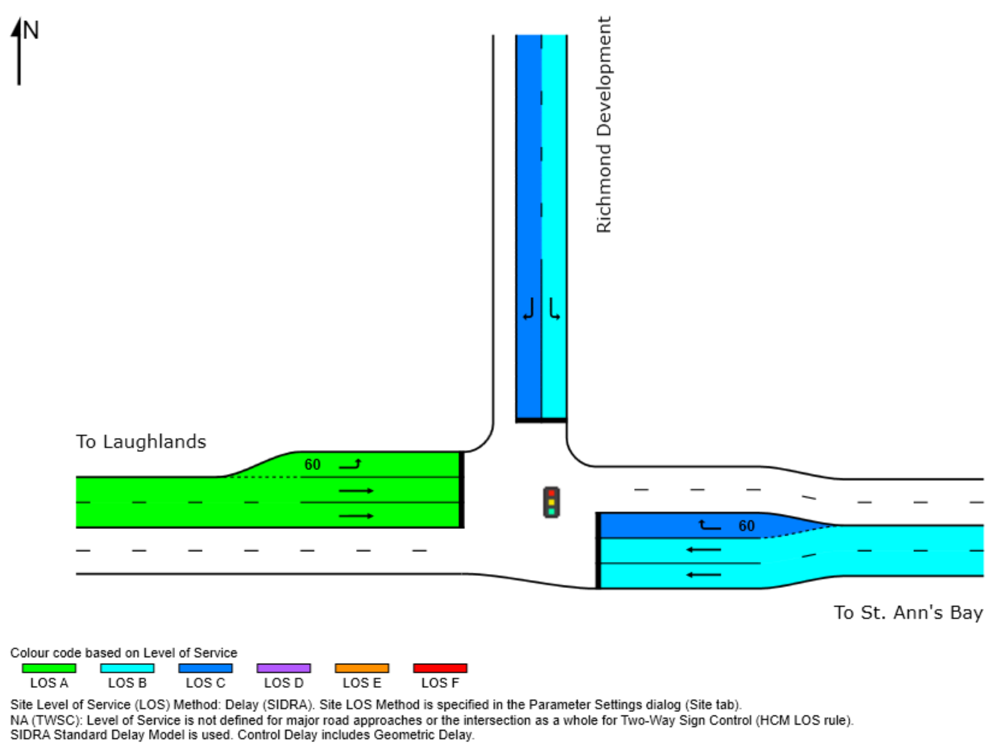


Figure 7-23 Showing Level of Service Recorded at the Proposed Main Gate Intersection w/corridor improvement

Table 7-21 Movement performance at the Propose Main Gate Intersection for the AM peak during the operational phase w/ corridor improvement

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total	HV				Vehicles	Distance				
		veh/h	%	v/c	sec		veh	m				km/h
East: To St. Ann's Bay												
5	T1	723	13.1	0.504	14.8	LOS B	7.7	59.6	0.79	0.67	0.79	49.5
6	R2	51	3.9	0.259	32.9	LOS C	1.4	10.0	0.93	0.73	0.93	38.2
Approach		774	12.5	0.504	15.9	LOS B	7.7	59.6	0.80	0.68	0.80	48.6
North: Richmond Development												
7	L2	20	5.0	0.051	15.8	LOS B	0.2	1.7	0.80	0.68	0.80	46.5
9	R2	20	5.0	0.102	32.1	LOS C	0.5	3.8	0.91	0.69	0.91	40.4
Approach		40	5.0	0.102	24.0	LOS C	0.5	3.8	0.86	0.68	0.86	43.0
West: To Laughlands												
10	L2	52	5.8	0.042	8.9	LOS A	0.5	3.4	0.34	0.64	0.34	51.9
11	T1	816	7.0	0.603	8.8	LOS A	4.9	36.2	0.85	0.72	0.85	53.2
Approach		868	6.9	0.603	8.8	LOS A	4.9	36.2	0.82	0.72	0.82	53.2
All Vehicles		1682	9.5	0.603	12.4	LOS B	7.7	59.6	0.81	0.70	0.81	50.7

Existing Bamboo/A1 Highway Intersection Signalized (Proposed Service Intersection)

The overall impact of the operational phase was expected to be relatively low as most of the traffic to the hotel the development would be through the proposed main gate. On the Laughlands Main Road, the level of service was observed to be similar to those observed during the signalized construction phase. The main and most significant loss of performance however was noticed on lanes of the St. Ann's Bay Road. Motorists needing to turn left onto Bamboo Main Road from St. Ann's Bay Road wait approximately 4.6 seconds longer than any other lane and persons traveling from St. Ann's Bay direction would have a 32.9 second longer delay on average.

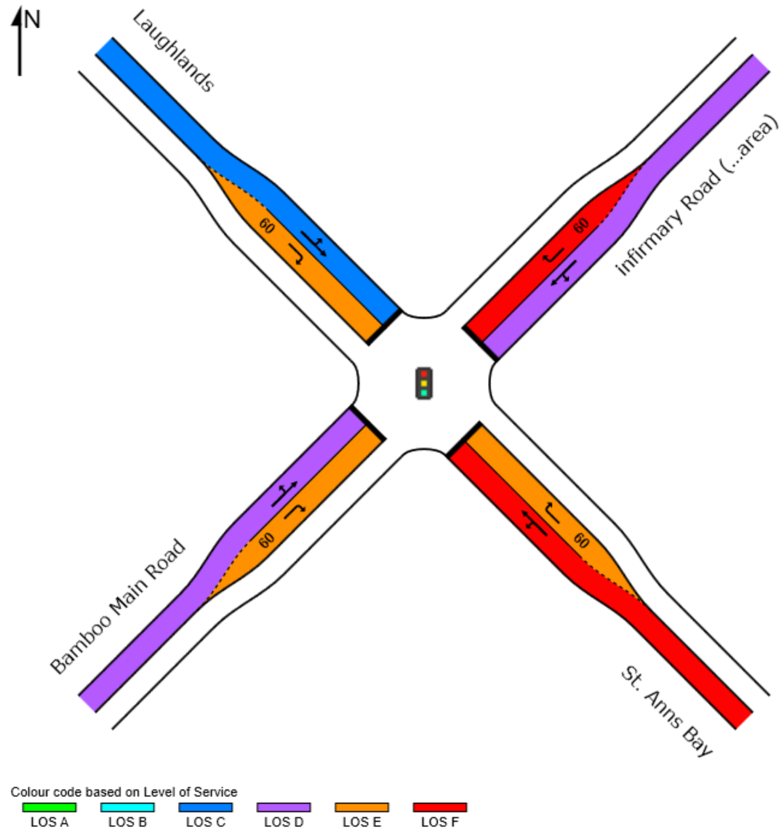


Figure 7-24 Showing Level of Service Recorded at the Bamboo/Laughlands Intersection

Table 7-22 Showing the movement performance at the Bamboo/Laughlands Intersection for the AM peak during the operational phase.

Mov ID	Turn	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
Movement Performance - Vehicles												
SouthEast: St. Anns Bay												
21	L2	98	3.1	1.020	109.2	LOS F	78.7	607.2	1.00	1.33	1.57	18.2
22	T1	723	13.1	1.020	104.6	LOS F	78.7	607.2	1.00	1.33	1.57	19.8
23	R2	13	23.1	0.065	69.2	LOS E	0.8	7.1	0.89	0.69	0.89	25.4
Approach		834	12.1	1.020	104.6	LOS F	78.7	607.2	1.00	1.32	1.56	19.7
NorthEast: infirmary Road (to project area)												
24	L2	18	5.6	0.076	41.0	LOS D	0.8	6.1	0.87	0.69	0.87	35.3
25	T1	1	0.0	0.076	35.4	LOS D	0.8	6.1	0.87	0.69	0.87	36.0
26	R2	8	37.5	0.136	87.6	LOS F	0.6	5.6	0.97	0.67	0.97	25.9
Approach		27	14.8	0.136	54.6	LOS D	0.8	6.1	0.90	0.68	0.90	31.6
NorthWest: Laughlands												
27	L2	4	25.0	0.872	37.7	LOS D	35.9	266.5	0.94	0.98	1.12	39.6
28	T1	806	7.1	0.872	31.9	LOS C	35.9	266.5	0.94	0.98	1.12	41.1
29	R2	17	11.8	0.057	62.8	LOS E	1.0	8.0	0.84	0.70	0.84	30.8

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
Approach		827	7.3	0.872	32.5	LOS C	35.9	266.5	0.93	0.97	1.11	40.8
SouthWest: Bamboo Main Road												
30	L2	32	18.8	0.098	37.3	LOS D	1.5	12.6	0.80	0.70	0.80	38.3
31	T1	4	25.0	0.098	31.5	LOS C	1.5	12.6	0.80	0.70	0.80	37.5
32	R2	201	4.0	0.835	78.0	LOS E	14.7	106.3	1.00	0.83	1.00	25.9
Approach		237	6.3	0.835	71.7	LOS E	14.7	106.3	0.97	0.81	0.97	27.4
All Vehicles		1925	9.4	1.020	68.9	LOS E	78.7	607.2	0.97	1.10	1.28	26.8

Operational Phase (10 Years @ 3% Annual Growth)

PROPOSED MAIN INTERSECTION SIGNALIZED

Application of a 3% annual growth to the base traffic volumes significantly reduced the observed performance and increased delays experienced on the assessed roadway segment. It was observed that the level of service from of the roads coming from St. Ann's Bay fell into the F category over a 10-year operational period for the proposed main gate intersection. It was also observed that the capacity of the intersection was exceeded for the aforementioned traffic movement direction, with a degree of saturation above 1, which implies that the signal would not be able to manage the approaching flows in a single cycle. The delay experienced is expected to be as great as 117 seconds.

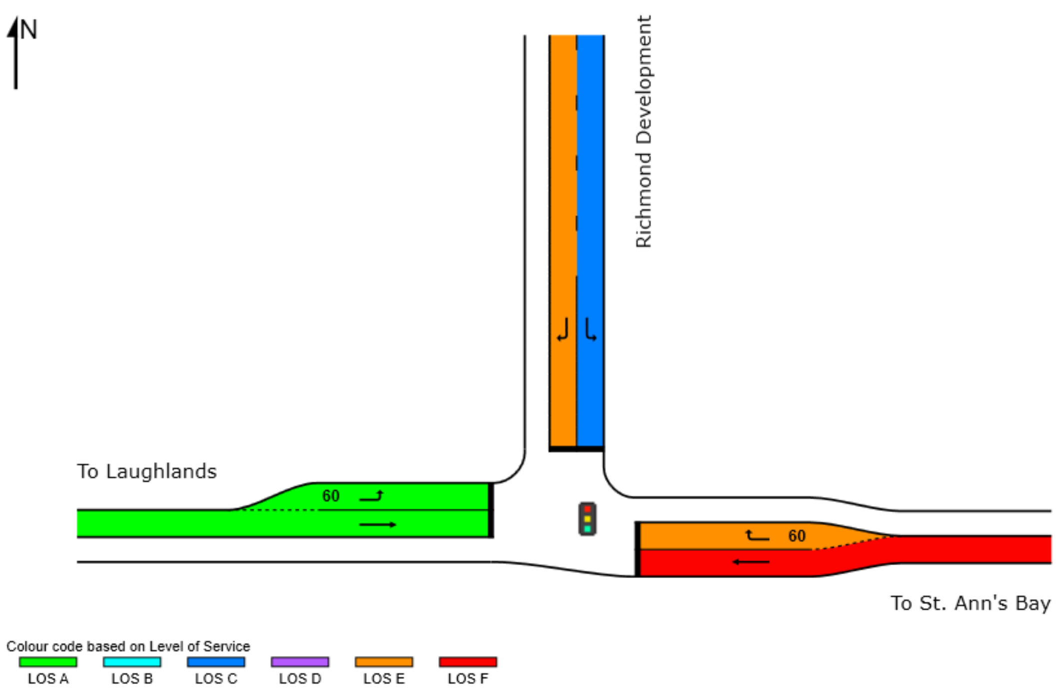


Figure 7-25 Showing Level of service for the road segment between the main entrance and Laughlands

Table 7-23 Showing the movement performance at the Proposed Main Gate Intersection for the AM peak during the operational phase (10 years @ 3% annual growth)

Movement Performance - Vehicles													
Mov ID	Turn	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total	HV				Vehicles	Distance				
		veh/h	%	v/c	sec		veh	m				km/h
East: To St. Ann's Bay												
5	T1	891	10.7	1.030	116.8	LOS F	87.5	668.6	1.00	1.62	1.89	22.2
6	R2	51	3.9	0.358	58.3	LOS E	2.6	18.6	0.96	0.74	0.96	30.1
Approach		942	10.3	1.030	113.7	LOS F	87.5	668.6	1.00	1.57	1.84	22.5
North: Richmond Development												
7	L2	20	5.0	0.081	28.4	LOS C	0.5	3.7	0.88	0.69	0.88	40.1
9	R2	21	9.5	0.204	60.0	LOS E	1.1	8.1	0.96	0.70	0.96	31.6
Approach		41	7.3	0.204	44.6	LOS D	1.1	8.1	0.92	0.69	0.92	35.0
West: To Laughlands												
10	L2	52	5.8	0.036	7.8	LOS A	0.5	3.7	0.20	0.62	0.20	52.6
11	T1	1006	5.7	0.854	9.4	LOS A	22.0	161.6	0.83	0.77	0.84	52.8
Approach		1058	5.7	0.854	9.3	LOS A	22.0	161.6	0.80	0.76	0.81	52.8
All Vehicles		2041	7.8	1.030	58.2	LOS E	87.5	668.6	0.89	1.14	1.29	32.4

PROPOSED MAIN INTERSECTION SIGNALIZED WITH CORRIDOR IMPROVEMENTS

After 10 operational years, improvement to the road corridor, of one queue length, improved the LOS at the intersection. Comparing this with the resulting model output in the instance when the number of lanes is kept constant should how improved the flow rates with the application of more lanes. The delays are significantly less than that experience with only 2 lanes, with the greatest delay being reduced to 35 seconds (from 117 seconds) experienced by motorists turning into the development.

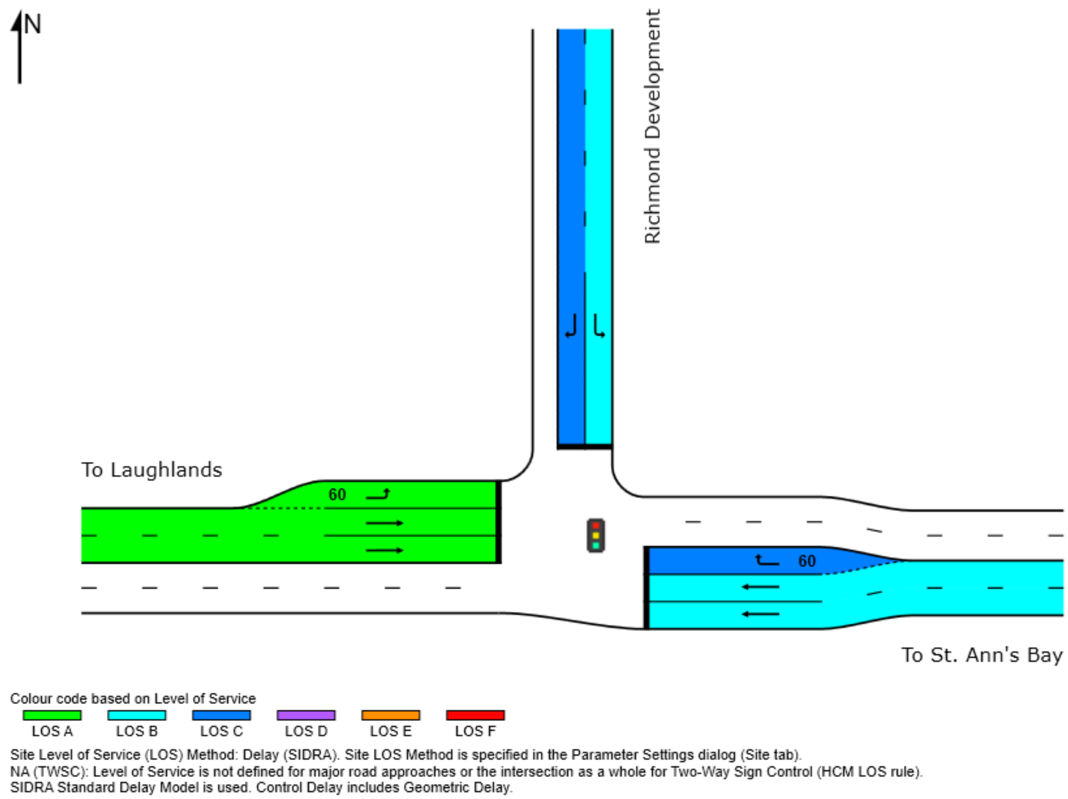


Figure 7-26 Showing Level of service for the road segment between the main entrance and Laughlands w/ Corridor Improvements

Table 7-24 Movement performance at the Proposed Main Gate Intersection for the AM peak during the operational phase (10 years @ 3% annual growth) w/ corridor improvement

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
East: To St. Ann's Bay												
5	T1	891	10.7	0.591	15.6	LOS B	10.2	78.1	0.82	0.71	0.82	48.9
6	R2	51	3.9	0.273	34.7	LOS C	1.5	10.6	0.94	0.73	0.94	37.5
Approach		942	10.3	0.591	16.7	LOS B	10.2	78.1	0.82	0.71	0.82	48.2
North: Richmond Development												
7	L2	20	5.0	0.054	16.7	LOS B	0.3	1.8	0.81	0.68	0.81	46.0
9	R2	21	9.5	0.117	34.0	LOS C	0.6	4.4	0.92	0.69	0.92	39.5
Approach		41	7.3	0.117	25.6	LOS C	0.6	4.4	0.87	0.69	0.87	42.2
West: To Laughlands												
10	L2	52	5.8	0.041	8.7	LOS A	0.5	3.4	0.32	0.64	0.32	52.0
11	T1	1006	5.7	0.676	8.8	LOS A	6.4	46.8	0.86	0.74	0.86	53.2
Approach		1058	5.7	0.676	8.8	LOS A	6.4	46.8	0.84	0.74	0.84	53.1
All Vehicles		2041	7.8	0.676	12.8	LOS B	10.2	78.1	0.83	0.72	0.83	50.5

EXISTING INTERSECTION SIGNALIZED (PROPOSED SERVICE INTERSECTION)

The delays experienced by vehicles leaving from the proposed intersection at the main entrance heading to the Bamboo/Laughlands intersection causes the class to fall from a class C lane to a class F attributed to flows being backed up by the signal at the Main Entrance in conjunction with a cumulative effect of each signal needing to manage larger flows without an increase in signal cycle capacity. The exceeded capacity observed at the Bamboo/Laughlands intersection has somewhat of a cumulative effect, wherein the delays are transferred to all flows contributing to it. This can also be seen by the reduced level of service for vehicles approaching from St. Ann's Bay.

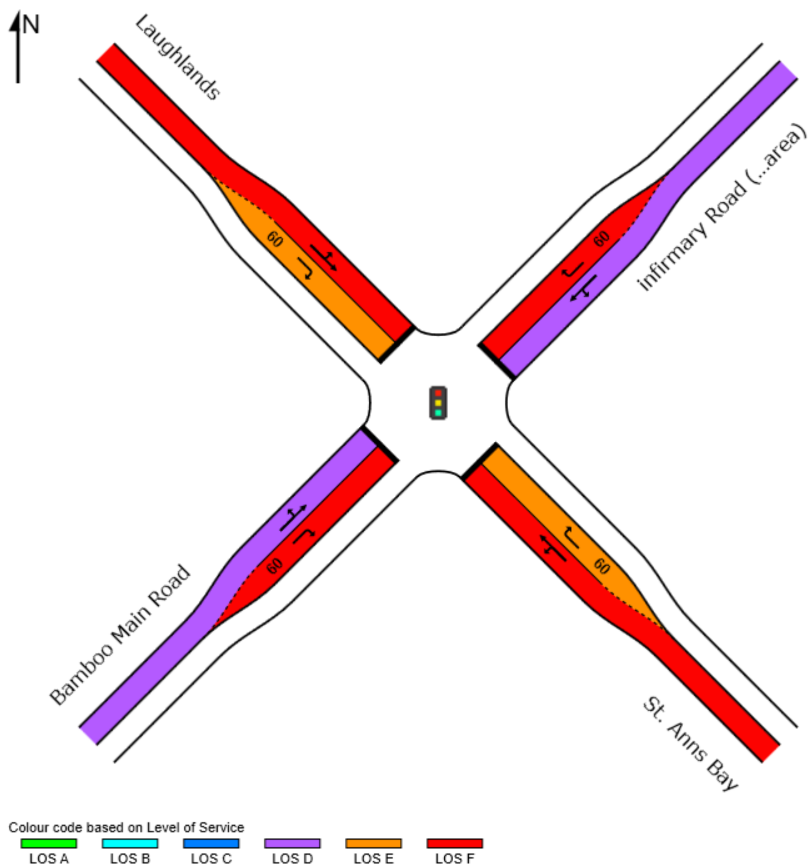


Figure 7-27 Showing Level of service for the road segment at the Bamboo/Laughlands Intersection

Table 7-25 Showing the movement performance at the Bamboo/Laughlands Intersection for the AM peak during the operational phase (10years @ 3% annual growth)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
SouthEast: St. Anns Bay												
21	L2	124	3.2	1.090	217.5	LOS F	120.2	943.9	1.00	1.79	2.20	11.8
22	T1	748	16.0	1.090	213.0	LOS F	120.2	943.9	1.00	1.79	2.20	13.0
23	R2	13	23.1	0.068	69.8	LOS E	0.8	7.1	0.89	0.69	0.89	25.3
Approach		885	14.4	1.090	211.5	LOS F	120.2	943.9	1.00	1.78	2.18	12.9
NorthEast: infirmary Road (to project area)												
24	L2	19	5.3	0.080	41.6	LOS D	0.9	6.4	0.88	0.69	0.88	35.1
25	T1	1	0.0	0.080	36.0	LOS D	0.9	6.4	0.88	0.69	0.88	35.8
26	R2	8	37.5	0.136	87.1	LOS F	0.6	5.6	0.97	0.67	0.97	26.0
Approach		28	14.3	0.136	54.4	LOS D	0.9	6.4	0.90	0.68	0.90	31.7
NorthWest: Laughlands												
27	L2	4	25.0	1.104	236.7	LOS F	142.9	1061.3	1.00	1.90	2.32	12.6
28	T1	1021	7.1	1.104	230.9	LOS F	142.9	1061.3	1.00	1.90	2.32	12.7
29	R2	17	11.8	0.059	63.3	LOS E	1.0	8.0	0.85	0.70	0.85	30.7
Approach		1042	7.2	1.104	228.2	LOS F	142.9	1061.3	1.00	1.88	2.30	12.9
SouthWest: Bamboo Main Road												
30	L2	39	17.9	0.112	36.8	LOS D	1.8	14.9	0.80	0.71	0.80	38.5
31	T1	4	25.0	0.112	31.0	LOS C	1.8	14.9	0.80	0.71	0.80	37.7
32	R2	242	4.1	1.029	147.4	LOS F	26.6	192.6	1.00	1.08	1.64	17.2
Approach		285	6.3	1.029	130.7	LOS F	26.6	192.6	0.97	1.03	1.52	18.9
All Vehicles		2240	10.0	1.104	207.0	LOS F	142.9	1061.3	0.99	1.71	2.13	13.5

Summary

There were increases in delays in the operational phase (initial) which were within an acceptable range for user satisfaction for most of the lanes except those which presently are already below acceptable levels. Hence, the delays became significant as a result of traffic conditions that were predicted for the operational phases 10 years after completion. The LOS fell into the Class F range for many intersection approaches and in some instances, flows began to exceed signal capacity.

Implementation and modelling for a scenario with an additional lane along the corridor showed significant improvement in LOS during the Operational phase. This also carries through to the future scenario as the LOS does not fall below an acceptable C rating.

Table 7-26 and Table 7-27 below give the summarized data.

Table 7-26 Summary of Bamboo/Laughlands Intersection Scenarios

Bamboo/ Laughlands	Fr St. Ann's Bay						Fr Infirmary Road						Fr Laughlands						Fr Bamboo Main Road					
Intersection	Left		Straight		Right		Left		Straight		Right		Left		Straight		Right		Left		Straight		Right	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Existing Conditions	160.2	F	155.6	F	69.8	E	40.2	D	34.6	C	83.4	F	30.2	C	24.1	C	55.7	E	30.1	C	24.3	C	77.1	E
Operational Phase	109.2	F	104.6	F	69.2	E	41.0	D	35.4	D	87.6	F	37.7	D	31.9	C	62.8	E	37.3	D	31.5	C	78.0	E
Operational Phase in 10 years	217.5	F	213.0	F	69.8	E	41.6	D	36.0	D	87.1	F	236.7	F	231	F	63.3	E	36.8	D	31.0	C	147.4	F

Table 7-27 Summary of Proposed Main Gate Intersection Scenarios

Proposed Main Gate Intersection	Fr St. Ann's Bay				From Hotel Main Gate				Fr Laughlands			
	Straight		Right		Left		Right		Left		Straight	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Operational Phase	23.8	C	47.8	D	23.2	C	47.9	D	8.0	A	8.4	A
Operational Phase w/ Corridor Improvement	14	B	32.9	C	15.8	B	32.1	C	8.9	A	8.8	A
Operational Phase 10 years	116.8	F	58.3	E	28.4	C	60.0	E	7.8	A	9.4	A
Operational Phase 10 years w/ Corridor Improvement	15.6	B	34.7	C	16.7	B	34.0	C	8.7	A	8.8	A

Conclusions and Recommended Mitigation

CONCLUSIONS

1. Implementation of the proposed entrance would significantly impact the LOS experienced by motorists traversing the ARG Byfield A1 Highway. The implementation of a signalized intersection improves the experience, however still below what is acceptable in terms of LOS.
2. The performance of the proposed intersection is expected to remain in a similar category throughout all phases however due to the significant increase in volume in 10 years, the intersection would lose its effectiveness
3. Bamboo/Laughlands intersections is expected to remain within similar category bounds during construction and within the initial operational years of the development. However, it is expected that future conditions are expected to significantly stress the capacities of the road network. It was also highlighted that the Laughlands approach towards St. Ann's Bay Road is the most susceptible to the effects of traffic volume increases.
4. It was also highlighted that a signalized intersection would be required to safely and effectively facilitate movement into the site during operation as opposed to an unaltered roadway.
5. An Increase in the number of lanes across the entire road corridor exceeding both the proposed Richmond and Bamboo intersections is the best way to promote a relatively good flow of traffic especially when considering that expected growth of vehicular volume and future growth and development of the surrounding communities and commercial entities. That being said, a minimum improvement length of one queue length will improve the LOS at the proposed intersection.

RECOMMENDED MITIGATION

v. Increasing the number of lanes on along the road corridor to facilitate a higher flow capacity of vehicles would significantly improve the LOS experienced by motorists traversing the area.
vi. Implement designated short lanes to allow traffic to leave the Laughlands and St. Ann Bay roads and enter the site without impeding the main road traffic.
vii. The scheduling of the arrival of heavy vehicles should be organized for off-peak traffic hours. This would of course decrease delays and reduce the chances of accidents which are usually increased by the introduction of slow-moving and stationary traffic into a relatively fast-moving environment.
viii. Installation of signs along the major road to warn motorists approaching each intersection, by NWA specifications. Signs instructing motorists to reduce their speed will significantly reduce the possibility of road accidents caused by the presence of the intersections.

7.3.4.6 Tourism

The proposed hotel is likely to improve the tourism product of the country. No mitigation is required for this impact.

7.3.4.7 Grievance Mechanism

During hotel operations stakeholders (both internal and external) may experience varying levels of inconvenience, discomfort, Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination.

Recommended Mitigation

With the aim of establishing and maintaining a harmonious relationship between the stakeholders (both internal and external) and the Project, a Claims and Complaints Absolution Program will be implemented, whose general objective is to create a system that allows timely response to complaints from residents who are perceived to be affected or harmed by any aspect of the Project. A Grievance Redress Mechanism (GRM) to include reports of allegations of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination will be formulated. The objectives of the GRM are outlined below:

- Ensure a fair and rapid response by the representatives of the Project to the questions, concerns and / or complaints of the stakeholders, so that they do not become negative impacts.
- Provide alternative methods to solve potential complaints in substitution of legal actions between the parties.
- Properly document complaints and claims, elaborating respective formats for each stage of the process.
- Build a process of mutual trust with local and regional groups of interest.
- Clearly defining policy statements about the handling of complaints and claims (including, when appropriate, mechanisms to ensure confidentiality and access to the information).
- Clearly establishing organizational responsibilities such as the assigning of specific personnel from the operation, managers, and/or functional units to implement the GRM, designating access points for complaints.
- Defining, documenting, and disclosing workflow procedures and standards to ensure that all complaints are understood and analysed, as well as the criteria for decisions to determine the appropriate responses.
- Establishing clear communications mechanisms with claimants, both regarding how to bring problems to the attention of the authorities and how those authorities communicate with the claimants.
- Establishing systems to register and follow up on all complaints, disputes, or claims.
- Establishing an appeal process (or other solutions) for cases where the parties involved in a complaint, or a dispute do not agree with the decisions at the operational level.

7.3.4.8 Fishers and Maritime Interests

Stakeholder consultations conducted revealed that spear fishers would take public transportation from St. Ann's Bay to Priory and walk through the proposed project area and swim from the beach to go fishing. In addition, spear fishers, on returning from sea, would walk through the proposed project site toward the Priory Main Road to get public transportation to return to St. Ann's Bay.

While some boat fishers may not use the proposed area regularly, the area is used as a channel in times of emergency and inclement weather.

Recommended Mitigation

- Coordinate with the Tourism Enhancement Fund and the National Fisheries Authority to ensure that the proposed upgrading to the official fishing beach at Priory have the requisite infrastructure to accommodate the displaced fishers.

7.4 BEACH WORKS AND OVERWATER STRUCTURES

7.4.1 Construction

7.4.1.1 Physical

Water Quality

Sedimentation of the water column and nearby reef and seagrass beds is possible as a result of construction activities within the proposed beach works and overwater rooms areas. Raw materials, for example sand used for beach creation will be stored on site or at a staging area; ground and surface water quality may be prone to increased suspended solids from run-off from rainfall events. Boulders to be used for coastal structures also have the potential to increase water turbidity.

Where necessary temporary construction pad/access road (typically 5m wide at the crest) will be built from the shoreline in a seaward direction. The access road will help with the delivery and removal of material and will serve as a work platform for the mechanical placement of stone for the proposed structures. This temporary construction pad has the potential to increase water turbidity.

RECOMMENDED MITIGATION

i. The project site will put in sediment control measures such as turbidity barriers/silt screens and should be erected around the active work area to prevent the dispersion of sediments and contaminants throughout the water column.
ii. A central area will be designated for the storage of raw materials. This area should be lined in order to prevent the leakage of chemicals into the sediment.
iii. Sand will be stockpiled away from drainage channels
iv. Stoppage of works during adverse weather conditions
v. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by bunds to contain the volume being stored in case of accidental spillage.
vi. Refuelling of boats should only be done at anchor out at sea if the sea conditions are calm, otherwise, all refuelling should be done when docked at land. Appropriate refuelling equipment (such as funnels) and techniques should always be used.
vii. Appropriate minor spill response equipment (for containment and clean- up) will kept on site, including oil absorbent pads and disposal bags.
viii. In terms of transporting equipment, the paths of the planned roadways will be used, rather than creating temporary pathways just for equipment access.

ix. Vehicle refuelling facilities must be situated on impermeable surfaces served by an oil trap, run-off collection system. Sediment basins and oil water separators should be constructed to intercept storm water before it is discharged.
x. Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity in and around the project area should be conducted during construction for the first 3 months of construction. Monitoring can be conducted fortnightly thereafter.
xi. Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed overwater villas and at control stations, on a monthly basis, for comparison to background levels and pre-construction sedimentation rates.

Marine Excavation and Dredging

Dredging of the wading area and flushing channel may result in deterioration of the water quality of the immediate area as well as some distance away in the direction of prevailing currents. Dredging may result in the increase of suspended solids, turbidity, BOD and the reduction in light penetration and dissolved oxygen in the water column. Suspension of heavy metals from the substrate is also possible and leakages and spillages of oil and solid waste from equipment associated with dredging.

The reduced water quality and light penetration may result in reduced photosynthesis of the seagrass beds nearby. Coral and Other sessile and filter feeding species in the vicinity of the dredge area may be affected by smothering.

Suitable dredged material will be used as fill material for backfilling the back of the beach and filling behind the revetment of the perched beach. Dredge spoil drainage from land may affect coastal water quality and sensitive species in the nearshore area. Dredged material will be placed in a bermed settling pond for dewatering after the fines have settled. Remaining unsuitable material will be transferred to trucks and disposed of at an approved disposal site.

RECOMMENDED MITIGATION

- Turbidity barriers/silt screens are recommended to be used around all dredging activities. These should be placed so as to reduce/contain the resultant sediment plume during these activities. Dredging activities should only occur when these barriers are fully operational, that is; placed correctly; in calm to moderate sea conditions; and without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms. The silt screens should encircle the areas and be deep enough to contain the plumes so that plumes will not travel in the direction of the prevailing currents.
- Care should be taken to dredge only in approved dredge areas. Dredge areas and a buffer area should be demarcated to avoid accidental dredging in unauthorized areas.
- Dredging operations should be continually monitored to ensure equipment and machinery are in good repair and regularly serviced to prevent oil leaks during regular operations.

- Dredge spoils deposited on land should be placed in a bermed holding area for dewatering after the fines have settle and then the material transferred to trucks to be either disposed of or used on site as fill material if needed.

Noise Pollution

Construction necessitates the use of heavy equipment to carry out the job. These possess the potential to have a direct negative impact on the noise climate. Noise directly attributable to construction activity should not result in noise levels in the residential areas to exceed 55dBA during daytime (7am – 10 pm) and 50 dBA during night-time (10 pm – 7 am). Where the baseline levels are above the stated levels then it should not result in an increase of the baseline levels by more than 3dBA. Construction noise can result in short-term impacts of varying duration and magnitude. The construction noise levels are a function of the scale of the project, the phase of the construction, the condition of the equipment and its operating cycles, the number of pieces of construction equipment operating concurrently.

RECOMMENDED MITIGATION

i. Use equipment that has low noise emissions as stated by the manufacturers.
ii. Use equipment that is properly fitted with noise reduction devices such as mufflers.
iii. Operate noise-generating equipment during regular working hours (e.g., 7 am – 7 pm) to reduce the potential of creating a noise nuisance during the night.
iv. Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.

7.4.1.2 Biological

Rocky Shore and Intertidal Communities

The rocky shore and intertidal communities found along the headland may be impacted by the proposed project. Species diversity and abundance is in general low. The impact of the loss of species and habitat is expected to be low. Species present on the rocky shore and intertidal areas should recolonise suitable areas post-construction. Any permanent structures with intertidal areas should provide additional substrate for colonisation by some species.

No recommended mitigation.

Benthic Communities

The marine works in both bays are in a shallow nearshore community which may result in the loss of several benthic habitats, including, seagrass beds, patch reefs and pavement, standalone large (10cm or greater) coral colonies and other sessile benthic species. The nearshore areas such pavement and algal reef areas which may be periodically exposed, have a high wave climate and other stressors, in general have low colonization, density and diversity. The pavement is dominated by turf and macroalgae, with small encrusting species such *Siderastrea sp*. colonies and rock boring urchins.

Some areas have very high densities such as the *Echinometra* zone. These cannot be successfully relocated and may result in species loss.

The potential impact area with a 4m buffer is given in Figure 7-28 for the west bay and Figure 7-29 for the east bay.

Table 7-28 Potentially impacted benthic habitat zones

Benthic zone	Western bay (sqm)	Eastern bay (sqm)	Total (sqm)
Algal reef	1176.2		1176.2
Echinometra zone	51.2	2.2	53.4
Fringing reef	189.4	244.4	433.9
Patch reef	49.6		49.6
Pavement	863.9		863.9
Rock and rubble	1215.6		1215.6
Rocky shore	505.8	6.4	512.3
Sand or silt	186.4	2086.5	2272.9
Sea fan zone	108.9		108.9
Seagrass	3660.7	21759.9	25420.7
Sun Anemone zone	128.9		128.9
Total impacted	**8136.6**	**24099.4**	**32236.2**

Various habitats impacted and the associated biota, Urchins and other mobile invertebrates can be relocated to similar areas outside the project, with the exception of species encrusting on or growing in pavement. Sections of the dense *Echinometra* community maybe impacted, these dig themselves deep into the pavement and are very difficult to successfully remove. *Echinometra* in pavement is not suitable for relocation.

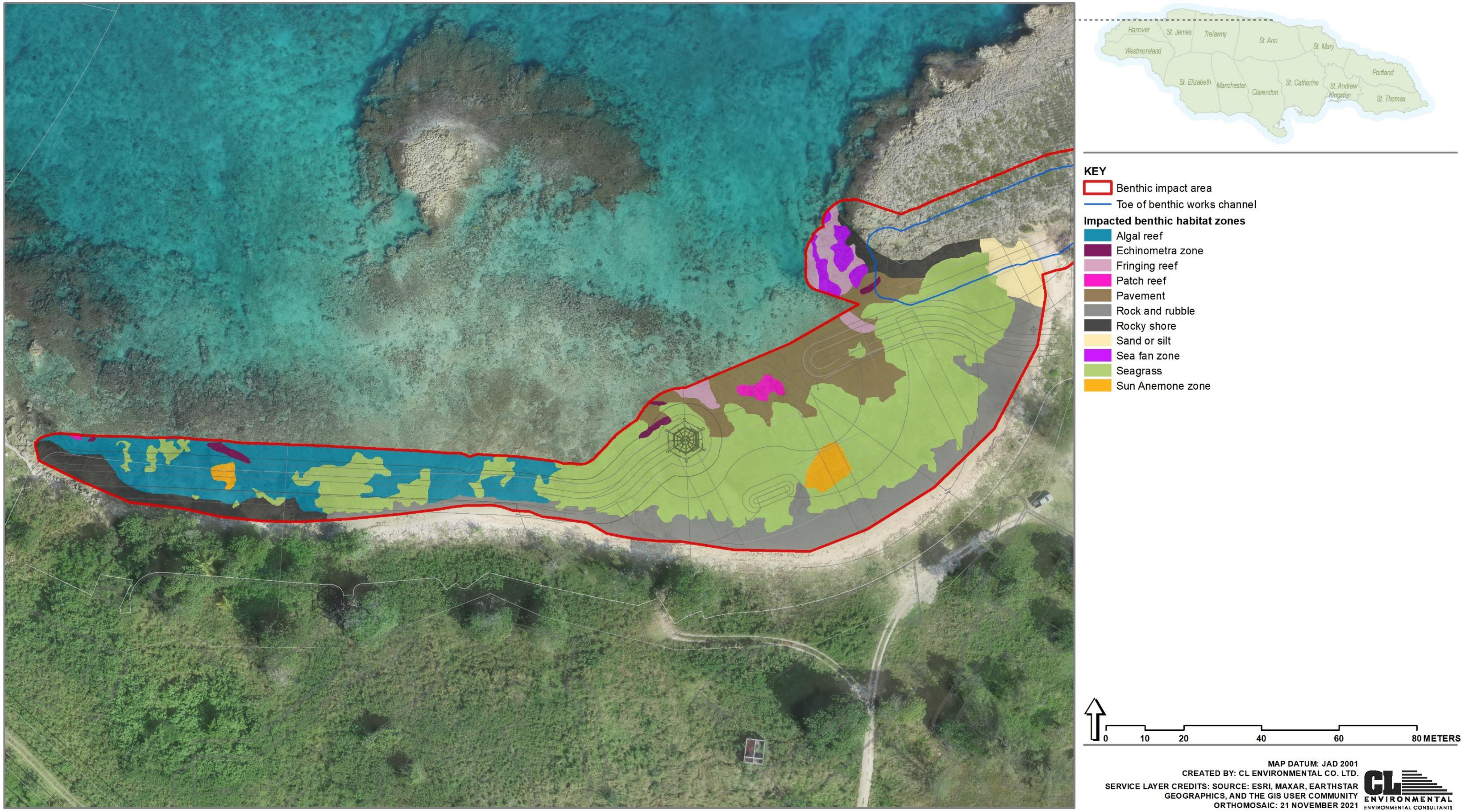


Figure 7-28 Potential Impact Area in the West Bay

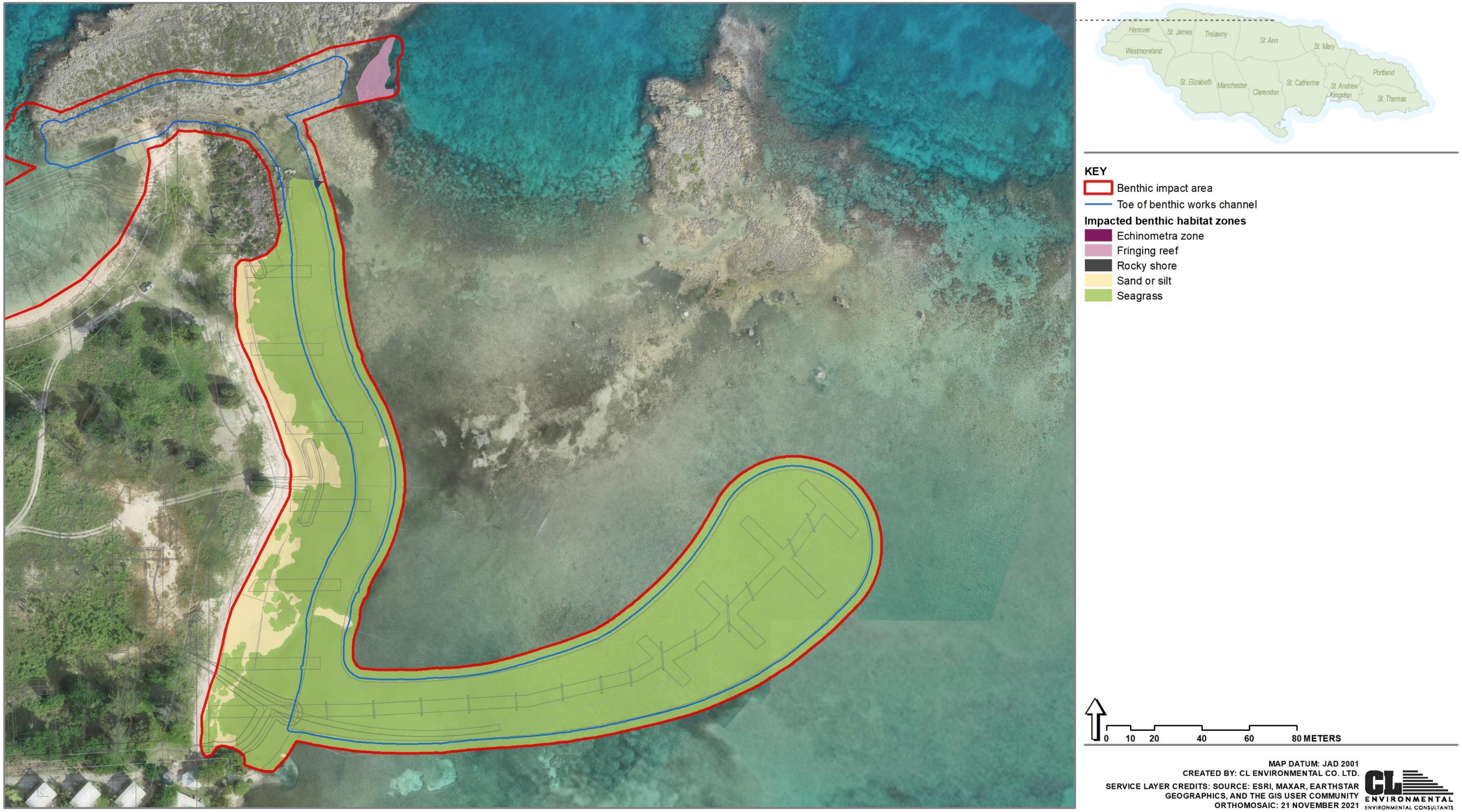


Figure 7-29 Potential Impact area in the East Bay

PRIMARY MITIGATION MEASURES

The surrounding benthic and intertidal community including seagrass, hard corals, fish, urchins and other invertebrates may be impacted by sedimentation and smothering, habitat fragmentation/loss, loss of suitable breeding, foraging and nursery grounds, increased water turbidity and suspended solids and species loss. As a result, the following mitigation measures should reduce the potential impact to the biological environment.

1. During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish.
2. Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity and Total Suspended Solids (TSS) in and around the project area should be conducted during construction for the first 3 months of construction. Monitoring can be conducted fortnightly thereafter.
3. Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and other marine works and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison.
4. All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area.
5. Relocation of sensitive species should be done if; they are suitable for relocation (that is suitable substrate, health and over all viability), those species fall within the potential impact area; and if mobile invertebrates are in or around the potential impact area. Sensitive organisms and systems in and outside the impact area include; hard and soft corals, sponges, seagrass and mobile invertebrates such as urchins, sea cucumbers, starfish and conch. **Detailed Seagrass and Coral Removal and Relocation Plans, as well as a Post-Relocation Monitoring Plan, must be prepared for approval by NEPA.**
6. Alternative mitigations should be proposed when relocation is unlikely to be successful.
7. Where possible, as little of the natural environment should be relocated or removed. Habitat fragmentation and species displacement should be temporary, with the placement of silt screens, construction materials and equipment as well as general human activity in the area.
8. Structures placed on the seafloor may cause habitat fragmentation and displace some species, however they may also serve to add ecological volume, providing substrate for organisms to settle and colonize and eventually may serve some ecosystem functions.
9. Any temporary floating structures and /or vessels should be placed in areas with less sensitive species where possible. Floating structures anchored or moored over seagrass beds or coral

colonies should not be left for prolonged time periods as the resulting shading effects may cause deterioration in overall health of the seagrass bed and coral colonies.

Reef Systems and Corals

The fringing reef system has a patchy distribution of hard coral, seafans and Millipora sp. Some section within the footprint also contain seagrass, loose colonies of *Porites divaricata*. Standard Quantitative measures along transect lines, quadrats or photographs are difficult and as such quantification of this community was difficult.

An estimated 165 standalone hard corals and 14 soft corals may be impacted by the marine works (Table 7-29) in both bays. An additional 1,768.5 m^2 of reef areas may be impacted.

Table 7-29 Number of potentially impacted coral (10cm or greater) within each habitat zone

KEY:

Suitable for relocation (green)
Not suitable for relocation (red)

Habitat zone	No. of hard corals	No. of soft corals	Potential relocation site
Algal reef	1 (suitable)		Area 1,2 and 3
Echinometra zone	1 (not suitable)		Area 1,2 and 3
Fringing reef	8 (suitable)		Area 1,2 and 3
Patch reef	12 (suitable)		Area 1,2 and 3
Pavement	9 (not suitable)		Area 1,2 and 3
Sand or silt	1 (suitable)		Area 1,2 and 3
Seagrass	133 (suitable)	14 (suitable)	Area 4
Total suitable for relocation:	**155**	**14**	
Total not suitable for relocation:	**10**		
Total number of corals impacted:	**165**	**14**	

Sections of impacted fringing reef with colonies above 10cm and high densities of seafans which will require relocation. Hard and soft corals on the fringing reef maybe relocated as standalone colonies or planting units. A planting unit (0.5 x0.5m cube) is a section of reef with several encrusting species present. Not every section of impacted reef area will be colonised with large coral colonies or seafans, instead approximately 5% of reef areas have larger encrusting species. Seafan area were more dense and therefore were estimated to have a 60% cover. Planting units allow colonies to remain intact and fixed to its original substrate, colonies are therefore removed intact and unit itself relocated to a suitable area. Each planting unit is then fixed to suitable substrate. This method allows colonies to remain intact and fixed to the existing reef which will help reducing stress and increase survivability. An estimated 836 Planting units will be relocated to proposed the relocation areas 1, 2 and 3. Table 7-30 details the each habitat and the estimated number of planting units and the proposed relocation areas.

Table 7-30 Estimated planting units for proposed relocation

Benthic zone	Western Bay			Eastern Bay			Combined Total	
	Area impacted (m^2)	Estimated area with coral cover (m^2)	No. of planting units	Area impacted (m^2)	Estimated area with coral cover (m^2)	No. of planting units	Estimated area with coral cover (m^2)	No. of planting units
Algal reef	1176.2	58.8	235	0.0	0.0	0	58.8	235
Fringing reef	189.4	9.5	38	244.4	12.2	49	21.7	87
Patch reef	49.6	2.5	10	0.0	0.0	0	2.5	10
Sea fan zone	108.9	65.3	261	0.0	0.0	0	65.3	261
Total:	**1524.1**	**136.1**	**544**	**244.4**	**12.2**	**49**	**148.3**	**593**

Both bays have significant colonies of *P. divaricata*. These colonies are mobile and not considered part of the overall total relocation numbers and do not require typical coral relocation methodologies, however sections of the benthos have very dense *P. divaricata* and as such need to be considered as part of any relocation exercise. Unlike a typical coral relocation which requires the use of tools to separate colonies from the substrate and fixed with cement, or epoxy to another substrate in the relocation site. *P.divaricata* found in seagrass are not fixed, instead these colonies are free moving often observed rolling around within seagrass beds or partially buried under sand. These colonies will be gathered and moved to seagrass areas outside the working footprint prior to any works. Standalone colonies as well in shallow seagrass beds may also be easily relocated to similar beds outside the project footprint. Similar seagrass bed areas can be found in the east bay outside the project footprint. It will be essential not place these colonies in sections of the bed with very silty or muddy substrate.

The area immediately in front of the fringing reef systems is a deeper sloping pavement community with little limited structure. As much of this area is sparsely populated with living coral, these patch reefs and old dead coral may provide suitable substrate for coral relocation.

Seagrass beds in the east bay, outside the project footprint are suitable for relocation of small coral colonies and mobile invertebrates.

OUTSIDE THE IMMEDIATE IMPACT AREA

The existing fringing reef system, including 49 colonies of *Acropora palmata*. These are critically endangered and highly sensitive species. Extreme care must be taken to limit any environmental changes such as water quality and sedimentation. Some colonies are in close proximity to the proposed works and as such are at risk of mechanical abrasion or damage during construction activities. There is also an extensive reef system outside the project area, but with the potential zone of influence of construction activities. The reef systems in and surrounding the nearby project has been stressed due to warming waters, outbreaks of two recent diseases, such as the Stony Coral Tissue Loss Disease and a mass die off of *Diadema antillarum*. Coral cover, density and diversity as well as reef structure vary, however these nearby features require extreme care during site preparation and construction.

Challenges with nearby areas include a high wave climate, exposure to storm surge and availability of suitable substrate.

Corals encrusting in pavement are unsuitable for relocation.

RECOMMENDED MITIGATION

See mitigation measures 1-9 listed previously (Primary Mitigation Measures).

Potential Coral Relocation Areas

Potential coral relocation sites were identified immediately outside the immediate project footprint, based on the similarity in habitat and in proximity to the removal areas. Areas identified as suitable for large colonies and plating units as well as areas for smaller colonies are shown in Table 7-31 and Figure 7-30.

Table 7-31 Potential coral relocation sites

Potential Coral Relocation Areas	Area (m^2)
Areas suitable for large colonies and planting units	12,264
Seagrass areas suitable for small colonies and invertebrates	16,568
TOTAL AREA	28,832

Monetary compensation is recommended for species and habitat loss, for areas and species, not suitable for relocation. Discussions will be had with NEPA regarding any financial compensation.

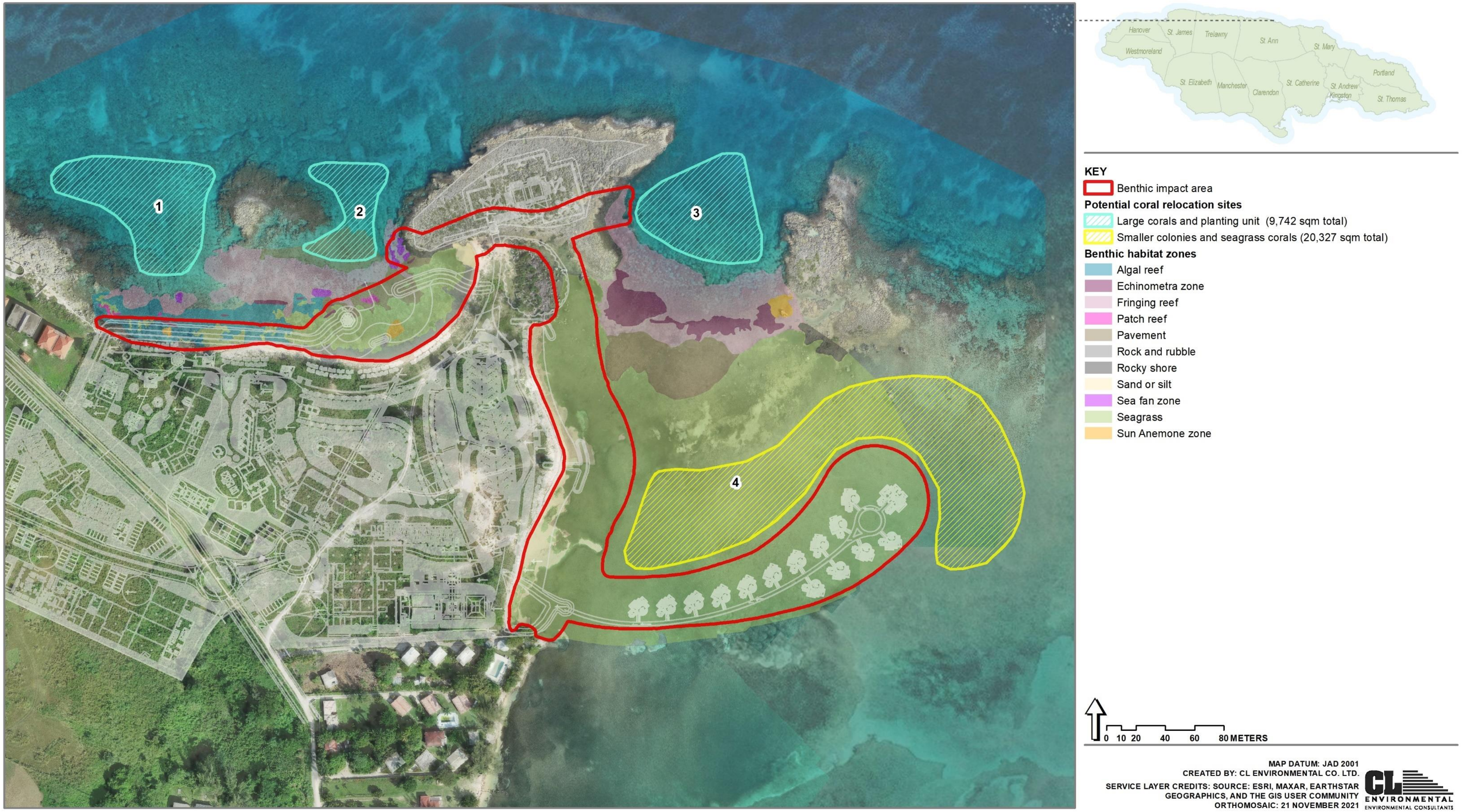


Figure 7-30 Potential coral relocation areas

Seagrass

SEAGRASS SUITABILITY

Sections of the project footprint lie within an expansive seagrass bed in east bay, a smaller bed in the west bay and beds along both coastlines. A 4-meter buffer outside of the project footprint was applied to account for the active working area and accidental seagrass damage during construction.

Approximately **23,956.30 m²** of seagrass located within the entire project footprint will be impacted for various project features. Figure 7-31 displays the impacted seagrass and suitability in the west bay; 2,196.40 m² of seagrass may be impacted in this area, none of which is suitable for relocation. In the east bay, a total of 21,759.9 m² of seagrass falls within the impact area (Figure 7-32). The total impacted seagrass and their relocation suitability can be seen in Table 7-32.

Table 7-32 Impacted seagrass within the West and East Bays and relocation suitability

	West Bay (m²)	East Bay (m²)	Total (m²)
Area of seagrass suitable for relocation	0	8,426.10	8,426.10
Area of seagrass not suitable for relocation	2,196.40	11,188.60	13,385.00
Area of seagrass not ideal for relocation	0	2145.20	2145.20
Total area of seagrass within potential impact zone	2,196.40	21,759.90	23,956.30

The removal seagrass should be limited where possible and all suitable seagrasses should be relocated to nearby surrounding areas.

The suitability of seagrasses for relocation is highly dependent on tolerance limits of the seagrass species for environmental variables such as water temperature, salinity, light availability (a function of water depth and turbidity), flow velocity, wave exposure, low tide exposure to air (desiccation) and substrate conditions (composition and stability). In order for seagrass beds to be removed and relocated successfully, substrate and sediment composition must be defined from donor beds as well as relocation/ replanting areas.

Construction activities associated with the hotel development and beach works may result in the mortality of seagrasses and associated biota within the project footprint. Seagrasses and associated biota around the project area but not directly within the footprint may also be affected by sedimentation and smothering from construction activities. The main potential impacts to the marine environment as a result of site preparation and construction activities are; Species loss/displacement, habitat loss/fragmentation, excess sedimentation and reduced water quality.

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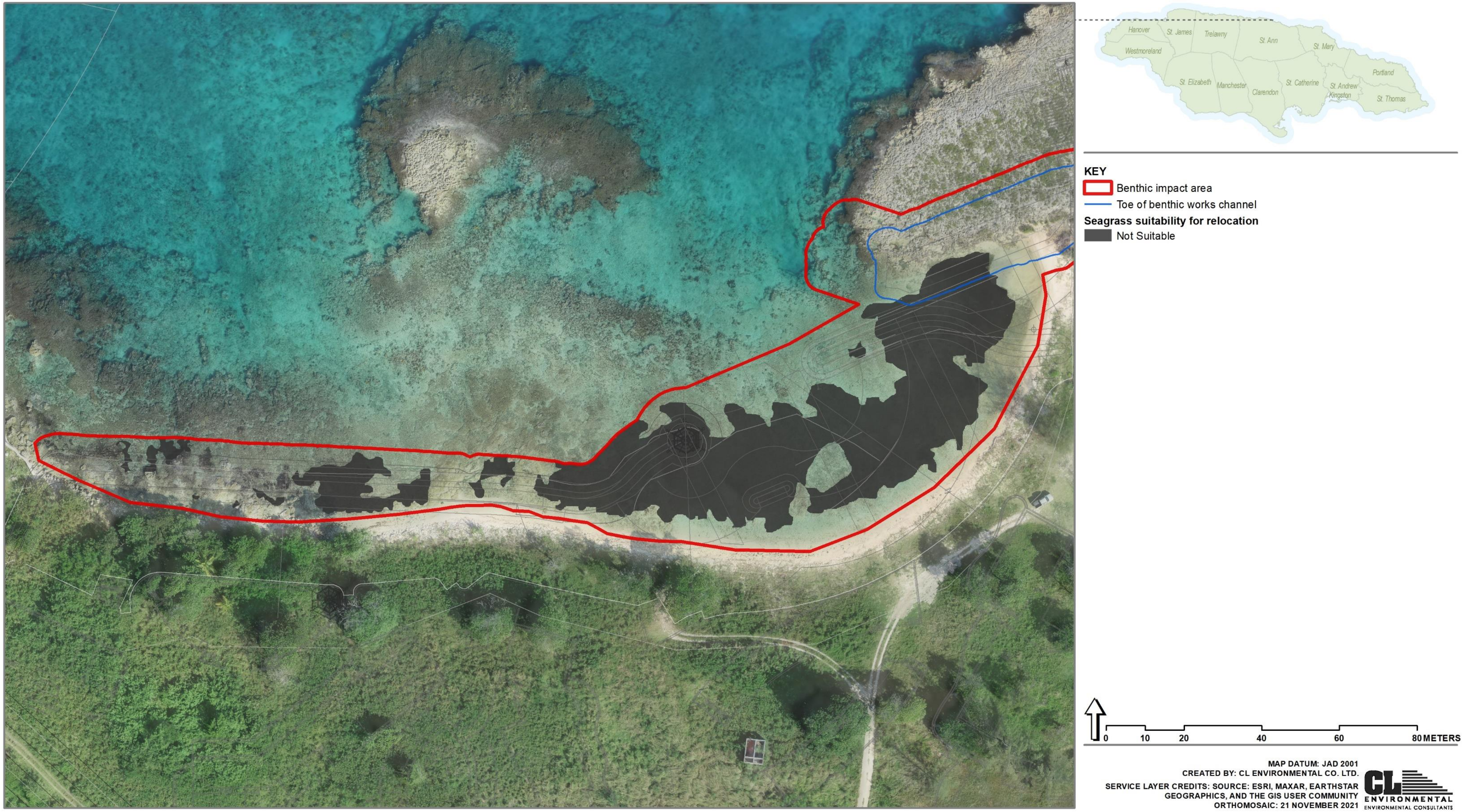

Figure 7-31 West Bay Impacted Seagrass and Suitability

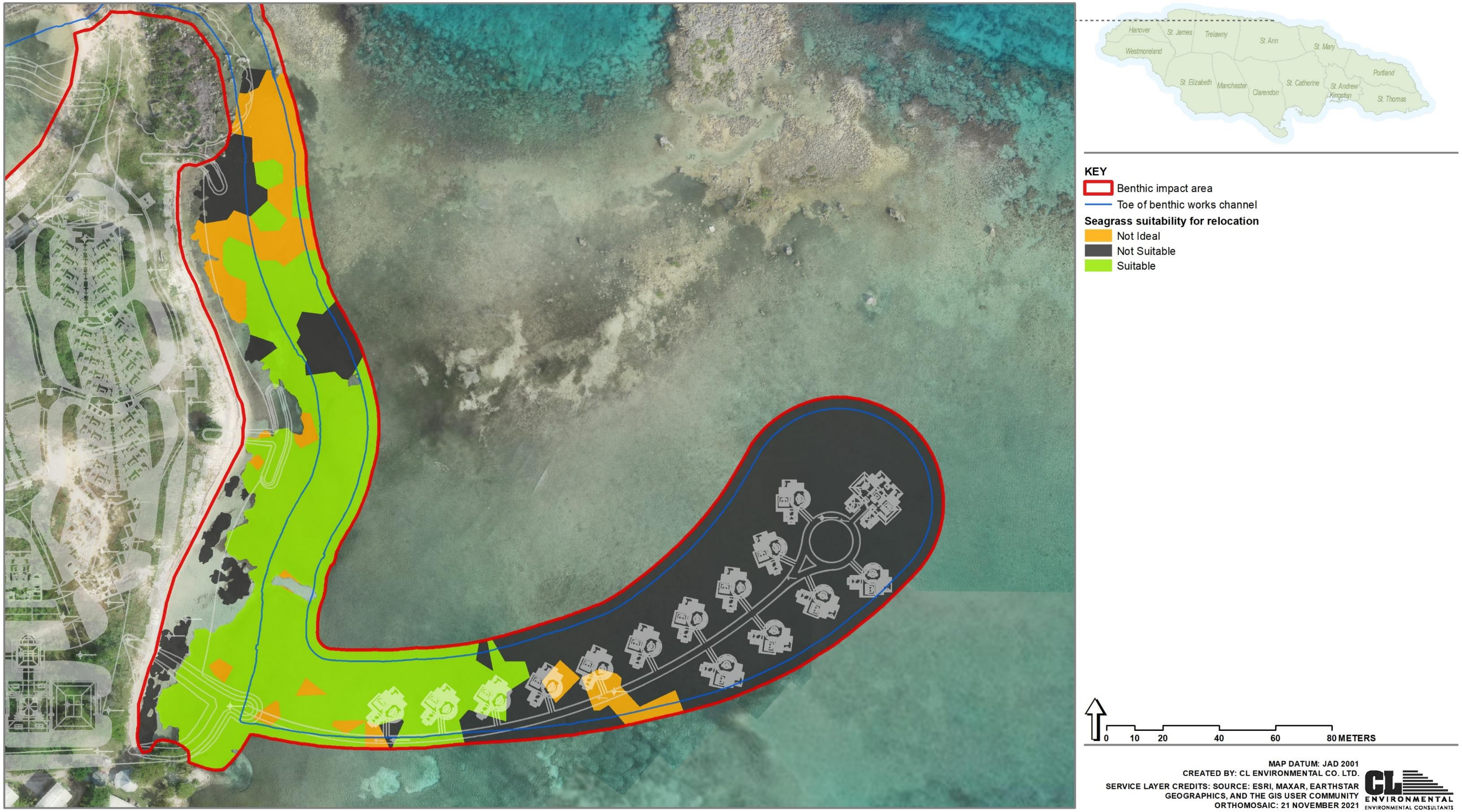

Figure 7-32 East Bay Impacted Seagrass and Suitability

Seagrass Relocation Sites

Of the 23,956.3 m² of seagrass to be impacted by the overall proposed project works, approximately 8,426.1 m² is deemed suitable for relocation. 2,145.2 m² is not ideal for relocation. The proposed seagrass replanting site 11,263.5m² is shown in Figure 7-33.

Relocation site selection is based on sediment suitability and other environmental parameters as well as proximity to donor areas.

Monetary compensation is recommended for the remainder of seagrass (16,994.5 m²) which is not suitable or not ideal for relocation. Discussions will be had with NEPA regarding any financial compensation.

Carbon Storage and Sequestration

Removal of seagrass may result in loss of both carbon stored within the seagrass beds as well as overall carbon sequestration in the project area. The estimated carbon storage is given in Table 7-33.

Table 7-33 Estimated Carbon in the Potential Seagrass Impact Area

Average Carbon Storage			
	Shoot Storage MgC/ha	Root Storage MgC/ha	Soil Storage MgC/ha
West Bay	0.0266	0.082	5.71
East Bay	0.0955	0.247	10.94

Recommended Mitigation

See mitigation measures 1-9 listed previously (Primary Mitigation Measures).

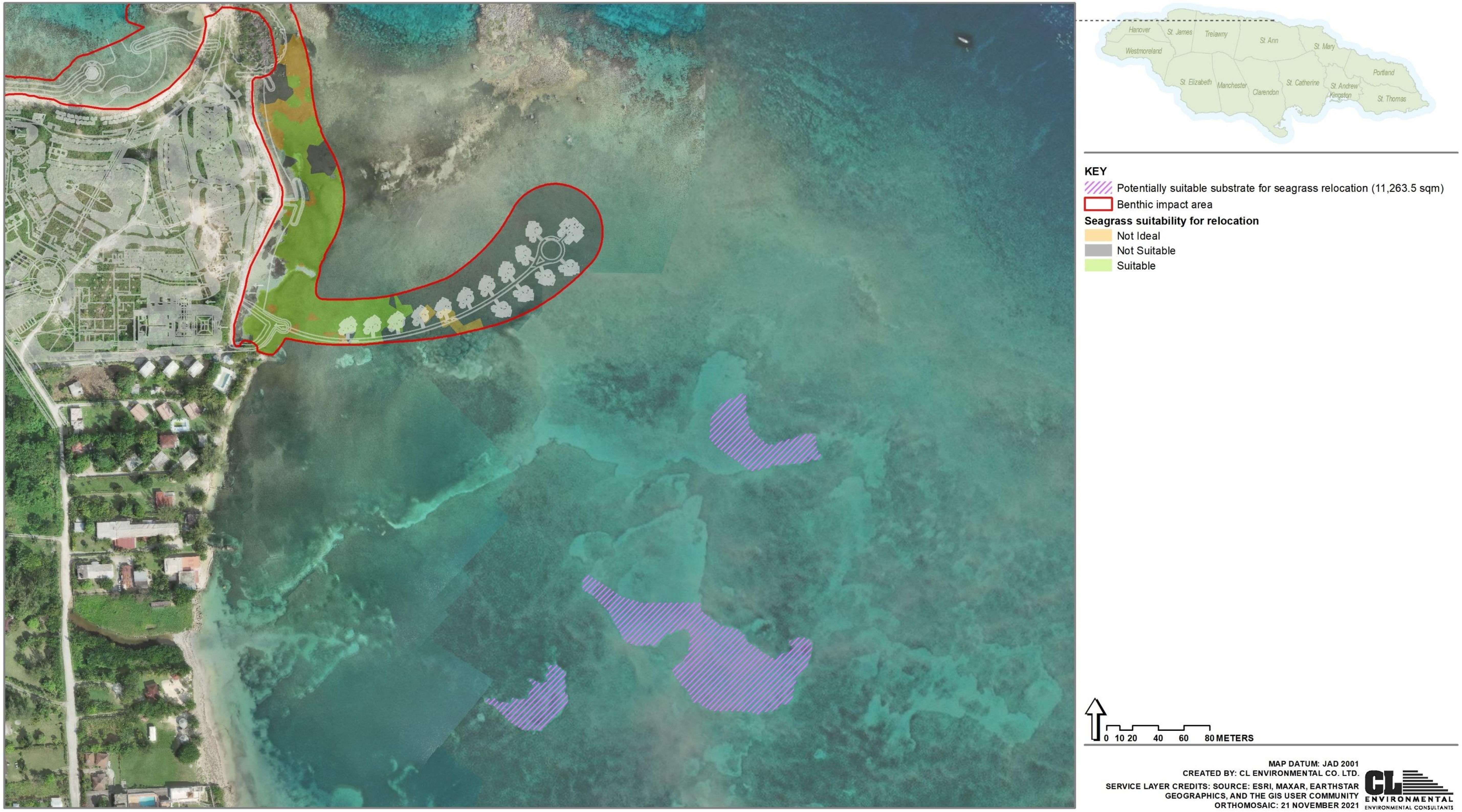

Figure 7-33 Potential Seagrass Relocation Sites

Sea Turtles

Site preparation and construction activities may result in the temporary displacement of any sea turtles that utilize the general area for foraging and nesting. Displacement may occur as a result of; silt screens and other barriers and equipment being utilized, this may prevent/limit access to various habitats and pathways (fragmentation).

Nesting turtles maybe particularly sensitive to varying and increased noise (Wendy E.D Piniak, 2016). Studies carried show that turtle have auditory cues however the impact of noise on their ecology is not fully known.

Lighting used during any night-time construction activities has the potential to interfere with nesting and navigation of some species.

RECOMMENDED MITIGATION

i. Attempts should be made to schedule the majority of the construction period outside of turtle nesting season (May – October).
ii. All staff and workers should be sensitized to all sensitive ecosystems and species in the area, in particular turtles. The site should be inspected daily for any signs of turtle activity. If a nest is suspected or found, all activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs.
iii. The stakeholders, proponents and the NEPA should develop clear lines of reporting and communication in the event that action needs to be taken.
iv. Silt screens should be used to prevent sedimentation but should be removed promptly along with any other construction debris and material upon completion.
v. Night-time activities should be limited or avoided when possible. No lights should be pointed out to sea confusion and disorientation of turtles or any other species that maybe affected by lunar activity.
vi. Fixtures in direct line-of-sight from the beach should be shielded down-light only fixtures or recessed fixtures having low wattage "bug" type bulbs and non-reflective interior surfaces.
vii. Fixtures mounted as low in elevation as possible through use of low-mounted wall fixtures, low bollards and ground level fixtures.
viii. Floodlights, up-lights or spotlights for decorative and accent purposes that are directly visible from the beach, or which indirectly or cumulatively illuminate the beach shall not be used.
ix. For high intensity lighting applications such as providing security and similar applications shielded low-pressure sodium vapour lamps and fixtures shall be used.

7.4.1.3 Socioeconomic

Maritime Traffic

Construction activity may have the potential to negatively impact fishing and other maritime activities taking place at sea due to vessels, machinery and equipment in the water being used during the construction process. Accident potential is also increased due to presence of vessels, structures and equipment at sea.

RECOMMENDED MITIGATION:

The use of highly visible marker buoys demarcating an exclusion zone should be used to keep out other marine traffic and fishers from the work area to prevent potential accidents.

Health and Safety

Construction will involve numerous construction workers and supervisors, both above water and in the water, during peak period. The possibility of accidental injury is high. There may be either minor or major accidents.

During the construction of coastal structures, a stockpile of armour stones will be created from which an excavator will retrieve and place stones in the various areas for structure construction. This activity has the potential for accidental injury.

MITIGATION

i. A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers.
ii. At least two (2) certified lifeguards should be hired and be on site during work hours in the event of potential accidental drowning.
iii. The construction management team should have onsite first aid kits and make arrangements for the nurse and doctor at St. Ann's Bay Hospital to be on call for the construction site. Prior arrangements should be made with health care facilities/clinics to accommodate any eventualities.
iv. Make prior arrangements with the St. Ann's Bay Fire Station and St. Ann's Bay Police Station to accommodate any eventualities.
v. Material Safety Data Sheets (MSDS) should be stored onsite.
vi. Spotters in the water will assist the heavy equipment in accurate placement of the armour units. The slopes and elevations of the armour layer will be demarcated with visual aids to guide the placement of boulders and to ensure they are properly interlocked.

Aesthetics

Construction activities may decrease the aesthetic appeal of the area; however, this will be for a short-term period during construction.

RECOMMENDED MITIGATION

Good housekeeping activities and adherence to other mitigative measures especially with regard to potential marine water quality contamination.

7.4.2 Operation

7.4.2.1 Physical

Operational waves, swell waves and circulation are discussed in Section 7.3.1.2.

7.4.2.2 Biological

Reef and Seagrass Communities

Reef and Seagrass communities, corals and other sessile organisms which live on the pavement near to the impact area (sponges, gorgonians, tube worms, fanworms) should return to normal conditions.

Pilings provide some ecological volume both on the seafloor and in the water column. Hard structures will provide substrate for colonization which should change in composition over time.

Seagrass beds found directly beneath the searooms will be shaded at times throughout the daytime. Some seagrasses may tolerate a certain amount of shading as they are adapted to turbid, lower light conditions. Too much shading may result in the deterioration of the seagrass health and functionality and even loss of species and eventually habitat.

Habitat fragmentation may result as changes in current patterns and permanent hard structures. This may result in changes in larval dispersal and recruitment. This is expected to minimal therefore no mitigation is recommended.

Fish

Fish may benefit from the pilings and shaded areas. These will act FADs (Fish Aggregation Devices). This area may also be more managed and as a result the fish may benefit from some protection from overfishing. Filter feeders should see normal conditions return over time.

Rocky Shore and Intertidal Communities

Species are expected to recolonise suitable areas on the rocky shore.

Sea Turtles

Turtles should see somewhat normal conditions return over time. However, turtles may experience some habitat fragmentation and loss of food sources from any modification to the seagrass beds in the area. The west bay breakwater and groins will reduce access to beaches for turtles. The loss of seagrass in the west bay will also reduce foraging grounds. In east bay, the searooms act as permanent obstacles which may deter turtles from returning to nest on the beach. Increased noise, maritime activity and lighting may affect and deter turtles from nesting.

MITIGATION

I. All staff and workers should be sensitized to the sensitive ecosystems and species in the area, in particular turtles. The beaches should be inspected daily for any signs of turtle activity. If a nest is suspected or found, all activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs.

II. Turtle-friendly lighting and light positioning (if any) should also be placed on the searooms. Hotel operators should also educate their guests on sea turtle conservation and the correct actions to take if a sea turtle is observed nesting on the beach.
III. The Hotel should also develop a Sea Turtle Monitoring programme which would include tagging and hatchling release. This could add to their attraction offerings (turtle watching).

7.4.2.3 Natural Hazards

See Section 7.3.3.1

Floor levels were developed for a 25-year hurricane and swell wave conditions. Hurricane conditions would cause the greatest increase in the static water level and combined with the large waves, there is potential for extreme flooding to occur. However, swell waves can also cause a notable increase in the wave heights.

Recommended Mitigation

A two-level approach was taken to setting the Sea Room floor elevations: the lower level is closer to sea level and could be a platform for entering and exiting the sea. The building elements placed on this lower platform should be mobile as this level would be flooded during a hurricane as its proposed deck floor level is at +1.25m above MSL. The upper level would not be flooded during hurricane conditions as the FFL will be at +2.95m above MSL.

7.4.2.4 Socioeconomic

Maritime Traffic

The existence of the over water searooms and coastal structures may have the potential to negatively impact other maritime activities taking place. There is also the potential for accidental collision with the structure during the night-time.

MITIGATION

After construction is completed, permanent highly visible marker buoys should be placed at strategic points around the overwater rooms. Turtle-friendly lighting and light positioning should also be placed on the searooms so that they are visible to marine vessels at night-time.

Aesthetics

The proposed sea rooms are likely to improve the aesthetic appeal of the hotel.

No mitigation is required for this impact.

Health and Safety

IMPACT

The operation of the proposed searooms will involve workers and guests, who may become ill or have accidents. In addition, disasters such as storm surge and fires are real possibilities.

MITIGATION

- Have first aid kits located in various sections of the hotel.
- Design and implement an emergency response plan.
- Staff should be trained in CPR and basic first aid.
- Arrange mutual assistance and make prior arrangements with:
    - Health care facilities, St. Ann's Bay Hospital and associated doctors and nurses to accommodate any eventualities.
    - Arrange with other health practitioners to be on call or have an in-house physician/nurse.
    - St. Ann's Bay Fire Station
    - St. Ann's Bay Police Station (Marine police to conduct patrols in the vicinity of the overwater searooms). This may also be conducted by contracted private security.

Tourism

The proposed sea rooms are likely to improve the tourism product of both the hotel and the country.

No mitigation is required for this impact.

8.0 IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

The discussion and analysis of alternatives in Environmental Impact Assessments should consider other practicable strategies that will promote the elimination of negative environmental impacts identified. This section is a requirement of the National and Environment and Planning Agency (NEPA) and is critical in consideration of the ideal development with minimal environmental disturbance.

The following project alternatives have been identified and are discussed in further detail below:

- Alternative 1 - The "No-Action" Alternative
- Alternative 2 - The Project as Proposed in the EIA
- Alternative 3 – The Project as Proposed in the EIA, but with a different Overwater Searoom Location
- Alternative 4 – The Project as Proposed in the EIA, but with a different layout for the northern beach
- Alternative 5 – The Project as Proposed in the EIA, but with a "No-Build" Zone on the peninsula
- Alternative 6 - The Project as Proposed in the EIA, but with a Reduced Wading Area at the Eastern Beach
- Alternative 7 - The Project as Proposed in the EIA, but with a Reduced Wading Area at the Eastern Beach and Shorter Overwater Room Boardwalk

The Preferred Alternative is Alternative 7 - The Project as Proposed in the EIA, but with a Reduced Wading Area at the Eastern Beach and Shorter Overwater Room Boardwalk.

8.1 ALTERNATIVE 1 – THE "NO-ACTION" ALTERNATIVE

Under the No-Action Alternative, the existing property, vegetation and benthic features at Richmond would remain as is.

The **advantages** of the No-Action Alternative include:

Physical

- No nuisance from construction activities (dust, noise, vibration etc.).
- No increased turbidity/TSS in the marine environment.
- No brine injection into marine environment
- No added drainage of stormwater into marine environment
- No potential spillage of fuel/oil/lubricants in the marine environment.

Biological

- Mangrove and terrestrial vegetation and associated fauna remain undisturbed
- No increased turbidity/TSS or oil and grease in the marine environment
- No permanent seagrass habitat loss
- No smothering and sedimentation of seagrass, coral and associated macrofauna
- No disturbance of possible turtle nesting by obstacles in water, increased noise and lighting.

Human/Social

- Maritime activities will not be affected by the physical presence of the searooms
- No increased maritime accident potential in the form of vessel collision with searoom structures
- No increased water usage and solid waste generation.
- No increased potential for pathogens entering the food supply and causing food borne illnesses
- No reduction of traffic flow in the area
- No increased accident potential of workers
- No decreased aesthetics from road wear and marl/mud/debris
- No restriction on beach access, recreational and fishing activities

The **disadvantages** of the No-Action Alternative include:

Biological

- No provision of added ecological volume from groynes, breakwaters and searoom pilings resulting in more available space for recruitment and colonization of hard coral and other sessile fauna.
- No creation of Fish Aggregation Devices (FADs) by the presence of groynes, breakwaters and the pilings and the shaded areas provided by the searoom structures.

Human/Social

- No additional economic benefits to the community and economy.
- No increased employment and creation of indirect and induced job opportunities
- No broadening of the tourism client base and overall diversified and enhanced Jamaican tourism product
- No further increase the room offerings of the island

8.2 ALTERNATIVE 2 – THE PROJECT AS PROPOSED IN THE EIA

Richmond Vista Limited wishes to develop a 715 room Secrets Resort & Spa at its 90,624 sqm (22.4 acre) property at Richmond Estate in the Parish of Saint Ann. The hotel resort will be developed in two (2) phases: i) the First Phase will include 500 hotel rooms and 15 over water suites; and ii) the Second Phase will include 200 additional hotel rooms. The proposed design is expanded across the site with buildings consisting of 1-7 storeys and the total floor area is 81,544.15 m^2. The built areas comprising of 2 Hotels with 700 Rooms, 15 Overwater Villas, Spa, Specialty Restaurants, Technical Area, 3 Beach Bars, 3 Pool Bars, Coco Café, 2 Barefoot Grill, 3 Towel Gazebo, 2 Wedding Gazebo, Pools Toilets, Temazcal, Water Sports, 2 Resort Access and Service Access. There are a total of 672 Parking and 15 coach Parking areas.

The biological, physical and socioeconomic impacts and mitigation measures for the project as proposed are discussed in detail throughout this report.

The **advantages** to this alternative include:

Biological

- Provision of added ecological volume from groynes, breakwaters and searoom pilings resulting in more available space for recruitment and colonization of hard coral and other sessile fauna.
- Creation of Fish Aggregation Devices (FADs) by the presence of groynes, breakwaters and the pilings and the shaded areas provided by the searoom structures.

Human/Social

- Additional economic benefits to the community and economy.
- Increased employment and creation of indirect and induced job opportunities
- Broadening of the tourism client base and overall diversified and enhanced Jamaican tourism product
- Further increase the room offerings of the island

The **disadvantages** to this alternative include:

Physical

- Nuisance from construction activities (dust, noise, vibration etc.).
- Increased turbidity/TSS in the marine environment.
- Brine injection into marine environment
- Added drainage of stormwater into marine environment
- Potential spillage of fuel/oil/lubricants in the marine environment.

Biological

- Disturbance and Loss of Mangrove and terrestrial vegetation and associated fauna
- Increased turbidity/TSS or oil and grease in the marine environment
- Permanent seagrass habitat loss
- Smothering and sedimentation of seagrass, coral and associated macrofauna
- Disturbance of possible turtle nesting by obstacles in water, increased noise and lighting

Human/Social

- Maritime activities affected by the physical presence of the searooms
- Increased maritime accident potential in the form of vessel collision with searoom structures
- Increased water usage and solid waste generation.
- Increased potential for pathogens entering the food supply and causing food borne illnesses
- Reduction of traffic flow in the area
- Increased accident potential of workers
- Decreased aesthetics from road wear and marl/mud/debris
- Restriction on beach access, recreational and fishing activities

8.3 ALTERNATIVE 3 – THE PROJECT AS PROPOSED IN THE EIA, BUT WITH A DIFFERENT OVERWATER SEAROOM LOCATION

For this alternative, the hotel and all structures on the land would remain the same as Alternative 2. However, the overwater rooms would be located further north, closer to the edge of the shelf. The nearshore area around the overwater villas would be deepened to encourage more flow in to the nearshore for better water quality.

Advantages and disadvantages would be similar to Alternative 2, however, there are a few differences that would occur. Disadvantages of this alternative would include:

- Modelling of hurricanes and storm surge showed that these overwater villas would be more exposed the closer they are to the edge of the shelf.
- Dredging to deepen the nearshore area around the overwater rooms will contribute to sedimentation of the water column and in turn smother nearby seagrass and benthos.

The layout is illustrated in Figure 8-1.

8.4 ALTERNATIVE 4 – THE PROJECT AS PROPOSED IN THE EIA, BUT WITH A DIFFERENT LAYOUT FOR THE NORTHWESTERN BEACH

For this alternative, the hotel and all structures on the land would remain the same as Alternative 2. The two sandy beach areas would be proposed on the north-western shoreline. Both beaches would be anchored by three (3) groynes with two (2) submerged breakwaters to protect from incoming high waves, as opposed to two (2) groynes and one (1) breakwater as proposed in Alternative 2.

Advantages and disadvantages would be similar to Alternative 2, however, there are a few differences that would occur. **Disadvantages** of this alternative would include:

- Greater impact on benthic habitats (coral reef) from beach groyne and breakwater positioning to the west.
- Greater impact on benthic habitats due to a larger footprint of coastal structures
- Reduction in swimming beach area due to benthic habitats

The layout is illustrated in Figure 8-1.

8.5 ALTERNATIVE 5 – THE PROJECT AS PROPOSED IN THE EIA, BUT WITH A “NO-BUILD” ZONE ON THE PENINSULA

For this alternative, the hotel and all structures on the land would remain the same as Alternative 2. However, a no-build zone would be established on the peninsula. Advantages and disadvantages would be similar to Alternative 2, however, there are a few differences that would occur.

An **advantage** of this alternative would be that any structures on the peninsula would not be prone to waves and overtopping (splash) which would cause significant damage to buildings. However, a disadvantage to this ‘No Build Zone’ is that there would be nowhere suitable to build the proposed Oceana Restaurant.

The layout is illustrated in Figure 8-1.

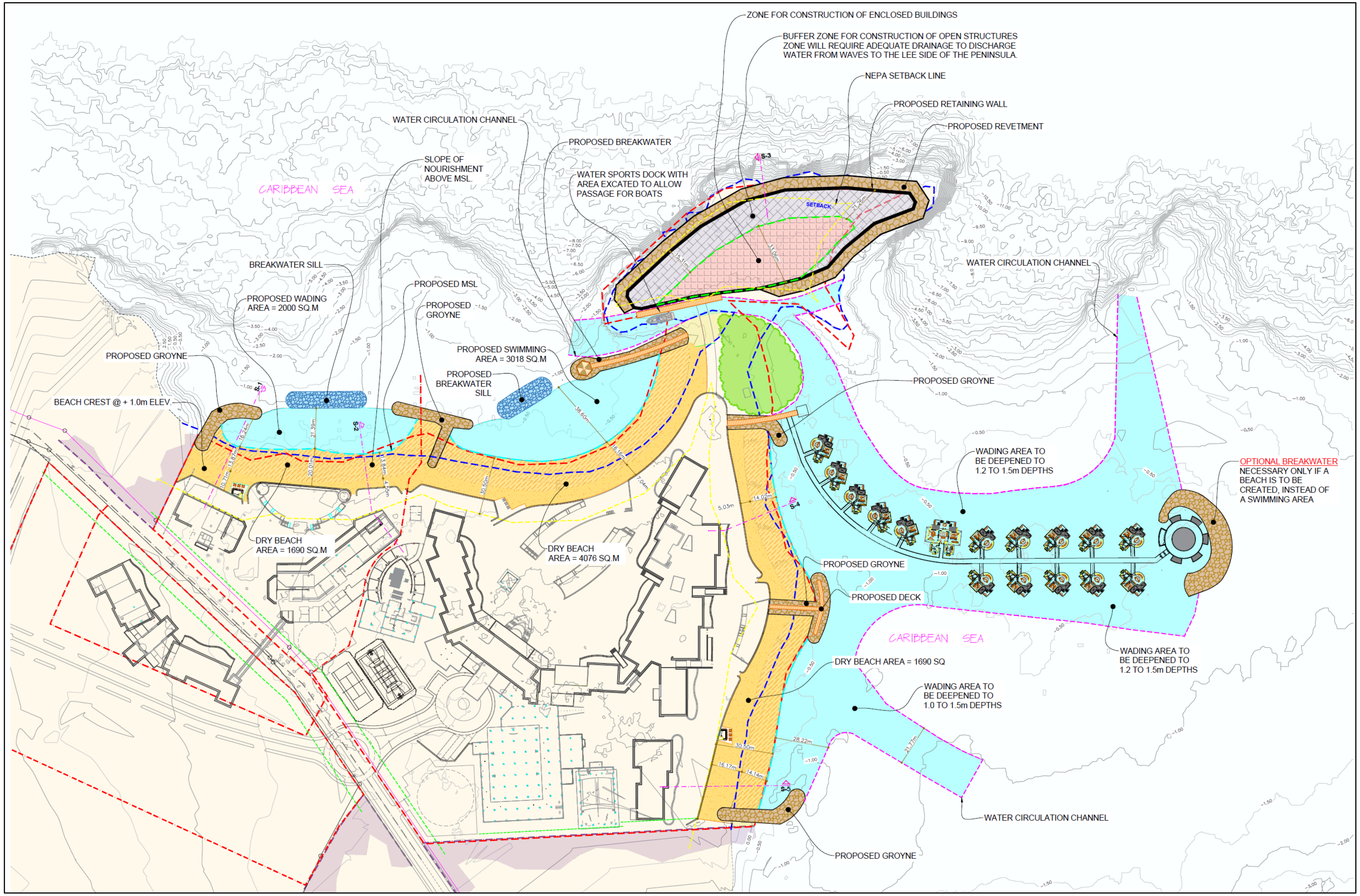

Figure 8-1 Alternative coastal design layout

8.6 ALTERNATIVE 6 – THE PROJECT AS PROPOSED IN THE EIA, BUT WITH A REDUCED WADING AREA AT THE EASTERN BEACH

For this alternative, the hotel and all structures on the land would remain the same as Alternative 2. However, the wading area along a portion of the eastern beach and around the overwater rooms would be reduced. The various locations where the reduction in wading areas occur are:

- At the T-groyne, where the nourishment area is also reduced resulting in the wading area being reduced.
- To the south of the overwater room boardwalk
- At the seaward end of the overwater rooms

Advantages and disadvantages would be similar to Alternative 2, however, there are a few differences that would occur.

Advantages of this alternative would include:

- Compared to Alternative 2 Eastern Beach design, there will be reduction of impacted seagrass by **2,737.91 square meters.** Table 8-1 below shows the breakdown of total impacted seagrass at both the western and eastern beaches, for Alternatives 2 and 6.

Disadvantages of this alternative would include:

- Less wading area for guests

Table 8-1 Alternative 6 Impacted seagrass compared to Alternative 2 Impacted Seagrass

Impacted seagrass suitability for relocation	Alternative 6 Area (m^2)			Alternative 2 Area (m^2)		
	West Beach (m^2)	East Beach (m^2)	Total (m^2)	West Beach (m^2)	East Beach (m^2)	Total (m^2)
Not Ideal	0	2,053.15	2,053.15	0	2,145.20	2,145.20
Not Suitable	2,196.40	9,496.41	11,692.81	2,196.40	11,188.60	1,3385.0
Suitable	0	7,472.43	7,472.43	0	8,426.10	8,426.10
Total	**2,196.40**	**19,021.99**	**21,218.39**	**2,196.40**	**21,759.90**	**23,956.30**

The layout is illustrated in Figure 8-2, while Figure 8-3 illustrates Impacted Seagrass and Relocation Suitability.

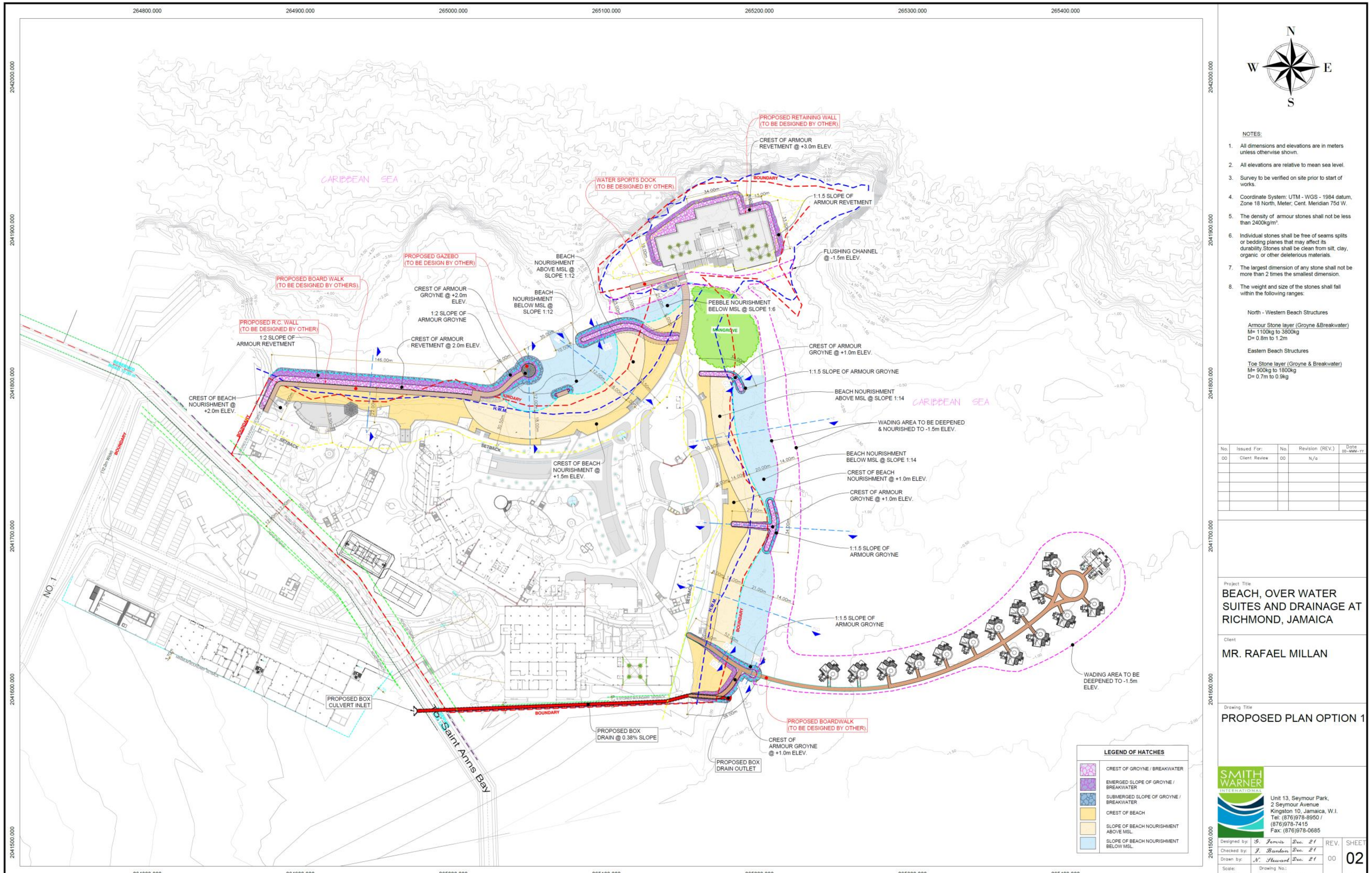

Figure 8-2 Alternative 6 layout showing reduced wading area

KEY

Option 1 with 3m Buffer

Seagrass suitability for relocation (East Bay) - Option 1 with 3m buffer

- Not Ideal
- Not Suitable
- Suitable

Impacted seagrass suitability for relocation	Area (m^2)
Not Ideal	2053.15
Not Suitable	9496.41
Suitable	7472.43
Total	**19021.99**

0 10 20 40 60 80 METERS

MAP DATUM: JAD 2001
CREATED BY: CL ENVIRONMENTAL CO. LTD.
SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
ORTHOMOSAIC: 21 NOVEMBER 2021

Figure 8-3 Alternative 6 Eastern Beach Impacted Seagrass and Relocation Suitability

8.7 ALTERNATIVE 7 – THE PROJECT AS PROPOSED IN THE EIA, BUT WITH A REDUCED WADING AREA AT THE EASTERN BEACH AND SHORTER OVERWATER ROOM BOARDWALK

For this alternative, the exact same scenario in Alternative 6 occurs here, however, the boardwalk for the overwater rooms is slightly shorter because of a shift of the overwater rooms one (1) villa-width in a landward direction.

Advantages of this alternative would include:

- Compared to Alternative 2 Eastern Beach design, there will be a reduction of impacted seagrass by **3,332.92 square meters.** Table 8-2 below shows the breakdown of total impacted seagrass at both the western and eastern beaches, for Alternatives 2 and 7.

Disadvantages of this alternative would include:

- Less wading area for guests

Table 8-2 Alternative 7 Impacted seagrass compared to Alternative 2 Impacted Seagrass

Impacted seagrass suitability for relocation	Alternative 7 Area (m^2)			Alternative 2 Area (m^2)		
	West Beach (m^2)	East Beach (m^2)	Total (m^2)	West Beach (m^2)	East Beach (m^2)	Total (m^2)
Not Ideal	0	2,177.35	2,177.35	0	2,145.20	2,145.20
Not Suitable	2,196.40	8,759.32	10,955.72	2196.40	11,188.60	1,3385.0
Suitable	0	7,490.31	7,490.31	0	8,426.10	8,426.10
Total	**2,196.40**	**18,426.98**	**20,623.38**	**2,196.40**	**21,759.90**	**23,956.30**

The layout is illustrated in Figure 8-4, while Figure 8-5 illustrates Impacted Seagrass and Relocation Suitability.

The Preferred Alternative for this project is Alternative 7.

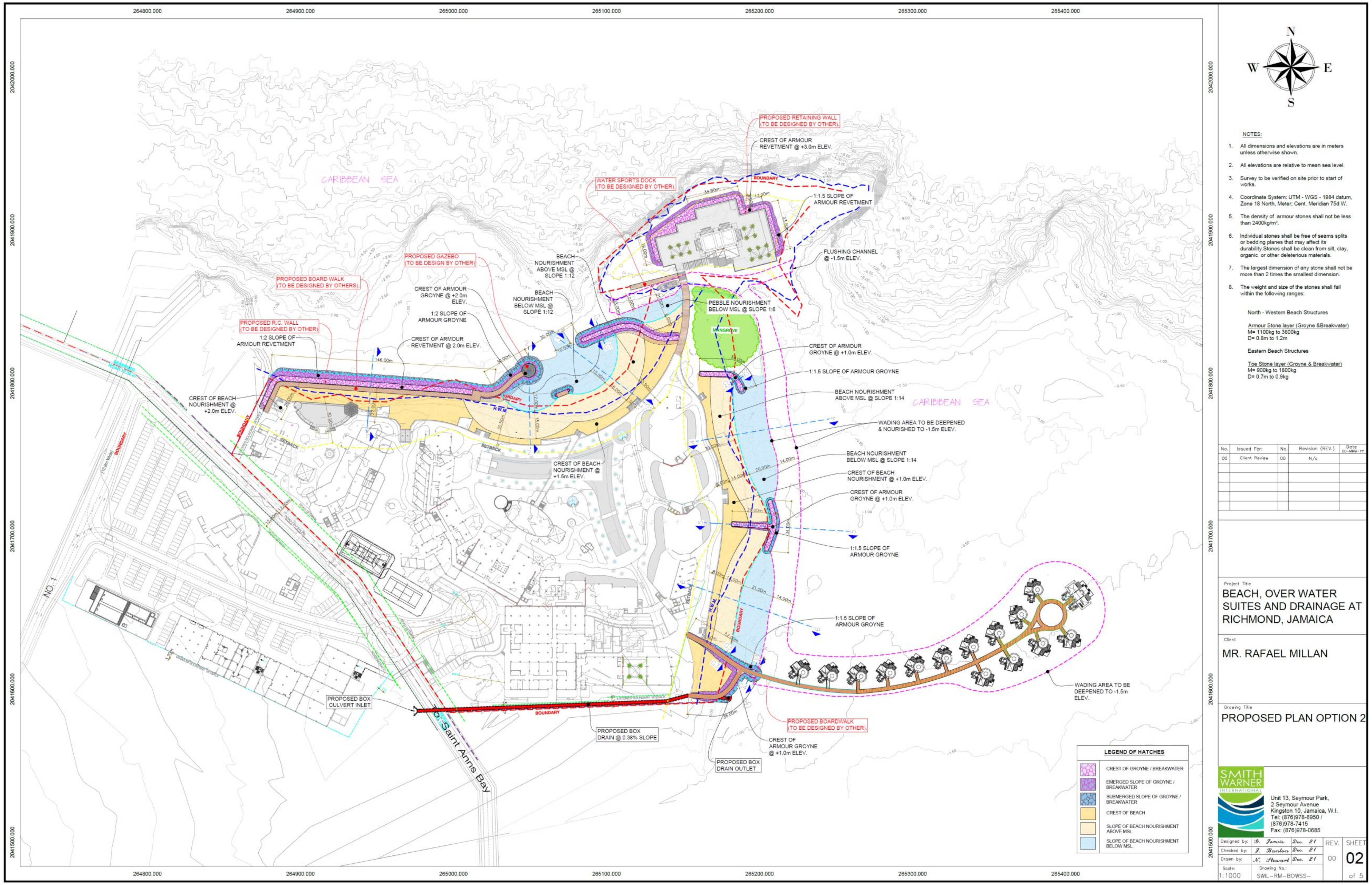

Figure 8-4 Alternative 7 layout showing reduced wading area and shorter overwater room boardwalk

KEY

Option 2 with 3m Buffer

Seagrass suitability for relocation (East Bay) - Option 2 with 3m buffer

- Not Ideal
- Not Suitable
- Suitable

Impacted seagrass suitability for relocation	Area (m^2)
Not Ideal	2177.35
Not Suitable	8759.32
Suitable	7490.31
Total	**18426.98**

0 10 20 40 60 80 METERS

MAP DATUM: JAD 2001
CREATED BY: CL ENVIRONMENTAL CO. LTD.
SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
ORTHOMOSAIC: 21 NOVEMBER 2021

Figure 8-5 Alternative 7 Eastern Beach Impacted Seagrass and Relocation Suitability

9.0 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

An Environmental Management System (EMS) is an important tool which can be used to assist operations managers in meeting current and future environmental requirements and challenges. It can be used to measure a company's operations against environmental performance indicators, thereby helping the company to reach its environmental targets. A good management system will integrate environmental management into a company's daily operations, long-term planning and other quality assurance systems.

It is therefore recommended that several parameters be monitored before, during and after the project implementation to record any negative construction impacts and to propose corrective or mitigation measures. The suggested parameters include but are not limited to the following:

1) Water Quality to include but not be limited to:
    a. Nitrates
    b. Phosphates
    c. BOD
    d. Fats, oil and grease
    e. pH
    f. TSS
    g. Turbidity
    h. TDS
    i. Faecal Coliform
2) Noise
3) Coral and Fisheries
4) Seagrass
5) Traffic
6) Maritime Operations
7) Solid Waste Generation and Disposal
8) Sewage Generation and Disposal
9) Equipment Maintenance
10) Health and Safety

9.1 DRAFT CORAL AND SEAGRASS MANAGEMENT PLANS

While the Environmental Monitoring Plan (Section 9.2) entails coral and seagrass related monitoring practices during construction, the draft plans below give more specifics with regard to coral and seagrass monitoring and management.

9.1.1 Coral Management Plan

The Coral Management Plan will include a combination of coral monitoring exercises, water quality monitoring and sediment dispersal monitoring, before, during and after construction. The activities will be conducted by qualified and trained marine scientists and SCUBA divers.

9.1.1.1 Coral Monitoring using Photo-transects

The Three (3) monitoring sites will the same areas as in the baseline survey areas. Each sample site will have three 30 metre-long transect lines. The start point of each line will be marked using a GPS and a permanent stake where possible. Along each 30m transect line, photos will be taken every 3 meters using a 1 m^2 quadrat, thus totalling 30 photos per survey area. A total of 30 m^2 will be assessed for each transect.

The photos will be analysed by using the Coral Point Count with Excel extensions (CPCe) program. This program involves overlaying spatially random points on each image. The benthic features under each of these points are user-identified (e.g., coral species, bleaching/disease incidents, algae, sand, recently killed coral, *Diadema* and other features). Coverage statistics are then able to be calculated and these results displayed in an excel spreadsheet.

1) Data collected will include but not limited to the following;
    - Percentage Coral Cover;
    - Live coral
    - Recently killed coral
    - Dead coral
    - Diseased or bleached coral
2) Percentage Algae Cover
    - Where possible Algae will be identified and categorised (fleshy, calcareous and cyanobacteria.
3) General Substrate Composition
    - The substrate type will also be identified (sand, pavement, rock etc.)
4) Other Data
    - Any rare, endangered, commercially important (lobster and conch) and invasive organisms observed will also be noted and photographed, as well as the presence/absence of seagrasses. Any obvious sedimentation, anchor damage, marine debris and other direct impacts will also be recorded.

9.1.1.2 Roving Coral Reef Surveys

Roving qualitative surveys will be conducted in and around the project area via snorkelling and/or SCUBA diving. Observations and photographs will be taken to include but not be limited to; incidence of coral disease and sedimentation. Special emphasis will be placed on *A. palmata* colonies nearby work areas.

9.1.1.3 Sediment Dispersal

To monitor the potential sediment impact from construction activities on the coral sites, one sediment trap will be deployed at each of the coral monitoring sites, as well as nearby the work area. A total of no less than four (4) sediment traps will be deployed. The sediment traps will be retrieved monthly, its contents analysed and redeployed to determine the rate of sedimentation ($mg/cm^2/day$) and dispersal patterns over the area. The sediment trap dimensions will be approximately 18" deep with an internal diameter of 3". Traps will be taken to the Mines and Geology Division laboratories for analysis.

The contents of the sediment traps will be filtered through a filter paper, dried and then weighed. The results will be represented in the form of mass of sediment recovered. Using the results retrieved from the laboratory, the unit mass of sediment dispersed per day will be calculated by dividing the mass of sediment recovered by the number of days deployed and the area of the sediment trap opening. Onsite observations will also be included where possible.

9.1.1.4 Water Quality Monitoring

Temperature, pH, salinity, conductivity, dissolved oxygen, light irradiance, turbidity and total dissolved solids will be measured *in situ* using a Hydrolab DataSonde DS-5 multiprobe at the coral monitoring locations, plus other locations in and around the project area. A total of no less than four (4) water quality monitoring locations will be chosen. Water quality readings will also be taken on the inside and outside of silt screens deployed (during construction). The results of the data collected will be compared with National Environment and Planning Agency (NEPA) marine water quality standards.

9.1.1.5 Phasing and Monitoring Frequency

The Coral Monitoring Programme will be implemented during three (3) phases:

- Pre-construction (to serve as a baseline)
- During construction period
- Post-construction (1 year)

The proposed frequency of monitoring is outlined below based on the various phases.

Pre-Construction

- One (1) coral monitoring run using phototransects
- One (1) roving coral reef survey
- One (1) sediment dispersal run
- One (1) water quality sampling run

During Construction

- Quarterly (every 3 months) coral monitoring using phototransects until the end of construction.
- Monthly roving coral surveys until the end of construction.

- Monthly sediment dispersal runs until the end of construction.
- Weekly water quality monitoring, in particular turbidity monitoring.

Any suspected new or increased incidence of coral disease observed will be immediately reported to NEPA.

Post-Construction

- Biannual coral monitoring using phototransects, for a period of one (1) year.
- Biannual roving coral survey for a period of one (1) year.

9.1.1.6 Coral Removal and Relocation Works (if any)

Any coral removal and relocation works to be conducted as a mitigation measure will be done in accordance with the NEPA Coral Relocation and Monitoring protocols (Table 9-1 and Table 9-2).

Table 9-1 NEPA-appointed Coral Relocation Summary Form – Weekly log of Relocation Activity

<table>
<tr><td colspan="2"></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Persons Conducting Relocation:

Authorized by:</td><td colspan="2">GPS Location of Relocation Site/s: (State format):</td><td>Date of Relocation:</td></tr>
<tr><td colspan="2">Site no:</td><td>Week No:</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="3">Average No of Corals Harvested per day (m^2):</td><td colspan="2">No. of Grids Harvested per week:</td></tr>
<tr><td colspan="3">Total No of Corals Harvested Per week (m^2):</td><td colspan="2">No. of Grid Relocated Per week:</td></tr>
<tr><td colspan="3" rowspan="2">Total No. of Coral Harvested Per week by species</td><td>Name of Harvested Grid:</td><td>Name of Equivalent Relocation Grid:</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="3">Total Corals Relocated to Date (This should include all corals relocated up to the end of the week stated above):</td><td colspan="2">Overall weather Conditions:</td></tr>
<tr><td colspan="5">Comments and Observations:</td></tr>
</table>

Table 9-2 NEPA-appointed Coral Monitoring Summary Form (post-relocation monitoring)

Persons Conducting Monitoring: **Authorized by:**	**GPS Location of Planting Site/s** *(State format)*:	**Date of Monitoring:** **Growth and Survival Trend Graph:**
**Monitoring Period: (**) *Time Zero () Time Zero Plus 60 days () Time Zero Plus 180 days () Time Zero Plus 365 days () Year 1 Plus 180 days () Year 1 Plus 365 days () Year 2 Plus 180days () Year 2 Plus 365days () Year 3 Plus 180 days () Year 3 Plus 365days () Year 4 Plus180 days () Year 4 Plus 365days*		
Total No. of Coral Relocated: **Average size of coral relocated (***Time Zero only***):**	**Presence of Bleaching on Relocated Corals:** *No of Coral Colonies Bleaches: () Total % Bleached: ( )* **List of Species Bleached:**	
Presence and Type of Coral Disease:	**No. of Coral Colonies affected by Coral Disease:**	
General Condition of Surrounding Reef		
% Overall Live Coral Cover: **%Hard Corals:** **%Soft Corals:**	**% Species Composition:**	
Fish: Numbers () **Species Observed:**	**% Algal Cover:** **Overall weather Conditions:**	
Water Quality Data: *Temperature: Total suspended solids: Nutrients {Nitrates and Phosphates}: Salinity:* *Temperature: pH: Dissolved Oxygen: BOD: Feacal coliform: PAR:* *Chlorophyll A:*		
Comments, Observations, Ecological Trends:		

9.1.2 Seagrass Management Plan

The Seagrass Management Plan will include a combination of seagrass survey/monitoring exercises and water quality monitoring before, during and after construction. The activities will be conducted by qualified and trained marine scientists and SCUBA divers.

9.1.2.1 Seagrass Surveys

Ten or more 0.25m^2 quadrats, divided into 10cm x 10cm grids, will be placed randomly within the Seagrass Beds to be assessed. Within each quadrat, seagrass percentage cover, shoot density and leaf blade length of 10 random blades will be recorded. Other observations to be made included: epiphytic cover, bioturbation, overall health and appearance, and other organisms located within the seagrass beds. The location of each quadrat assessed will be recorded using a GPS.

9.1.2.2 Water Quality Monitoring

Temperature, pH, salinity, conductivity, dissolved oxygen, light irradiance, turbidity and total dissolved solids will be measured *in situ* using a Hydrolab DataSonde DS-5 multiprobe at the seagrass monitoring locations, plus other locations in and around the project area. A total of no less than four (4) water quality monitoring locations will be chosen. Water quality readings will also be taken on the inside and outside of silt screens deployed (during construction). The results of the data collected will be compared with National Environment and Planning Agency (NEPA) marine water quality standards.

9.1.2.3 Phasing and Monitoring Frequency

The Seagrass Monitoring Programme will be implemented during three (3) phases:

- Pre-construction (to serve as a baseline)
- During construction period
- Post-construction (5 years assuming relocation)

The proposed frequency of monitoring is outlined below based on the various phases.

Pre-Construction

- One (1) seagrass survey
- One (1) water quality sampling run

During Construction

- Quarterly (every 3 months) seagrass surveys until the end of construction
- Weekly water quality monitoring, in particular turbidity monitoring.

Post-Construction

- Quarterly relocated seagrass monitoring for the first 2 years, then biannual thereafter. Water quality monitoring is also to be conducted alongside the relocated seagrass monitoring, at each relocation site, using the same frequency.

9.1.2.4 Seagrass Removal and Replanting Works (if any)

Any seagrass removal and replanting works to be conducted as a mitigation measure will be done in accordance with the NEPA Seagrass Relocation and Monitoring protocols (Table 9-3 and Table 9-4).

Table 9-3 NEPA-appointed Seagrass planting Summary Form – Weekly log of planting activities

Persons Conducting Planting: **Authorized by:**	**GPS Location of Planting Site** *(State format)*:	**Date of Planting:**
	Site no:	**Week No:**

Average Seagrass Harvested per day (m^2):	**No. of Grids Harvested per week:**	
Total Seagrass Harvester Per week(m^2):	**No. of Grid Planted Per week:**	
Total Seagrass Harvester Per week by species (m^2): ***Thalassia sp:*** ***Syringodium sp:*** ***Halodule sp:***	**Name of Harvested Grid**	**Name of Equivalent Planting Grid**
Total Seagrass Planted to Date (*This should include all seagrass planted up to the end of the week stated above***):**	**Overall weather conditions:**	
Comments and Observation:		

Table 9-4 NEPA-appointed Seagrass Monitoring Summary Form (post relocation monitoring)

Persons Conducting Monitoring: **Authorized by:**	**GPS Location of Planting Site** *(state format)*:	**Date of Monitoring:**
	Site no: **Depth:**	**Survival Trend Graph:**
**Monitoring Period: Monitoring Period: (***) Time Zero () Time Zero Plus 60 days () Time Zero Plus 180 days () Time Zero Plus 365 days* *() Year 1 Plus 180 days () Year 1 Plus 365 days () Year 2 Plus 180days () Year 2 Plus 365days*		

() Year 3 Plus 180 days () Year 3 Plus 365days () Year 4 Plus180 days () Year 4 Plus 365days		
Average Leaf Length (cm):	**Percentage Cover Surviving:**	**Total Area replanted (m^2):**
Bioturbation Presence/Absence/Type of Animals noted:		
Water Quality Data: *Temperature: Total suspended solids: Nutrients {Nitrates and Phosphates}: Salinity:* *Temperature: pH: Dissolved Oxygen: BOD: Feacal coliform: PAR:*		
Incidence and Extent of Erosion: N/A		
Date and Extent of Remedial Planting *if any (details should be outlined on the remediation monitoring form):* N/A		
Comments, Observations, Ecological Trends:		

9.2 DRAFT ENVIRONMENTAL MONITORING PLAN

9.2.1 Site Preparation and Construction Phase

- Undertake weekly water quality monitoring (for the first 3 months, then fortnightly thereafter) for temperature, salinity, pH, Dissolved Oxygen, light irradiance and turbidity in and around the project area, or at a frequency agreed to with NEPA to ensure that the construction works are not negatively impacting on water quality.
  Any organization with the capability to conduct monitoring of the listed parameters should be used to perform this exercise. It is recommended that a report should be given to NEPA at the end of each monitoring exercise. This is estimated to cost approximately **J$180,000** per weekly turbidity monitoring exercise.
- Daily inspections to ensure that construction activities are not being conducted outside of regular working hours (e.g., 7 am – 7 pm). In addition to environmental noise monitoring, a noise survey should be undertaken to determine workers exposure and construction equipment noise emission. Noise monitoring to be conducted monthly at the site and settlements near to site.
  The project engineer / site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that the hours are being followed. The noise survey is estimated to cost approximately **J$340,000** per monitoring exercise.

- Daily monitoring to ensure that fugitive dust from raw materials is not being entrained in the wind and creating a dust nuisance.
  The project engineer / site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that this stipulation is being followed.
- Conduct daily inspections to ensure that flagmen where necessary are in place and that adequate signs are posted along the roadways where heavy equipment interact with existing roads. This is to ensure that traffic have adequate warnings and direction.
- Undertake daily assessment of the quantity of solid waste generated and keep records of its ultimate disposal. Additionally, solid waste generation and disposal of the campsite should also be monitored.
- Weekly assessment to determine that there are adequate numbers of portable toilets and that they are in proper working order. This will ensure that sewage disposal will be adequately treated.
- Daily monitoring of vehicle refuelling, and repair should be undertaken to ensure that these exercises are carried out on hardstands. This is to reduce the potential of water/soil/sand contamination from spills. Spot checks should be conducted by NEPA.
- Traffic and maritime operations should be monitored to ensure approved management plans at critical areas are being followed. NEPA and NWA and other relevant authorities should perform spot checks to ensure compliance. Monitoring should be conducted daily to ensure major disruption is avoided. Reports should be made to NWA on a fortnightly basis.
- Undertake daily inspections to ensure that workers are wearing adequate personal protective equipment (PPE), such as hard hats, hard boots, air protection, safety glasses, reflective vests and fall protection is necessary. Ensure that safety signage is in place.
- Health, safety and emergency response plans should be prepared prior to site preparation and construction phases.
- Where possible, construction crews should be sourced from within the study area. This will ensure that the local community will benefit from the investment.
- Coral and seagrass in the vicinity of the monitoring sites should be monitored quarterly or at a frequency agreed to with NEPA. This will include:

  1) Photo Inventory and/or Roving Surveys:

  Corals of particular interest (endangered species, diseased or bleached colonies for example), Fish species and counts. This is estimated to cost approximately **J$ 525,000** per monitoring exercise.

  2) To monitor the potential sediment impact from construction activities on the marine environment, one sediment trap should be deployed in the vicinity of construction activity and in nearby sensitive reef areas. The settlers should be retrieved on a monthly basis, its contents analysed and redeployed to determine the rate of sedimentation (mg/cm^2/day) and dispersal patterns over the area. This is estimated to cost approximately **J$ 380,000** per monitoring exercise.

- Mangrove swamp water quality will also be monitored to ensure there is no drainage of oil, lubricants and excess sediments into the mangrove swamp.

9.2.2 Operational Phase

- Water quality monitoring should be done at least fortnightly after construction. If three to six results demonstrate that the site or parts of the site have stabilised, the sampling frequency and sampling locations may be reviewed and reduced or discontinued as per and approved monitoring plan. This is estimated to cost approximately **J$ 180,000** per monitoring exercise.
- Monitor the potential sediment impact on the marine environment, sediment traps should be deployed in the vicinity of the villas and in nearby sensitive reef areas. The settlers should be retrieved on a monthly basis, its contents analysed and redeployed to determine the rate of sedimentation (mg/cm^2/day) and dispersal patterns over the area. This is estimated to cost approximately **J$ 380,000** per monitoring exercise.

9.2.3 Reporting Requirements

9.2.3.1 Water Quality

A report shall be prepared by the Contracted party. It shall include the following data:

i. Dates, times and places of test.
ii. Weather condition.
iii. A defined map of each location with distance clearly outlined in metric.
iv. Test Method used.
v. Parameters measured
vi. Results
vii. Conclusions

The report will be submitted to the Client or his designate within two weeks of the monitoring being completed.

The Client shall distribute the report within two (2) weeks of testing being completed to NEPA.

In the event that the water quality does not meet the required criteria, investigations shall be carried out and corrective actions were necessary taken and a re-test shall be scheduled at the earliest possible time and a new report submitted.

If three (3) to six (6) results demonstrate that the site or parts of the site have stabilised, the sampling frequency and sampling locations may be reviewed and reduced or discontinued as per approved monitoring plan.

Reports will be maintained on file for a minimum of three years.

9.2.3.2 Coral and Fish

A report shall be prepared by the Contracted party. It shall include the following data:

1) Percentage Coral Cover
    a. Live coral
    b. Recently killed coral
    c. Dead coral
    d. Diseased or bleached coral
2) Percentage Algae Cover
   Where possible Algae will be identified and categorised (fleshy, calcareous and cyanobacteria.
3) General Substrate Composition
   The substrate type will also be identified (sand, pavement rock etc.)
4) *Diadema sp.* Counts
5) Sediment Dispersal
6) Fish counts, species and size classes
7) Presence of fish nets, pots, spearfishers, invasive and rare species.
8) Dates, times and places of test.
9) Weather condition.
10) A defined map of each survey location with distance clearly outlined in metric.
11) Other Data

Any rare, endangered, commercially important (lobster and conch) and invasive organisms (lionfish) observed will also be noted and photographed, as well as the presence/absence of seagrasses. Any obvious sedimentation, anchor damage, marine debris and other direct impacts will also be recorded.

The report will be submitted to the Client or his designate within two weeks of the monitoring being completed.

The Client shall distribute the report within two (2) weeks of testing being completed to NEPA.

Reports will be maintained on file for a minimum of three years.

9.2.3.3 Seagrass

A report shall be prepared by the Contracted party. It shall include the following data:

1. Percentage cover of various seagrass species
2. Shoot density
3. Leaf blade length
4. Presence of fish nets, pots, invasive and rare species.
5. Dates, times and places of test.
6. Weather condition.
7. A defined map of each survey location with distance clearly outlined in metric.

8. Other Data

Any rare, endangered, commercially important (lobster and conch) and invasive organisms (lionfish) observed will also be noted and photographed, as well as the presence/absence of seagrasses. Any obvious sedimentation, anchor damage, marine debris and other direct impacts will also be recorded.

The report will be submitted to the Client or his designate within two weeks of the monitoring being completed.

The Client shall distribute the report within two (2) weeks of testing being completed to NEPA.

Reports will be maintained on file for a minimum of three years.

10.0 CONCLUSION AND RECOMMENDATIONS

The proposed development is slated to increase the room offerings of the island, thereby creating jobs and economic benefits, growing the tourist clientele and in the process enhance and diversify the Jamaican tourism product.

On the contrary, the degradation, loss and adverse effects of natural habitats as well as impacts on the noise climate, air quality and solid waste facilities, are some of the potential negative impacts of the project. These concerns are highlighted through the stakeholder involvement and public interviews conducted for the purposes of this EIA.

The implementation of the recommended mitigation measures detailed in this EIA, as well as the various environmental management and monitoring programmes, will assist in reducing these negative impacts.

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12.0 APPENDICES

Appendix 1 – Terms of Reference

TERMS OF REFERENCE
For An
ENVIRONMENTAL IMPACT ASSESSMENT

For

Hotel Development

At

Part of Richmond Estates, St. Ann

By

Secrets Resorts and Spa

APPLICATION SECRETARIAT BRANCH
JAN 03 2023
NEPA

APPLICATION
JAN 03 2023
ACCEPTED

Date: 30 December 2022
Submitted By: C.L. Environmental Company Limited
Prepared by: Carlton Campbell

C. L. ENVIRONMENTAL CO. LTD.
Terms of Reference for an Environmental Impact Assessment
Proposed Secrets Resorts and Spa, Part of Richmond Estates, Richmond, St Ann by Richmond Vista Limited

Table of Contents

Project Description

Richmond Vista Limited wishes to develop a 715 room Secrets Resort & Spa in its 90,624 sqm (22.4 acre) property at Richmond Estate in the Parish of Saint Ann (Jamaica) (Figure 1).

The project will be developed on a 22.4 acre property which includes 3 parcels. In accessing the site there is an existing 40' reserved road that connects the site to the highway. In addition, there will be another 40' wide access road from the north coast highway.

Richmond Estate has an uneven terrain with natural vegetation. The site comprises of physical features including mangrove in a small section of the property and a small pond area. The site has an outstanding coastal front with white sand beaches and a great oceanic view. The site provides sufficient natural lighting without any obstructions from adjacent properties and ventilation inclusive of its natural sea breeze.

The hotel resort will be developed in 2 phases: i) the First Phase will include 500 hotel rooms and 15 over water suites; ii) the Second Phase will include 200 additional hotel rooms. The proposed design is expanded across the site with buildings with level from 1-7 storeys. The total floor area is 81,544.15 m^2. The built areas comprising of 2 Hotels with 700 Rooms, 15 Overwater Villas, Spa, Specialty Restaurants, Technical Area, 3 Beach Bars, 3 Pool Bars, Coco Café, 2 Barefoot Grill, 3 Towel Gazebo, 2 Wedding Gazebo, Pools Toilets, Temazcal, Water Sports, 2 Resort Access and Service Access. There are a total of 672 Parking and 15 couch Parking. A part of the design intent is to reclaim the apart of the beach.

Water & Sewage Treatment System
The two types of wastewater will be generated at the hotel development:
1. Black Water (faecal content and general human egested/excreted waste)
2. Grey Water (bath, laundry, and wash basin water)

In order to preserve the ecological integrity of the site, the project will incorporate a Wastewater Treatment Plant (WWTP) and a Seawater desalination plant (SWDP) that will adequately service the proposed development efficiently.

The **Seawater desalination plant (SWDP)** designed process includes the following phases:
- Seawater abstraction from wells
- Filtration pre-treatment
- Reverse osmosis
- Remineralization of osmosed water and pumping to the inner network
- Brine injection in the marine environment *(All attempts should be made to treat the reject to meet the NRCA Trade Effluent standards prior to the discharge of the effluent)*
- Electrical installation
- Tanks and other treatments needed for the proper operation of the system.

Electricity supply will be obtained from the Jamaica Public Service.

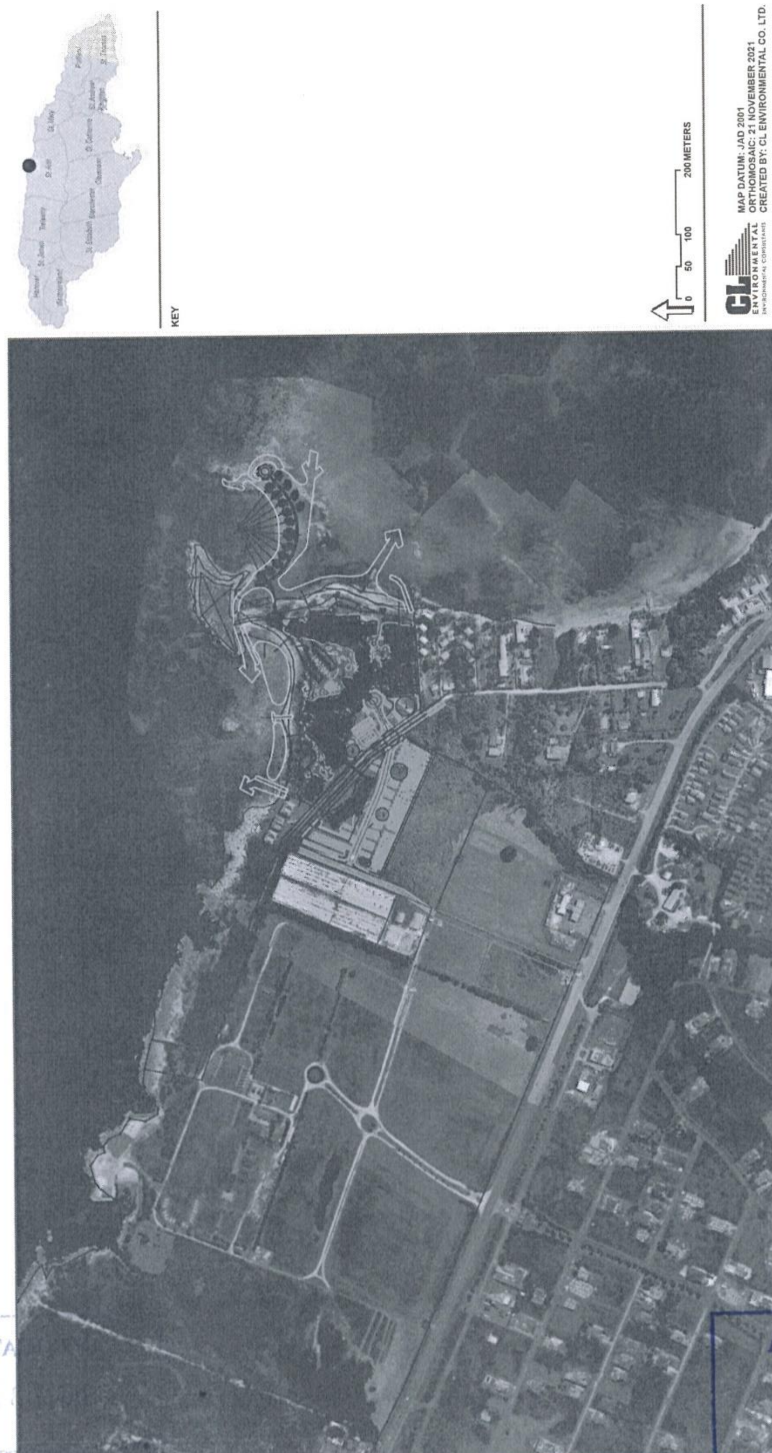

Figure 1 Location Map for the proposed Secrets Resort & Spa, Part of Richmond Estates, Richmond, St. Ann

CL ENVIRONMENTAL CO. LTD.
Terms of Reference for an Environmental Impact Assessment
Proposed Secrets Resorts and Spa Part of Richmond Estates, Richmond, St Ann by Richmond Vista Limited

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JAN 03 2023
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Foreword

The purpose of this document is to establish the Terms of Reference (TOR) for the Environmental Impact Assessment (EIA) for Proposed Secrets Resorts and Spa, Part of Richmond Estates, Richmond, St Ann by Richmond Vista Limited. An EIA seeks to identify the impacts the proposed project is likely to have on the area in which the physical development will be carried out as well as the impact of the environment on the proposed development. It also outlines mitigation measures necessary to reduce the negative impacts of the project.

The EIA will be prepared using a participatory approach involving key stakeholders. The EIA report must be produced in accordance with the agreed TOR issued by the National Environment and Planning Agency (NEPA) to Richmond Vista Ltd.

Where the need arises to modify the TOR, the required amendments/modifications are to be made and submitted to the Agency. Approval for the TOR must be obtained from the Agency, in writing, prior to the commencement of the EIA study.

The National Environment and Planning Agency and the Natural Resources Conservation Authority (NRCA) reserves the right to reproduce, transfer and disclose any and all contents contained in the submitted environmental impact assessment report without the written consent of the proponent, consultants and/or its agents.

The Terms of Reference to conduct the Environmental Impact Assessment (EIA) are as follows:

1.0 EXECUTIVE SUMMARY

Provide a brief statement on the content of the EIA report. The executive summary should provide a comprehensive overview and objectives for the project proposal, natural resources, justification for the project, etc. In addition, it should include relevant background information and provide a summary of the main findings, including but not limited to main impacts and mitigation measures, analyses, and conclusions in the report. A summary of the environmental monitoring and management plans as well as alternatives should also be included.

2.0 INTRODUCTION

The introduction should provide a background and seek to explain the need for and the context of the project and the EIA. It should also provide the delineation and justification of the boundary of the study area, general methodology, assumptions, and constraints of the study. Additionally, a profile of the project proponent, implementing organization, project consultants, etc. should also be provided. The study area shall include at least the area within a 2km radius of the boundaries of the proposed project area.

3.0 LEGISLATION AND REGULATORY CONSIDERATION

This section should provide details of the pertinent regulations, standards, policies, and legislations governing environmental quality, safety and health, cultural significant finds, protection of sensitive areas, protection of endangered species, tourism enterprises, siting, and land use control at the local and national levels. The examination of the legislation should include at a minimum the Natural Resources Conservation Authority Act 1991, Natural Resources Conservation Regulations 1996, amended 2015, Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013, Beach Control Act,, Jamaica National Heritage Trust Act, Wild Life Protection Act, Fisheries Act 2018, National Solid Waste Management Authority Act, the Town and Country Planning Act, Building Act and Codes and Standards promulgated there under, Planning Guidelines – Overwater Structures, Development Orders and Plans and all appropriate international convention/protocol/treaty where applicable. Describe traditional land use and advise of any prescriptive rights including public access rights.

4.0 PROJECT DESCRIPTION

The report should provide a comprehensive description of all proposed terrestrial and marine project component, including information necessary to identify and assess the potential environmental impacts of the project. This should include but not be limited to:

- An overall master plan of the site including current, proposed, and future use of the lands showing the various components and design elements of the proposed development
- Location Map and total site area
- Objectives and information on, rationale for the project.
- History and Project Background, the nature, location/existing setting, timing, duration, frequency, general layout, as well as the impact on the carbon footprint of the energy sector are to be discussed.
- Existing site and its characteristics (landward & seaward)
- Description of the surrounding areas
- Site maps illustrating areas to be impacted and areas to be preserved in their existing state
- Hotel construction methods, works, duration and maintenance schedule, which must include methodology for the proposed cutting/trenching, beach nourishment and coastal protection works.
- Detailed description of the project, project objectives and phases (where applicable), including all applicable timelines for the various aspects of the project (from pre to post development). The description should also provide details of the design concept, design components, material(s) to be used, total number, size, and types of guest rooms/suites, and supporting services such as administrative, "back-of-house" facilities, power generation, laundry facilities and amenities to serve the proposed development such as pools, restaurants, chapel etc. This should be supported using maps, diagrams, and other visual aids where appropriate.
- Detailed description of all activities and features which will introduce risks or generate an impact (positive or negative) on the environment including but not limited to seagrass, mangrove and/or coral relocation and shading; collection, beach works, transfer, and disposal of waste (solid waste and sewage); provision of potable water and electricity.

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- Details of the methods, equipment, and machinery to be employed to undertake each aspect of the project including coral/seagrass relocation, dredging/excavation, beach nourishment, transportation of material, disposal of spoils (if applicable), storage of material, installation of pylons, construction of units, installation of required infrastructure and secondary activities such as refuelling of vessels, proposed location(s) for equipment storage (staging area) and establishment of a site office.
- Source and characteristic of fill sediment for beach nourishment and the impact on coastal morpho-dynamics should be include.
- The study area should be clearly delineated and referenced. Considering the types of resources located in the area and the magnitude of the associated impacts, the study area should be large enough to include all valued resources that might be significantly affected by the project.
- Detailed drainage report which should be designed for a 1 in 100-year event
- Details regarding access points and accessibility during pre-construction, construction, and post-construction, to the proposed work site(s)
- A detailed landscape plan highlighting grading and proposed changes in topography. The landscape plan should emphasize the retention of mature trees and use of native species in landscaping activities.
- Estimated duration and schedule of the project for construction
- Details of any required decommissioning of the works and/or facilities.

4.1 Overwater Rooms

Detailed description of Overwater Room details to include but not be limited to:

- Detailed description of the project, project objectives and phases (where applicable), including all applicable timelines for the various aspects of the project (from pre to post development). The description should also provide details of the design concept, design components, material(s) to be used, total number, size, and types of guest rooms/suites; boardwalk or means of access to the rooms; design height of structures above sea level; and supporting services such as administrative, "back-of-house" facilities and amenities to serve the proposed development. This should be supported by the use of maps, diagrams, and other visual aids where appropriate.
- Detailed description of all activities and features which will introduce risks or generate an impact (positive or negative) on the environment including but not limited to seagrass and/or coral relocation and shading; collection, transfer, and disposal of waste (solid waste and sewage); provision of potable water and electricity; and dredging.
- Details of the construction methods, equipment and machinery to be employed to undertake each aspect of the project including coral/seagrass relocation, dredging, transportation of material, disposal of spoils (if applicable), storage of material, installation of pylons, construction of units, installation of required infrastructure and secondary activities such as refueling of vessels, proposed location(s) for equipment storage (staging area) and establishment of a site office.
- Details regarding access points and accessibility to the proposed work site(s)

- Estimated duration of the project for construction
- Maintenance schedule
- Details of any required decommissioning of the works and/or facilities.

4.2 Wastewater Treatment Plant

Detailed description of Wastewater Treatment Plant details to include but not be limited to:

- Projected daily flows (average and peak)
- Effluent discharge details (including projected water quality)
- Treatment processes
- WWTP components.

4.3 Seawater Desalination Plant

Details of the proposed desalination process should be clearly outlined in the EIA report. Seawater Desalination Plant details to include but not be limited to:

- Daily abstraction volumes
- Abstraction well information
- Brine discharge
- Post-treatment projected water quality
- Desalination process and components.

4.4 Batching Plant (construction phase only)

Details of the proposed batching plant to be used during construction phase, should be clearly outlined in the EIA report. These details should include but not be limited to:

- Concrete generation rate per hour
- Raw materials to be used and where they will be bought/sourced from
- Raw material storage details
- Amount of water to be used and source of water
- Dust generation mitigation details
- Washdown activities and treatment of wastewater
- Maintenance and operations
- Emergency Response

5.0 DESCRIPTION OF ENVIRONMENT

This section should include a detailed description of the proposed sites (marine and terrestrial) and surrounding environment. Preliminary background data should be generated in order to give an overall evaluation of the existing environmental conditions. The study area should be large enough to include all valued resources that might be significantly affected by the project. This information will form the basis upon which impacts of the project will be assessed. The following aspects should be described in this section, broken down into the following:

- Physical Environment

- Biological Environment
- Socio-economic and Cultural/Heritage

5.1 Physical Environment:

- Topography, soils, climate/meteorology, drainage (including gullies), geology (including but not limited to rock type and formation, susceptibility to erosion, seismicity, and faults), geomorphology of the site and impacts on current landscape, aesthetic appeal and hydrology should be examined. Special emphasis should be placed on storm water runoff and drainage pattern.
- A detailed hydrological assessment of the proposed project area should be conducted to:
    - Identify and clearly map locations of natural and manmade drainage features within the project area. These are to include sinkholes, rivers, gullies and drainage infrastructure;
    - Estimation of peak flows under the 10-, 25-, 50- and 100-year Return Periods;
    - Flushing/circulation analysis of immediate coastal area against generated stormwater runoff.
    - Scenarios for hurricane should consider 25-, 50- and 100-year return periods.
    - Consultations should be had with the National Works Agency (NWA) regarding the drainage plan for the development.
- A Geotechnical Assessment for the site should be conducted
- Hydrodynamics, including but not limited to bathymetry, waves (hurricane, operational and swell), currents, tides and baseline sediment transport and circulation patterns.
- Water Quality of the marine environment. Preliminary background water quality data should include study areas and associated environs and control sites (total 7 sampling locations). These should be accurately mapped, and a spatial comparison of the data should be done in order to determine any possible source(s) of pollutants. Water quality should include but not be limited to the following parameters:
    - Physical parameters: Temperature, salinity, conductivity, pH, dissolved oxygen, turbidity, Total Suspended Solids and Total Dissolved Solids.
    - Chemical Parameters: Nitrate, Phosphate
    - Biological Parameters: Biochemical Oxygen Demand, Faecal Coliform.

Water quality data (primary and/or secondary) shall represent the wet and dry seasons and as such a minimum of six (6) months data shall be presented and analyzed in the Environmental Impact Assessment. Six (6) water quality sampling events will be conducted, each at least one month apart. At least one of these sampling events should occur after a heavy rainfall event, to represent the wet season.

Results from the water quality sampling should be compared to NRCA water quality standards.

- Analysis of Marine Sediments to include but not be limited to the following parameters:
    - Arsenic
    - Cadmium
    - Mercury
    - Lead
    - Total Petroleum Hydrocarbons

- Analysis of Sediment Loading in project area
- Noise levels of undeveloped site and the ambient noise in the area of influence (total 6 locations).
- Particulate Matter (PM10 and PM2.5) of the undeveloped site and in the area of influence (total 6 locations). Data is to be compared with the NRCA daily ambient air quality standard limit for PM10, and the USEPA daily limit for PM2.5 since a PM2.5 standard has not yet been promulgated for Jamaica. Three (3) sampling events will be conducted for PM10 and three (3) for PM2.5. This sampling will be spread over three different months.
- Sources of existing pollution (coastal, surface and groundwater) and extent of contamination.

5.2 Biological Environment:

Detailed description of terrestrial and marine habitats, existing vegetation type, detailed floral and faunal surveys inclusive of a species list; commentary on the biodiversity, ecological health and function in the project area, threats and conservation and significance. This should include:

- A qualitative and quantitative assessment of ecologically sensitive terrestrial and marine habitats in and around the proposed project sites and the areas of impact.
- Benthic surveys should be conducted with emphasis placed on the working footprint (seafloor) inclusive of temporary access points and buffer zones, which will be impacted by the proposed project structures/features such as coastal protection works, overwater structures, beach nourishment and dredging/excavation.
    - Where practical, the benthic survey should include the size and species name of coral colonies greater than 10cm (>10cm), within the project footprint.
    - Carbon sequestration should be calculated for seagrasses in the project area, in suitable sediment types
- A species list of terrestrial and marine flora and fauna (including but not limited to marine mammals, herpetofauna, avifauna, invertebrates, and bats) should be generated with special emphasis on those species considered rare, threatened, endangered, endemic, protected, invasive and economically or nationally important. Identification and description of the different ecosystem types and structure including species dominance, possible biological loss or habitat fragmentation ought to be considered.
- Location of threatened and endemic flora and fauna species should be geo-referenced and displayed on a site overlay map in relation to the footprint of the development.
- Habitat Map of area
- The abundance, height and diameter at breast height (DBH) for a representational subset of all floral species
- Any crocodile, sea turtle or bird nests observed in or around the project area should be recorded and mapped. This should be supported by information including but not limited to the following: existing sea turtle and bird nesting sites and seasons and habitat usage by migratory species

5.3 Natural Hazards

Natural Hazards and Disaster Risk Reduction for Climate Change, in relation to:

- Earthquakes (Seismic risk to be evaluated in relation to findings of the geotechnical study)

- Hurricane
- Storm surges (coastal flooding)
- Flooding
- Beach Stability (should account for under current and future scenarios influencing beach erosion)

The natural hazard risk assessment should take in account climate change projections for return periods of 25, 50 and 100 years.

5.4 Cultural/Heritage

An assessment of artefacts, archaeological, and paleontological features of the site. The historical importance of the area should also be examined including identification of culturally significant features e.g., archaeological finds. Where there is a need, this should be conducted in collaboration with the Jamaica National Heritage Trust.

5.5 Traffic Impact Assessment

The objectives are to investigate the potential impact of the traffic during construction and during operations on the existing and future main road traffic.

It will involve:

- Meeting with the St. Ann Municipal Corporation and National Works Agency to discuss the project parameters and assumptions that will be made to refine the scope of works required for approval
- Background Data Collection
  - Existing traffic count data on main road and associated intersection
  - Field/road conditions parameters will be collected for all the relevant roads and intersections
  - Other developments currently planned within the area

The data collected will be used to describe the existing conditions at all the selected locations. Comparisons will also be drawn to show what the existing conditions are as opposed to what the standards recommend. Analysis will be conducted to determine the existing Level of Service (LOS) at each intersection as well as on the roads.

The potential impact of hotel construction and operations on LOS will be determined and recommended mitigation measures provided.

5.6 Socioeconomic

This section should provide details on: Demography, regional setting, current and potential land-use patterns; description of existing infrastructure such as transportation, electricity, water and telecommunications, and public health and safety; should be explored and other material assets of the area should also be examined. This will be done within 5 km of the proposed site.

A socio-economic survey to determine public perceptions of the project (both negative and positive) should also be completed and this should include but not be limited to potential impacts on social, physical, biological, and historical/cultural values. This assessment may vary with community structure and may take multiple forms such as public meetings or questionnaires. The methodology for conducting the survey should be included as part of the EIA report. This survey will be conducted within 2 km of the proposed site.

6.0 PUBLIC PARTICIPATION

Describe the public participation methods, timing, type of information provided and collected from public and stakeholder target groups meetings. The instrument used to collect the information must be included in the appendix. It may be useful and necessary to hold stakeholder meetings to inform the public of the proposed development and the possible impacts. This will also gauge the feeling/response of the public toward the development.

The issues identified during the public participation process should be summarized and public input that has been incorporated or addressed in the EIA should be outlined.

Public Meetings should be held in accordance with the NEPA's Guidelines for Conducting Public Presentations". A public meeting will be held to present the findings of the EIA once the EIA is completed and submitted for consideration. All relevant documents are required to be made available to the public. In addition, any material change to the design of the project will require a further public meeting to be undertaken by the developer and all changes made to the document. should be clearly outlined to the public.

7.0 IDENTIFICATION AND ASSESSMENT OF POTENTIAL IMPACTS AND RECOMMENDED MITIGATION

A detailed analysis of the project components should be done in order to: identify the major potential environmental and public health impacts of the project; distinguish between levels of impact, significance of impact (a ranking from major to minor/significant to insignificant should be developed), positive and negative impacts, duration of impacts (long term or short term or immediate), direct and indirect and impacts, reversible or irreversible, long term and immediate impacts and identify avoidable impacts.

Cumulative impacts should also be evaluated considering previous developments and any proposed development immediately adjacent to the subject development within the area. The identified impacts should be profiled to assess the magnitude of the impacts. The major concerns surrounding environmental and public health issues should be noted and their relative importance to the design of the project and the intended activities indicated.

The extent and quality of the available data should be characterized, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts. A major environmental issue is determined after examining the impact (positive and negative) on the environment and having the negative impact significantly outweigh the positive. It is also determined by the number and magnitude of mitigation strategies which need to be employed to reduce the risk(s) introduced to the environment. Project activities and impacts should then be ranked as major, moderate, and minor and presented in separate matrices for all the phases of the project (i.e., preconstruction, construction, operational and decommissioning/closure). The potential impacts may be subdivided into Physical

Impacts, Biological Impacts and Socio-economic/Cultural Impacts. All impacts should be listed, ranked, and assessed, preferably in a single table.

The impacts to be assessed should include but not be limited to the following:

7.1 Physical Impacts:

- Construction activities such as site clearance, earthworks, and spoil disposal.
- Sediment plume dispersal,
- Modification of waves and current patterns
- Water quality (during construction and operation)
- Air Quality
- Spoil Disposal
- Impacts of potential spills (such as oil and chemical spills)
- Drainage
- Traffic
- Solid Waste
- Noise impacts
- Operation and maintenance – provision of and demand requirements for potable water and electricity, waste disposal, sewage treatment and disposal, communication, and other utility requirements
- Impacts on aesthetics, landscape, and seascape

7.2 Biological Impacts:

This should include an assessment of the direct and indirect impacts of the project on the ecology of ecologically sensitive marine ecosystems with emphasis being placed on rare, endemic, threatened, protected, endangered, invasive, and economically important species. Other impacts should include:

- Coastal modification and shoreline modification including but not limited sandy and rocky shore ecosystem.
- Removal of seagrass, mangrove and corals, relocation of seagrass and corals, shading.
- Assessment on impacts on other marine resources including but not limited to corals and seagrass.
- If coral and seagrass are to be impacted then the criterion for relocation site(s) selection should be included. Relocation sites will be proposed based on spatial features only (satellite imagery, proximity to project site etc.)
- If ecologically sensitive floral species are to be impacted then the criterion for relocation site(s) selection should be included
- Proposals to compensate for the unavoidable loss of natural resources should be included.

7.3 Natural Hazards

Potential impact of natural hazards including tropical storms, hurricanes, earthquakes, and tsunamis

7.4 Socioeconomic/Cultural/Heritage Impacts:

Effects on the socio-economic status such as changes to public access and recreational use; impacts on existing and potential economic activities; contribution of the development to the national economy and development of surrounding communities should be examined. Socio-economic and cultural impacts to include prescriptive rights, land use/resource effects, health, and safety of the potential workers as well as the residents of the surrounding environs should be described. Public perception as it relates to loss of property value, loss of aesthetic enjoyment among other things should be explored, as well as Loss of and damage to artefacts, archaeological and paleontological features.

Mitigation:

The mitigation measures should endeavour to avoid, reduce, and remedy the potential negative effects while at the same time enhancing the positive impacts projected. Mitigation and abatement measures should be developed for each potential negative impact identified. Full details of the methods proposed to be employed in the implementation of these measures should be provided, including details on the scheduling/timelines, source of materials, location, and responsible parties, where appropriate. Maps and diagrams should also be used to illustrate areas where mitigation measures are proposed to be implemented.

This should be represented in a table/matrix outlining the identified impacts and the proposed mitigation measures. The sustainable design and mitigation strategies should be clearly stated in the EIA report

8.0 IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

Alternatives to the proposed development/project including the no-action alternative should be examined. These should be assessed according to the physical, biological, and socio-economic parameters of the site. This examination of alternatives should incorporate the use of the history of the overall area in which the site is located and previous uses of the site itself. Alternatives should also address specific aspects of the project such as methods proposed in the execution of the project (works) that have been identified as being causes of major impacts. A rationale for the selection of any project alternative should be provided.

This section should include at least three (3) alternatives including the No-Action alternative.

9.0 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

9.1 Environmental Management Plan

An Environmental Management Plan should be developed which will detail the requirements for the construction and operational phases of the project. This should include, but not be limited to methodology, training for construction and operation staff, recommendations to ensure that the implementation of mitigation measures and long-term minimization of negative impacts. Special emphasis should be placed on the preparation of an outline Coral Management Plan, Mangrove and/or Seagrass Management.

9.2 Environmental Monitoring Plan

An outline Environmental Monitoring Plan should be included in the EIA. At the minimum the outline monitoring plan should include:

- Introduction outlining the need for a monitoring programme
- The locations selected for monitoring
- The mitigation measures to be implemented and the parameters and activities which will be monitored for each activity
- The proposed methodology to be employed for the monitoring of the various parameter.
- The frequency of the monitoring
- The proposed format that the monitoring reports should take
- The frequency of the submission of the monitoring reports
- The responsible parties for the monitoring

10.0 CONCLUSION AND RECOMMENDATIONS

11.0 LIST OF REFERENCES

12.0 APPENDICES

The appendices should include but not be limited to the following documents:

- Reference documents
- Photographs/ maps
- Data Tables
- Glossary of Technical Terms used
- Terms of Reference
- Composition of the consulting team, team that undertook the study/assessment, including name, qualification, and roles of team members
- Notes of Public Consultation sessions
- Instruments used in community surveys

All findings must be presented in the EIA report and must reflect the headings in the body of the TORs, as well as references. GIS references should be provided where applicable. Two hard copies and an electronic copy must be submitted to NEPA for review after which the Agency will indicate the number of hard copies along with an electronic copy of the report to be submitted. One copy of the document should be perfect bound.

The report should include appendices with items such as maps, site plans, the study team and their individual qualifications, photographs, and other relevant information. All the foregoing should be properly sourced and credited.

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JAN 03 20[illegible]
ACCEPTED

Appendix 2 – Study Team

C.L. Environmental Company Limited

- Carlton Campbell, Ph.D., CIEC (Project Coordinator)
- Matthew Lee, M.Sc. (Noise, Vibration, Air Quality, Marine Benthic Sediments)
- Rachel D'Silva, B.Sc. (Marine and Benthic Studies)
- Karen McIntyre, M.Sc. (GIS, Cartography, Socioeconomics)
- Alec Silvera, B. Sc (Water Quality, Marine and Benthic Studies)
- Glen Patrick (Field Technician)
- Patrick Litchmore (Field Technician)

Smith Warner International Limited

- Oceanography and Hydrodynamics (Currents and Tides, Wave Climate, Hurricane Wave Climate, Storm Surge, Sediment Transport, Sedimentology, Shoreline Morphology, Bathymetry)
- Drainage and Hydrology

Associate Consultants

- CEAC Solutions Company Limited (Traffic Impact Assessment)
- Camilo Trench, M.Sc. (Mangrove and Coastal Vegetation)
- Damion Whyte, M.Sc. (Terrestrial Faunal Studies)
- Jannette Manning, M.Sc. (Public Perception Survey)
- Jamaica National Heritage Trust (Archaeological Impact Assessment)

Appendix 3 – Hydrolab Multiprobe Calibration Test Sheet

DATE: 4/1	DOCUMENT #: 19005-00-Tech_Series5_Instruc
PAGE: 1 OF 2	REVISION: 1

OTT HydroMet

Section A: **Series 5, and 5x Sonde Functional Test Data Sheet**

Work Order # WO-01204206	Customer CL Environmental	Date Started 11/12/21
Housing Serial # 100100048757	Embedded Serial# 48757	Additional Driver Firmware:
Technician Phillip Druyor	Model: **Datasonde** ✓ 5 ✓ **Minisonde** 5x	Depth100 2.13 PAR 1.02 Turbidity 3.21 LDO 3.23

Customer Display Information

I/D N/A	DOM 011510	Baud Rate 19200	Security 2	SDI N/A	TTY
Parameter	Time	Temp	pH	SpCond	ORP
Units	HH:MM:SS	°C	Units	mS/cm	mV
Parameter	Dep100	PAR	TurbSC	LDO%	LDO
Units	meters	µE/s/m²	NTU	Sat	mg/l

For Sonde with Depth – Coefficients

A:	-4230.0	B:	14300.0	C:	16.8	D:	-16000.0
E:	-0.0101	F:	-6.03	G:	6000.0	H:	3.44E-05
I:	0.008519	J:	3.37			SER:	0.0

FLUOROMETER OFFSETS

1ST	N/A	X10:	N/A	X1:	N/A
2ND	N/A	X10:	N/A	X1:	N/A

For Sonde with TDG or PAR – Coefficients

A:	-220.98	**B:**	-220.98	**C:**	N/A	**D:**	N/A
Local:	N/A			Ref:	N/A		

Performance, Test and Evaluation

Current MPL Rev-- 5.44 Upgrade to MPL Rev--	pH Electrolyte & Teflon Junction Replaced- Yes ✓ No NA	DO membrane Replaced Yes No NA
Sensors cleaned –Yes ✓	RTC Battery Replaced Yes ✓ No	Desiccant Replaced –Yes ✓ No

Section B:

	Submission 1 Day 1	Submission Day
Customer Observations Verified / Customer Request	Y ✓ N N/A PT&E ✓ Upgrade	Y N N/A PT&E Upgrade
Set Time and Date	Yes ✓	Yes
Verified all hardware updates as current	Yes ✓	Yes
Total current draw. (Check all that apply) MPL PCB 40mA ✓ SC Turbidity 20mA ✓ LDO 80mA ✓ 4Beam Turbidity 10mA Flourometers: 1st 30mA 2nd 30mA 3rd 30mA PAR 10mA ✓ (Optimal Values not to exceed +20mA overall.)	140	
Current draw of circulator. (20 mA max. beyond previous values.)	N/A	
Operation of self-cleaning motor verified—	P ✓ F NA	P F NA
Audio functions correctly	P ✓ F	P F
RTC sleep/wake-up test.	P ✓ F	P F

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Additional Notes:

DATE: 10-2-12	DOCUMENT #: 19005-00-Tech_Series5_Instruc
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Temp probe test at room temperature. 20.00 ° C (+/- 0.1)	Sonde Temp : 20.00 ° C	Sonde Temp : ° C
DO 100% sat integrity window verified at +50 mmHg over current bp. (Clark Cell only)	P F NA ✓	P F NA
DO 100% saturation calibration verified - local BP (+/- 0.2 mg/L Clark Cell) (+/- 0.1mg/L LDO)	Temp : 21.62 BP : 626.46 mg/L : 7.21 Drift +/- :	Temp : BP : mg/L : Drift +/- :
Scale Factor (0.7 -- 1.3) LDO Only	1.094391	
Conductivity zero (air) calibration verified - (+/-.005mS)	0.0000	
Conductivity calibration verified – ✓ 1.412 mS/cm (± .04 mS) 12.856 mS/cm (± .2 mS) 47.6 mS/cm (± .2 mS)	1.412	
Conductivity linearity verified – .100 mS/cm (± .005 mS) ✓ .500 mS/cm (± .025 mS)	.510	
pH 7 buffer calibration verified– (+/- .2 pH)	7.01	
pH slope calibration verified at 10.01 units.	10.01	
ORP calibration verified at 22.35 ° C (+/- 20 mV)	434	
Turbidity - Calibration accepted & verified with DI Water (0.0 +/- 0.7 NTU)	0.0	
Turbidity - Calibration accepted & verified at (100.0 +/- 1 NTU) with Hach StablCal	100.3	
Turbidity - Linearity verified with 40 NTU Hach StablCal – (+/- 4 NTU)	40.2	
Depth zero calibration verified – (.02 meters)	0.00	
Depth Check verified – (+/- 0.03 meters) Tank depth: 0.685	0.68	

Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A	Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A	Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A

N03- calibration verified	P F NA ✓	P F NA
NH4+ calibration verified	P F NA ✓	P F NA
Cl- calibration verified	P F NA ✓	P F NA
Chlorophyll 'a' calibration verified	P F NA ✓	P F NA
Rhodamine 'wt' calibration verified	P F NA ✓	P F NA
Blue-green Algae calibration verified	P F NA ✓	P F NA
PAR calibration verified	P ✓ F NA	P F NA
TDG calibration verified (+/- 2 mmHg)	P F NA ✓	P F NA
Logging/Sensor Stability Test	P ✓ F	P F
pH linearity verified at 4 units. (+/- 0.20 units)	4.01	
Battery pack setup and checked	P ✓ F NA	P F NA
Display, Baud Rate, Communications mode settings returned as received.	Yes ✓ No	

Calibrated Test Equipment Used – Description | **X-number**

Power Supply BK Precision 1617A	X- 8954
Fluke 1524 -- Reference Thermometer	X- 8244
DVM Digital Multimeter	X- 001765

Section C. Final Check-off Prior to Submitting for Estimate

Exterior is clean ✓	Hach Business System updated ✓
Clear pH 4 Buffer in storage cup ✓	Date Completed 11/17/21

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DATE: 4/1	DOCUMENT #: 19005-00-Tech_Series5_Instruc
PAGE: 1 OF 2	REVISION: 1

OTT HydroMet

Section A: **Series 5, and 5x Sonde Functional Test Data Sheet**

Work Order # WO-01261722	Customer CL Environmental	Date Started 05/06/22
Housing Serial # 100100048757	Embedded Serial# 48757	Additional Driver Firmware:
Technician Phillip Druyor	Model: **Datasonde** ✓ **Minisonde** 5 ✓ 5x	Depth100 2.13 PAR 1.02 Turbidity 3.21 LDO 3.07

Customer Display Information

I/D N/A	DOM 011510	Baud Rate 19200	Security 2	SDI N/A	TTY
Parameter	Time	Temp	pH	SpCond	ORP
Units	HH:MM:SS	°C	Units	mS/cm	mV
Parameter	Dep100	PAR	TurbSC	LDO%	LDO
Units	meters	µE/s/m²	NTU	Sat	mg/l

For Sonde with Depth – Coefficients

A: -4230.0	B: 14300.0	C: 16.8	D: -16000.0
E: -0.0101	F: -6.03	G: 6000.0	H: 3.44E-05
I: 0.008519	J: 3.37	SER: 0.0	

FLUOROMETER OFFSETS

1ST N/A	X10: N/A	X1: N/A
2ND N/A	X10: N/A	X1: N/A

For Sonde with TDG or PAR – Coefficients

A: -220.98	**B:** -220.98	**C:** N/A	**D:** N/A
Local: N/A	Ref: N/A		

Performance, Test and Evaluation

Current MPL Rev-- 5.44 Upgrade to MPL Rev--	pH Electrolyte & Teflon Junction Replaced- Yes ✓ No NA	DO membrane Replaced Yes No NA ✓
Sensors cleaned –Yes ✓	RTC Battery Replaced Yes ✓ No	Desiccant Replaced –Yes ✓ No

Section B:

	Submission 1 Day 1	Submission Day
Customer Observations Verified / Customer Request	Y ✓ N N/A PT&E ✓ Upgrade	Y N N/A PT&E Upgrade
Set Time and Date	Yes ✓	Yes
Verified all hardware updates as current	Yes ✓	Yes
Total current draw. (Check all that apply) MPL PCB 40mA ✓ SC Turbidity 20mA ✓ LDO 80mA ✓ 4Beam Turbidity 10mA Flourometers: 1st 30mA 2nd 30mA 3rd 30mA PAR 10mA ✓ (Optimal Values not to exceed +20mA overall.)	140	
Current draw of circulator. (20 mA max. beyond previous values.)	N/A	
Operation of self-cleaning motor verified—	P ✓ F NA	P F NA
Audio functions correctly	P ✓ F	P F
RTC sleep/wake-up test.	P ✓ F	P F

Additional Notes:

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DATE: 10-2-12	DOCUMENT #: 19005-00-Tech_Series5_Instruc
PAGE: 2 OF 2	REVISION: 1

Temp probe test at room temperature. 20.00 **° C (+/- 0.1)**	Sonde Temp : 20.01 ° C	Sonde Temp : ° C
DO 100% sat integrity window verified at +50 mmHg over current bp. (Clark Cell only)	P F NA ✓	P F NA
DO 100% saturation calibration verified - local BP (+/- 0.2 mg/L Clark Cell) (+/- 0.1mg/L LDO)	Temp : 21.90 BP : 630.25 mg/L : 7.22 Drift +/- :	Temp : BP : mg/L : Drift +/- :
Scale Factor (0.7 -- 1.3) LDO Only	1.11066	
Conductivity zero (air) calibration verified - (+/-.005mS)	0.0000	
Conductivity calibration verified – ✓ 1.412 mS/cm (± .04 mS) 12.856 mS/cm (± .2 mS) 47.6 mS/cm (± .2 mS)	1.412	
Conductivity linearity verified – .100 mS/cm (± .005 mS) ✓ .500 mS/cm (± .025 mS)	.505	
pH 7 buffer calibration verified– (+/- .2 pH)	7.00	
pH slope calibration verified at 10.01 units.	10.02	
ORP calibration verified at 21.63 ° C (+/- 20 mV)	435	
Turbidity - Calibration accepted & verified with DI Water (0.0 +/- 0.7 NTU)	0.0	
Turbidity - Calibration accepted & verified at (100.0 +/- 1 NTU) with Hach StablCal	99.9	
Turbidity - Linearity verified with 40 NTU Hach StablCal – (+/- 4 NTU)	40.3	
Depth zero calibration verified – (.02 meters)	0.00	
Depth Check verified – (+/- 0.03 meters) Tank depth: 0.685	0.69	

Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A	Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A	Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A

N03- calibration verified	P F NA ✓	P F NA
NH4+ calibration verified	P F NA ✓	P F NA
Cl- calibration verified	P F NA ✓	P F NA
Chlorophyll 'a' calibration verified	P F NA ✓	P F NA
Rhodamine 'wt' calibration verified	P F NA ✓	P F NA
Blue-green Algae calibration verified	P F NA ✓	P F NA
PAR calibration verified	P ✓ F NA	P F NA
TDG calibration verified (+/- 2 mmHg)	P F NA ✓	P F NA
Logging/Sensor Stability Test	P ✓ F	P F
pH linearity verified at 4.01 units. (+/- 0.20 units)	4.02	
Battery pack setup and checked	P ✓ F NA	P F NA

Display, Baud Rate, Communications mode settings returned as received.	Yes ✓ No

Calibrated Test Equipment Used – Description	**X-number**
Power Supply BK Precision 1617A	X- 8954
Fluke 1524 -- Reference Thermometer	X- 8244
DVM Digital Multimeter	X- 001765

Section C. Final Check-off Prior to Submitting for Estimate

Exterior is clean ✓	Hach Business System updated ✓
Clear pH 4 Buffer in storage cup ✓	Date Completed 05/09/22

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Appendix 4 – Bruel and Kjaer Noise Calibration Certificate

HBK HOTTINGER BRÜEL & KJÆR

The Hottinger Brüel & Kjær Inc. Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: http://www.hbkworld.com

ACCREDITED

Calibration Certificate # 1568.01

CERTIFICATE OF CALIBRATION No.: CAS-533887-W0Z6N6-401 Page 1 of 2

CALIBRATION OF:

Calibrator:	Brüel & Kjær	Type 4231 IEC Class: 1	Serial No.:	3008614

CUSTOMER:

C.L. Environmental Company Ltd.
20 Windsor Avenue, Kingston 5
Kingston, Jamaica

CALIBRATION CONDITIONS:

Environment conditions:	Air temperature:	23.7	°C
	Air pressure:	98.131	kPa
	Relative Humidity:	49.9	%RH

SPECIFICATIONS:

This document certifies that the acoustic calibrator as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants. The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.

PROCEDURE:

The measurements have been performed with the assistance of Hottinger Brüel & Kjær Inc. acoustic calibrator calibration application
Software version 2.3.4 Type 7794 using calibration procedure 4231 Complete

RESULTS:

- [X] "As Received" Data: Within Acceptance Criteria
- [ ] "As Received" Data: Outside Acceptance Criteria
- [X] "Final" Data : Within Acceptance Criteria
- [ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the calibrator under calibration.

Date of Calibration: September 14, 2021

Certificate issued: September 14, 2021

Meshaun Hobbs
Calibration Technician

Harold Williams
Harold Williams
Quality Representative

CERTIFICATE OF CALIBRATION

No.: CAS-533887-W0Z6N6-401

Type: 4231 Serial No.: 3008614 Page 2 of 2

Sound Pressure Levels

All stated values are valid at environmental reference conditions

Nominal Level [dB]	Accept Limit Lower [dB]	Accept Limit Upper [dB]	Measured Level [dB]	Measurement Uncertainty [dB]
94	93.80	94.20	93.96	0.12
114	113.80	114.20	113.93	0.12

Frequency

Nominal Frequency [Hz]	Accept Limit Lower [Hz]	Accept Limit Upper [Hz]	Measured Frequency [Hz]	Measurement Uncertainty [Hz]
1000	999.00	1001.00	999.98	0.10

Total Distortion*

Distortion mode: [X] TD* [ ] THD*

Calibration Level [dB]*	Accept Limit [%]*	Measured Distortion [%]*	Measurement Uncertainty [%]*
94	1.00	0.34	0.13
114	1.00	0.10	0.13

Environmental Reference Conditions:

Pressure: 101.3 kPa, Temperature: 23 °C, Relative Humidity: 50%

Instrument List

Type	Description	Serial no	Cal. date	Due date	Calibrated by	Trace number
3560	PULSE Analyzer	2723320	2020-10-20	2021-10-20	JCA	CAS-475391-Q6N6H0-103
9545	Transfer Microphone	3	2020-10-21	2021-10-21	MH	CAS-475391-Q6N6H0-404
4228	Reference Sound Source	1618502	2021-04-30	2023-04-30	M. Hobbs	CAS-512601-T0X4B1-402

During the calibration the calibrator has been loaded by the load volume of the Transfer Microphone. The load volumes for a number of different types of Transfer Microphones are listed in the table below.
For Brüel & Kjær Pistonphones types 4220 and 4228 the result of the SPL calibration has been corrected to be valid for a load volume of 1333 mm^3 . For all other types the result is valid with the actual load volume.

Transfer Microphone Type	Fulfils standard IEC 61094-1 LS	Fulfils standard IEC 61094-4 WS	Load Volume 1" (1/2" mic including DP-0776)	Load Volume 1/2"
4180	yes	yes	1126 mm^3	43 mm^3
4192	-	yes	1273 mm^3	190 mm^3
9545	-	-	1333 mm^3	-

Condition "As Received":

Good

Comments

Appendix 5 – Airmetrics Tactical Air Sampler Calibration Certificate

NIST Traceable Transfer Standard Calibration

Calibration Date:	07/21/2021	Orifice #	MNF1829-	By:	
Ambient Temp, °K:	297.9	Pri Std #	LFE774300		
Amb Press, mmHg:	758.0	Manometer #	DIG1829	Chk:	

Std ΔH (inH_2O)	Manometer ΔH (inH_2O)	Actual Flow (alpm)	Calc Flow (alpm)	Difference* (%diff)
4.82	4.75	7.867	7.852	0.20
4.00	3.92	7.108	7.123	-0.21
3.20	3.13	6.343	6.354	-0.17
2.47	2.41	5.571	5.563	0.15
1.84	1.79	4.792	4.780	0.26
1.49	1.44	4.269	4.276	-0.17
1.16	1.12	3.743	3.759	-0.43
0.86	0.82	3.215	3.201	0.42

Manometer ΔH vs Act Flow Linear Regression Results:

m_{flo} =	**5.8231**
b_{flo} =	**-0.1039**
r^2 =	**0.9999**

* all points must be within ± 2%

The MiniFlo calibration is performed with an NIST-traceable standard. Each unit has a unique pair of calibration constants derived from the calibration which are used to calculate the actual air flow rate at all ambient conditions. The unit's calibration should be recertified annually.

The actual flow rate is a function of the pressure drop across the device, the ambient temperature, and the ambient pressure. The relationship of these variables and the unique calibration constants ("m" and "b") for each device is presented in the following equation (Eq.A):

$$Q_{act} = m_{flo} \times \sqrt{\frac{\Delta H \times T_{act}}{P_{act}}} + b_{flo}$$

Q_{act} = actual flowrate, liters per min
ΔH = manometer reading, inches of water
T_{act} = ambient temperature, °K
P_{act} = ambient pressure, millimeters of mercury

CAUTION: The weather service, most airports, etc, reduce the atmospheric pressure to a common reference (sea level). The equation above requires the atmospheric pressure at the location where the MiniFlo is being used.

The equation below may be used to estimate the ambient atmospheric pressure at any elevation if the sea level pressure is known.

$$P_{act} = P_{sea} \times \left(1 - \frac{E}{145300}\right)^{5.25}$$

P_{act} = Ambient Atmospheric Pressure
P_{sea} = Sea Level Atmospheric Pressure
E = Site elevation, feet

Airmetrics
1940 Don St., Suite 300
Springfield, OR 97477
(541) 683-5420

Appendix 6 – Community Questionnaire

SECRETS RESORT & SPA, RICHMOND ESTATE, ST ANN
COMMUNITY QUESTIONNAIRE

DATE:____________________ **INTERVIEWER:**______________

Richmond Vista Limited is proposing to develop approximately 22.4 acres (90,624 sqm) of waterfront property located at Richmond Estate, St Ann, to be known as "Secrets Resort and Spa". The project as proposed and will be done in two phases and upon completion will comprise 715 rooms.

- Phase One will include 500 hotel rooms and fifteen (15) over water suites
- Phase Two will include 200 hotel rooms

The overall design will be expanded across the site and will occupy an approximate floor area of 81,544 square metres with building heights ranging between one and seven (1-7) storeys. The proposed height for floor levels of both hotels will be 3.5 metres (approx. 11.5ft) for levels 2-5, while the ground level, level one and level six will be 5.0 metres (approx. 16.5ft) in height

The proposed development will entail:

- 2 hotels with 700 rooms (500 and 200 rooms)
- 15 over-water villas/suites
- Leisure and recreational amenities to include – specialty restaurants, beach and pool bars, gazebos, spa, Temazcal (Mexican sweat lodge/sauna)
- A "Technical Area" (the area for the desalination and wastewater treatment plants)

It is also proposed that a part of the design includes modifying a part of the existing beach. The project as proposed will incorporate a batching plant for the mixing of concrete required during the construction phase of the project. Associated with the batching plant will be the storage of stockpiled aggregate (gravel, sand) needed in the concrete mixing/batching process. It is also proposed that the project will include a wastewater treatment plant and a seawater desalination plant to service the requirements of the development

COHORT DESCRIPTION

1. What is the name of this/your community? ___________________________
2. Gender (i) Male (ii) Female (iii) do not wish to disclose
3. Age group (i) 18- 25 yrs (ii) 26-33 yrs (iii) 34-41 yrs (iv) 42 – 50 yrs (v) 51 – 60 yrs (vi) older than 60 yrs
4. Are you the head of your household (i) yes (ii) no
5. What is your current employment status? (i) self-employed (ii) employed (iii) unemployed (iv) retired
6. Including yourself, how many people live in your household? ____ (i) # of adults ____ (ii) # of children under 18 yrs ____
7. How long have you lived in your community? (i) <2 yrs (ii) 3-5 yrs (iii) 5- 10 yrs (iv)10-15 yrs (v) >15 yrs (vi) all your life
8. In the event of illness, where do you mainly obtain health care (write in name & location)?(i) Public Clinic______________ (ii) Public Hospital _________________(iii) Private Doctor __________________ (iv) Private Hospital________________
9. Do you suffer from any of the following conditions? (i). Asthma (ii). Sinusitis (iii) coughing (iv) congestion/bronchial problems (v) chest pains (vi) bouts of diarrhoea (vii) none

What is your average weekly income? (i) no income (ii) under $9,000 per week (iii) $9,000 per week (iv) $9,001 - $12,000 per week (v) $12,001 - $20,000 per week (vi) over $20,000 per week (vii) do not wish to disclose

10. What is the highest level of education you completed? (Which was the last school you attended) (i) None (ii) Primary/All Age (iii) Some High School (iv) High School (v) College (vi) University (vii) HEART/Vocational training institute
11. Is there anyone in your household attending school at this time? (i) yes (ii) no
    a. What school(s) do they attend (i) infant/basic (ii) primary/all age (iii) high school (iv) college (v) University (vi) HEART/ Vocational Training Institute
12. Are there any recreational centres/spaces in your community? (i). Yes (ii) No
    a. **If yes** please give name and type _______________________________

PERCEPTION

13. Have you ever heard of a company called Richmond Vista Limited? (i) yes; (ii) no
14. Have you ever heard of a project called Secrets Resort & Spa? (i) yes; (ii) no
15. Do you know what a desalination plant is? (i) yes; (ii) no
16. Do you know what an overwater suite/villa is? (i) yes; (ii) no
17. Did you know that Richmond Vista Limited is proposing to construct a 715- room hotel Development in the Richmond Estate area of St. Ann? (i) yes (ii) no
    a. **If yes** Were you aware that this development would include 15 overwater suites/villas? (i) yes; (ii) no
    b. **If yes** Were you aware that this development would include two buildings comprising 700 rooms in total? (i) yes; (ii) no
    c. **If yes** Were you aware that this development would include modifying a section of existing beach? (i) yes; (ii) no

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d. **If yes** Were you aware that this development would include constructing a wastewater treatment plant (i) yes; (ii) no
e. **If yes** Were you aware that this development would include constructing a desalination plant (i) yes; (ii) no

f. **If yes**, how were you made aware? (i) Newspaper (ii) Television (iii) Radio (iv) Community meeting (v) Word of mouth (vi) social media (vii) Other -----------------------------

18. Have there been any problems/issues on the proposed project site in Richmond Estate? (i) yes (ii) no (iii) don't know
    a. **If yes** what were/are the issues ____________________
19. Do you have any general concerns about the project as proposed? (i) yes; (ii) no (iii) not sure/don't know
    a. **If yes**, what are they? ____________________
    ____
    b. **If yes**, what would you suggest to address/resolve your concern(s)? ____________________
    ____
20. Do you have any specific concern(s) relating to a section of the beach being modified? (i) yes; (ii) no (iii) not sure/don't know
    a. **If yes**, what are they? ____________________
    ____
    b. **If yes**, what would you suggest to address/resolve your concern(s)? ____________________
    ____
21. Do you have any specific concern(s) relating to suites/villas being built over water? (i) yes; (ii) no (iii) not sure/don't know
    c. **If yes**, what are they? ____________________
    ____
    d. **If yes**, what would you suggest to address/resolve your concern(s)? ____________________
    ____
22. Do you have any specific concern(s) relating to the seawater desalination plant? (i) yes; (ii) no (iii) not sure/don't know
    e. **If yes**, what are they? ____________________
    ____
    f. **If yes**, what would you suggest to address/resolve your concern(s)? ____________________
    ____
23. Do you have any specific concern(s) relating to the project having its own batching/concrete mixing plant to allow for the onsite mixing of concrete during construction activities? (i) yes; (ii) no (iii) not sure/don't know
    g. **If yes**, what are they? ____________________
    ____
    h. **If yes**, what would you suggest to address/resolve your concern(s)? ____________________
    ____
24. Do you depend/use the proposed site (the lands/ beach area) for any type of activity? (i) yes; (ii) no
    a. **If yes** for what purpose ____________________
25. Do you depend/use the section the marine environment proposed for the overwater suites for any type of activity? (i) yes; (ii) no
    a. **If yes** for what purpose ____________________
26. In the past did you walk through the proposed site? (i) yes; (ii) no
    a. **If yes** why (i) to access the beach/ for recreation (ii) fishing (iii) other____________________
    b. **If yes** how long were you doing this? (i) less than a year (ii) 1-5 years (iii) 6-10 years (iv) 11-15 years (v) 16-19 years (vi) 20 or more years

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27. Do you still walk through the proposed site? (i) yes; (ii) no
    a. **If yes** why (i) to access the beach/ for recreation (ii) fishing (iii) other______________________________
28. Do you know of anyone who depends/uses the proposed site (lands/ beach area) for any type of activity? (i) yes; (ii) no
    a. **If yes** for what purpose ____

29. Do you think this project will affect your life/livelihood (i) positively or (ii) negatively? (iii) not at all (iv) not sure/don't know
    a. **If positive** how so? ____
    b. **If negative** how so?____
    c. **If negative** how do you think your issue could be resolved**?** ____
    ____

30. Do you think this project will affect your community (i) positively or (ii) negatively? (iii) not at all (iv) not sure/don't know
    a. **If positive** how so? ____
    b. **If negative** how so?____
    c. **If negative** how do you think this issue could be resolved**?** ____
    ____

31. Do you think this project will affect the environment (i) positively or (ii) negatively? (iii) not at all (iv) not sure
    a. **If positive** how so? ____
    b. **If negative** how so?____
    c. **If negative** how do you think this issue could be resolved**?** ____
    ____

HOUSING, HEALTH AND SOCIAL SERVICES

32. What is the ownership status of the house you live in? (i) Own (ii) Lease (iii) Rent (iv) Government Own (v) Squat (vi) Family own (vii) Other, specify ____________
33. What is the ownership status of the land on which your house is located?
    (i) Own (ii) Lease (iii) Squat on (iv) Family Owned (v) Government Owned (vi) Other, specify ______________
34. What type of construction material is your residence made from?
    a. **Walls:** (i) Concrete and blocks (ii) Wood/Board (iii) Zinc (iv) Other specify________
    b. **Roof:** (i) Metal sheeting (zinc) (ii)Concrete (iii)Wood (iv) Other specify________
35. How many of the following rooms does your residence have? (i) Bedrooms _______ (ii) Bathrooms ________
36. What type of toilet facility do you have? (i) Water Closet (ii) Pit Latrine (iii) None (iv)Other, specify ____________
37. What does your household use for lighting? (i) Electricity (ii) Kerosene oil (iii) Gas (iv) Solar (v) Other, specify ___________
38. What (type of fuel does the household) do you **use most** for cooking? (i) Gas (ii) Electricity (iii)Wood (iv)Coal (v)Other, specify _____________
39. What is the main source of domestic water supply for the household? (i) Public piped water into dwelling (ii) Private Tank (iii) Community Tank (iv) Government Water Trucks (free) (v)Public Standpipe (vi). Private Water Trucks (paid) (vii) Spring or River (viii) Other, specify________
40. Do you have any problems with domestic/household water supply (i) yes (ii) no
    a. **If yes**, what is the problem? (i) no water at all (ii) no pipes run to the area (iii) irregular water supply (iv) low water pressure (v) other ____________________________
    b. **If yes** how do you cope with the problem (i) collect rain water (ii) buy water (iii) collect water from a spring/river (iv) water truck supplies water (v) community standpipe (vi) other ______________________
41. Do you have access to a residential telephone (land line)?(i) yes (ii) no
    a. **If no**, do you have a mobile/cell phone? (i) yes (ii) no
42. Does your community have fixed line (residential) telephone (land line) service? (i) yes (ii) no (iii) don't know
43. What is the main method of garbage disposal for your household? (i) Public Garbage Truck (ii) Private Collection (iii) Burn (iv)Other specify ________
    a. **If public garbage truck**, how often do trucks pick up garbage? (i) once per week (ii) twice per week (iii) every 2 weeks (iv) 1 time per month (v) less than once per month

NATURAL HAZARDS & SOCIAL AMENITIES

44. Are there frequent flooding problems in your community? (i) Yes (ii) No (iii) don't know
    a. **If yes** when does flooding occur (i) each time it rains (ii) only times of heavy rains (iii) during hurricanes
    b. **If yes** how often does it rain to cause flooding? (i) once weekly (ii) once monthly (iii) once in three months (iv) once in six months (v) once in a year (vi) less than once in a year
    c. **If yes** where are the affected areas? ____________________

45. **If yes** how high does the water level rise? (i) less than 1 foot (ii) 1-5 ft (iii) more than 5 ft (iv) don't know

46. Are there frequent flooding problems at or near the proposed area? (i) Yes (ii) No (iii) don't know
    a. **If yes** when does flooding occur (i) each time it rains (ii) only times of heavy rains (iii) during hurricanes
    b. **If yes** how often does it rain to cause flooding? (i) once weekly (ii) once monthly (iii) once in three months (iv) once in six months (v) once in a year (vi) less than once in a year
    c. **If yes** where are the affected areas? ____________________

47. **If yes** how high does the water level rise? (i) less than 1 foot (ii) 1-5 ft (iii) more than 5 ft (iv) don't know

48. Is the proposed area affected by tidal changes such as storm surge/sea level rise? (i) yes (ii) no (iii)not sure/don't know

49. Do you know of any site or area nearby considered to be (i) a protected area/ area of environmental importance (ii) historic area (iii) or other area of national importance? (i) Yes (ii) No (iii) don't know
    a. **If yes** please give us as much detail as you can on this area ____________________

50. Is there any other relevant information that you would like to share ?

    ____

Signature of Interviewer: .... Thank You for your time.

Would you mind submitting your name and contact information (telephone/email) for verification/follow-up purposes if the National Environment & Planning Agency (NEPA) wishes to make contact?

____

July 2022

Appendix 7 – Fishers Questionnaire

SECRETS RESORT & SPA, RICHMOND ESTATE, ST ANN
FISHERS QUESTIONNAIRE

DATE:__________________ **INTERVIEWER:**______________

Richmond Vista Limited is proposing to develop approximately 22.4 acres (90,624 sqm) of waterfront property located at Richmond Estate (**Priory**), St Ann, to be known as "Secrets Resort and Spa". The project as proposed and will be done in two phases and upon completion will comprise 715 rooms.

- Phase One will include 500 hotel rooms and fifteen (15) over water suites
- Phase Two will include 200 hotel rooms

The overall design will be expanded across the site and will occupy an approximate floor area of 81,544 square metres with building heights ranging between one and seven (1-7) storeys. The proposed height for floor levels of both hotels will be 3.5 metres (approx. 11.5ft) for levels 2-5, while the ground level, level one and level six will be 5.0 metres (approx. 16.5ft) in height

The proposed development will entail:

- 2 hotels with 700 rooms (500 and 200 rooms)
- 15 over-water villas/suites
- Leisure and recreational amenities to include – specialty restaurants, beach and pool bars, gazebos, spa, Temazcal (Mexican sweat lodge/sauna)
- A "Technical Area" " (the area for the desalination and wastewater treatment plants)

It is also proposed that a part of the design includes modifying a part of the existing beach. The project as proposed will incorporate a batching plant for the mixing of concrete required during the construction phase of the project. Associated with the batching plant will be the storage of stockpiled aggregate (gravel, sand) needed in the concrete mixing/batching process. It is also proposed that the project will include a wastewater treatment plant and a seawater desalination plant to service the requirements of the development

COHORT DESCRIPTION

1. What is the name of this Fishing Beach/community? _________________________
2. Do you live in this community? (i) yes (ii) no
   a. **IF no,** which community do you live in? __________________________________
3. Gender (i) Male (ii) Female (iii) do not wish to disclose
4. Age group i) 18- 25 yrs (ii) 26-33 yrs (iii) 34-41 yrs (iv) 42 – 50 yrs (v) 51 – 60 yrs (vi) older than 60 yrs
5. Are you a fisher (man/woman) (i) yes (ii) no
   a. **If yes** do you sell your catch yourself (i) yes (ii) no
6. Are you a fish vendor (i) yes (ii) no
   a. **If yes** how do you source (get) the fish you sell? (i) have a boat that goes to sea (ii) buy directly from local fishermen (iii) buy from outside the community
7. Is anyone else in your household a fisher (man/woman) (i) yes (ii) no
   a. **If yes** how many persons (i) one (ii) two (iii) three (iv) four (v) more than four
8. Is anyone else in your household a fish vendor (i) yes (ii) no
   a. **If yes** how many persons (i) one (ii) two (iii) three (iv) four (v) more than four
9. Is fishing/ fish vending your full-time job (i) yes (ii) no
   a. **If no** are you otherwise employed (i) yes full time (ii) yes part time (iii) unemployed
10. What is the highest level of education you completed? (Which was the last school you attended) (i) None (ii) Primary/All Age (iii) Some High School (iv) High School (v) College (vi) University (vii) HEART/Vocational training institute
11. How long have you been a fisher or fish vendor?
    (i) 0 - 5 yrs. (ii) 6 - 11 yrs. (iii) 12 - 17 yrs. (iv) 18 - 24 yrs. (v) 25 - 30yrs. (vi) Over 30 yrs.
12. Where do you/what is the name(s) of the area(s) where you dock/beach your boat and launch your boat?
    ____
13. Where do you fish? (i) nearshore/inner harbour (ii) deep sea 1-5 miles from shore (iii) deep sea more than 5 miles from shore
14. What are the name(s) of the areas that you fish? ____
15. What do you use for fishing (i) line (ii) spear (iii) net (iv)fish pot (v) other _______________
16. What type of vessel do you use for fishing (i) canoe without engine (ii) canoe with engine (iii) large boat with net (trawler)
    (iv) other ____
    a. **If your vessel has an engine** how many engines does it have (i) one (ii) two (iii) three (iv) four (v) more than four
    b. **What is the engine size**? (i) 10HP (ii) 15HP (iii) 20HP (iv) 25HP (v) 40HP (vi) 60HP (vii) 75HP (viii) other ______
17. Including you how many persons work on your vessel? (i) one (ii) two (iii) three (iv) four (v) more than four
18. Does anyone else sell fish with you? (i) yes (ii) no
    a. If yes how many persons (i) one (ii) two (iii) three (iv) four (v) more than four
19. How many times per week do you go fishing/sell fish? (i) one (ii) two (iii) three (iv) four (v) five (vi) more than 5

20. Each time you go fishing on average how many pounds of fish do you usually catch? (i) less than 10lbs (ii) 11 – 20 lbs (iii) 21 - 50lbs (iv) 51-100 lbs (v) more than 100 lbs
21. How has the quantity/quality of fish catch/ sale changed over time? (i) increase (ii) decrease (iii) no change (iv) not sure
22. Have you noticed a change in the size and types of fish you catch or sell? (i) yes increase (ii) yes decrease (iii) no change (iv) not sure
    a. **If yes** what do you think is the reason (s)? _______________________________
23. What is the average weekly income of fish sales?
    (i) Below $1000, (ii) $1001 - $2000, (iii) $2001 - $4000, (iv) $4000 - $6000, (v) $6001 - $8000, (vi) Over $8000
24. Have you noticed a change in money earned from sales? (i) yes increase (ii) yes decrease (iii) no change
    If yes what do you think is the reason (s)? _______________________________

PERCEPTION

25. Have you ever heard of a company called Richmond Vista Limited? (i) yes; (ii) no
26. Have you ever heard of a project called Secrets Resort & Spa? (i) yes; (ii) no
27. Do you know what a desalination plant is? (i) yes; (ii) no
28. Do you know what an overwater suite/villa is? (i) yes; (ii) no
29. Did you know that Richmond Vista Limited is proposing to construct a 715- room hotel Development in the Richmond Estate **(Priory)** area of St. Ann? (i) yes (ii) no
    a. **If yes** Were you aware that this development would include 15 overwater suites/villas? (i) yes; (ii) no
    b. **If yes** Were you aware that this development would include two buildings comprising 700 rooms in total? (i) yes; (ii) no
    c. **If yes** Were you aware that this development would include modifying a section of existing beach? (i) yes; (ii) no
    d. **If yes** Were you aware that this development would include constructing a wastewater treatment plant (i) yes; (ii) no
    e. **If yes** Were you aware that this development would include constructing a desalination plant (i) yes; (ii) no
    f. **If yes** Were you aware that this development would include a batching plant for mixing concrete (i) yes; (ii) no
    g. **If yes**, how were you made aware? (i) Newspaper (ii) Television (iii) Radio (iv) Community meeting (v) Word of mouth (vi) social media (vii) Other -----------------------------
30. Have there been any problems/issues on the proposed project site in Richmond Estate (Priory)? (i) yes (ii) no (iii) don't know
    a. **If yes** what were/are the issues ____
31. Do you have any general concerns about the project as proposed? (i) yes; (ii) no (iii) not sure/don't know
    a. **If yes**, what are they? ____
    ____
    b. **If yes**, what would you suggest to address/resolve your concern(s)?____
    ____
32. Do you have any specific concern(s) relating to a section of the beach being modified? (i) yes; (ii) no (iii) not sure/don't know
    a. **If yes**, what are they? ____
    ____
    b. **If yes**, what would you suggest to address/resolve your concern(s)? ______________________
    ____
33. Do you have any specific concern(s) relating to suites/villas being built over water? (i) yes; (ii) no (iii) not sure/don't know
    c. **If yes**, what are they? ____
    ____
    d. **If yes**, what would you suggest to address/resolve your concern(s)? ______________________
    ____
34. Do you have any specific concern(s) relating to the seawater desalination plant? (i) yes; (ii) no (iii) not sure/don't know
    e. **If yes**, what are they? ____
    ____
    f. **If yes**, what would you suggest to address/resolve your concern(s)? ______________________
    ____
35. Do you have any specific concern(s) relating to the project having its own batching/concrete mixing plant to allow for the onsite mixing of concrete during construction activities? (i) yes; (ii) no (iii) not sure/don't know
    g. **If yes**, what are they? ____

____

h. **If yes**, what would you suggest to address/resolve your concern(s)? ______________________

____

36. Do you depend/use the proposed site (the lands/ beach area) for any type of activity? (i) yes; (ii) no
    a. **If yes** for what purpose ______________________

37. Do you depend/use the section the marine environment proposed for the overwater suites for any type of activity? (i) yes; (ii) no
    a. **If yes** for what purpose ______________________

38. In the past did you walk through the proposed site? (i) yes; (ii) no
    a. **If yes** why (i) to access the beach/ for recreation (ii) fishing (iii) other______________
    b. **If yes** how long were you doing this? (i) less than a year (ii) 1-5 years (iii) 6-10 years (iv) 11-15 years (v) 16-19 years (vi) 20 or more years
39. Do you still walk through the proposed site? (i) yes; (ii) no
    a. **If yes** why (i) to access the beach/ for recreation (ii) fishing (iii) other______________
40. Do you know of anyone who depends/uses the proposed site (lands/ beach area) for any type of activity? (i) yes; (ii) no
    a. **If yes** for what purpose ______________________

41. Do you think this project will affect your life/livelihood (i) positively or (ii) negatively? (iii) not at all (iv) not sure/don't know
    a. **If positive** how so? ______________________
    b. **If negative** how so?______________________
    c. **If negative** how do you think your issue could be resolved**?** ______________________

    ____

42. Do you think this project will affect your community (i) positively or (ii) negatively? (iii) not at all (iv) not sure/don't know
    a. **If positive** how so? ______________________
    b. **If negative** how so?______________________
    c. **If negative** how do you think this issue could be resolved**?** ______________________

    ____

43. Do you think this project will affect the environment (i) positively or (ii) negatively? (iii) not at all (iv) not sure
    a. **If positive** how so? ______________________
    b. **If negative** how so?______________________
    c. **If negative** how do you think this issue could be resolved**?** ______________________

____

44. Is there any other relevant information that you would like to share? ______________________

____

Signature of Interviewer: .... Thank You for your time.

Would you mind submitting your name and contact information (telephone/email) for verification/follow-up purposes if the National Environment & Planning Agency (NEPA) wishes to make contact?

____

Appendix 8 – Statistical Water Quality Data

Table 12-1 Water Quality Data Analysis of Variance

Variable	Analysis of Variance (Richmond WQ Full set revised for stats) Marked effects are significant at p < .05000							
	SS Effect	df Effect	MS Effect	SS Error	df Error	MS Error	F	p
TEMP. °C	0.2	7	0.0	23	32	0.7	0.037823	0.999917
COND (mS/cm)	1.7	7	0.2	18	32	0.5	0.451149	0.861940
SAL (ppt)	1.8	7	0.3	16	32	0.5	0.513521	0.817486
pH	0.0	7	0.0	0	32	0.0	0.226511	0.976028
D.O. (mg/l)	8.5	7	1.2	40	32	1.3	0.966317	0.471934
Turb (NTU)	17.4	7	2.5	33	32	1.0	2.384717	0.044140
TDS (g/l)	0.5	7	0.1	7	32	0.2	0.355962	0.920821
PAR (uE/cm/s)	882034.7	7	126005.0	4145947	32	129560.8	0.972554	0.467696
Light Extinction	1822.9	7	260.4	8063	32	252.0	1.033587	0.427569
BOD (mg/l)	0.9	7	0.1	12	32	0.4	0.339925	0.929377
TSS (mg/l)	0.0	7	0.0	0	32	0.0	0.857143	0.549905
NIT (mg/l)	1.5	7	0.2	10	32	0.3	0.661392	0.702509
PHOS (mg/l)	1.3	7	0.2	9	32	0.3	0.694592	0.676052
F.COLI (mpn/100ml)	77.3	7	11.0	360	32	11.3	0.980953	0.462029

Appendix 9 – Laboratory Water Quality Result Sheets

Caribbean Environmental Testing and Monitoring Services Ltd. (CETMS)

caribbean environmental
TESTING & MONITORING SERVICES LTD.

SR 2022-07-08

July 13, 2022

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: July 8, 2022

Date Received: July 8, 2022

Number of Samples: 8

Type of Material: Marine

Date Tested: July 8 -13, 2021

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	SR 1	SR 2	SR 3	SR 4	SR 5	SR 6	SR 7	SR 8	NRCA Standard
Nitrates	Mg/L	HACH 8039	0.03	2.0	2.6	1.6	2.3	3.1	1.8	3.4	1.5	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	0.69	0.51	0.69	0.55	0.20	0.37	0.22	0.01	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	>5	<5	>5	<5	<5	>5	<5	NA
Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.1	<11	<11	<11	<11	<11	<11	<11	11	<2-13

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caribbean environmental
TESTING & MONITORING SERVICES LTD.

SR 2022-07-08

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett, Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

CETMS Ltd. does not accept responsibility for any deviations in results if:
i. Samples are not collected and handled in accordance with the Ministry of Health, Environmental Health Unit, Sampling and Field Measurements Protocol (January 2015)
ii. Samples are not delivered to the lab within the maximum holding time for each respective analysis requested
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caribbean environmental
TESTING & MONITORING SERVICES LTD.

SR 2022-09-02

September 15, 2022

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: September 02, 2022

Date Received: September 02, 2022

Number of Samples: 6

Type of Material: Marine

Date Tested: September 01-09, 2022

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	SR 1	SR 2	SR 3	SR 4	SR 5	SR 6	SR 7	SR 8	NRCA Standard
Nitrates	Mg/L	HACH 8039	0.03	1.8	2.0	1.8	2.0	2.9	1.9	2.0	1.1	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	2.06	0.21	0.20	0.07	0.17	1.25	2.34	0.11	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	<5	<5	<5	<5	<5	NA
Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.1	<1.1	<1.1	1.1	<1.1	<1.1	11	11	<1.1	<2-13

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SR 2022-09-02

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett, Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

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TESTING & MONITORING SERVICES LTD.

SR 2022-10-05

October 17, 2022

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: October 05, 2022

Date Received: October 05, 2022

Number of Samples: 8

Type of Material: Marine

Date Tested: October 05 -13, 2021

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	SR 1	SR 2	SR 3	SR 4	SR 5	SR 6	SR 7	SR 8	NRCA Standard
Nitrates	Mg/L	HACH 8039	0.03	2.3	2.2	2.4	2.1	2.4	2.0	2.2	2.8	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	0.08	0.21	0.17	0.25	0.08	0.10	0.16	0.07	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	<5	<5	<5	<5	<5	NA
Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.1	<1.1	<1.1	<1.1	<1.1	11	<1.1	<1.1	11	<2-13

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SR 2022-10-05

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett, Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

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ii. Samples are not delivered to the lab within the maximum holding time for each respective analysis requested
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caribbean environmental
TESTING & MONITORING SERVICES LTD.

SR 2022-12-06

December 16, 2022

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: December 06, 2022

Date Received: December 06, 2022

Number of Samples: 8

Type of Material: Marine

Date Tested: December 06-15, 2021

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	SR 1	SR 2	SR 3	SR 4	SR 5	SR 6	SR 7	SR 8	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	1.34	2.16	2.60	1.84	0.98	1.38	1.20	1.86	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	1.7	1.1	1.8	2.0	1.3	1.8	1.8	1.6	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	0.09	0.08	0.05	0.04	0.06	0.05	0.10	0.06	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	<5	<5	<5	<5	<5	NA

DIRECTORS: DENISE FORREST MSc, MBA, PMP - MANAGING DIRECTOR • NILZA JUSTIZ-SMITH PhD, PE • CARLTON CAMPBELL MPhil, CIEC
Tel: 876.906.7638 | Fax: 876.929.1856 4 Chelsea Avenue, Kgn 10, Jamaica

caribbean environmental
TESTING & MONITORING SERVICES LTD.

SR 2022-12-06

Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	1.1	<2-13

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett, Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

CETMS Ltd. does not accept responsibility for any deviations in results if:
i. Samples are not collected and handled in accordance with the Ministry of Health, Environmental Health Unit, Sampling and Field Measurements Protocol (January 2015)
ii. Samples are not delivered to the lab within the maximum holding time for each respective analysis requested
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Tel: 876.906.7638 | Fax: 876.929.1856 4 Chelsea Avenue, Kgn 10, Jamaica

caribbean environmental
TESTING & MONITORING SERVICES LTD.

SR 2023-01-10

January 18, 2023

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: January 10, 2023

Date Received: January 10, 2023

Number of Samples: 8

Type of Material: Marine

Date Tested: January 10-17, 2023

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	SR 1	SR 2	SR 3	SR 4	SR 5	SR 6	SR 7	SR 8	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	1.20	1.78	1.68	1.80	1.10	1.34	1.26	1.84	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	2.1	1.4	1.0	1.1	1.7	1.3	1.4	1.7	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	0.09	0.19	0.10	0.12	0.04	0.03	0.04	0.27	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	<5	<5	<5	<5	<5	NA

DIRECTORS: DENISE FORREST, MSc, MBA, PMP - MANAGING DIRECTOR • NILZA JUSTIZ-SMITH, PhD, PE • CARLTON CAMPBELL, MPhil, CIEC
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caribbean environmental
TESTING & MONITORING SERVICES LTD.

SR 2023-01-10

Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<2-13

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett, Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

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Environmental, Technical and Analytical Services Limited (ETAS)

CLE 2207ET971_etc,shr

ENVIRONMENTAL, TECHNICAL AND ANALYTICAL SERVICES LIMITED
Hope Gardens, P.O. Box 28, Kingston 6
Telephone: 927-1944

Water and Wastewater Report Sheet, Page 1 of 2

REF. #:2207ET971-978 **ATTENTION:** Mr. Matthew Lee

COMPANY	C. L. Environmental Co. Ltd.		MEANS OF CONTRACT	Written
DATE RECEIVED	July 8, 2022		DATE REPORTED	July 22, 2022
NO. OF SAMPLES	Eleven (11)		SAMPLE VOLUME	Approx. 2L
STARTED	July 8, 2022		SAMPLE TYPE	Marine Water

REF. #	Sample Name	Parameter	Remarks
- - -	- - -	BOD_5, mg/L D. O.	- - -
2207ET971	RP1	0.6	
2207ET972	RP2	0.8	
2207ET973	RP3	0.9	
2207ET974	RP4	1.3	
2207ET975	RP5	0.5	
2207ET976	RP6	0.6	
2207ET977	RP7	0.9	
2207ET978	RP8	0.7	

R11	DATE SAMPLED	July 8, 2022		TIME SAMPLED	8:00 AM – 8:40 AM
R11	DATE RECEIVED	July 8, 2022		TIME RECEIVED	12:15 PM
R11	DATE STARTED	April 47, 2022		TIME STARTED	12:15 PM

CLE 2207ET971_etc,shr

ENVIRONMENTAL, TECHNICAL AND ANALYTICAL SERVICES LIMITED
Hope Gardens, P.O. Box 28, Kingston 6
Telephone: 927-1944

Water and Wastewater Report Sheet, Page 2 of 2

REF. #:2207ET971-978 **ATTENTION:** Mr. Matthew Lee

Parameter	Test Method	Detection Limit	Range
BOD_5, mg/L D. O.	Dilution Method adapted from HACH Method 8043 **and** Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017 (SMEWW) Method 5210.	(Method 1b) Sample unseeded & undiluted: Approx 0.1 mg/L	

Certified By : .... Ryan Warburton, Quality Manager

Certified By : .... Analyst (Name)

.... (Signature)

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Form ET2

CLE 2210ET1316_etc,shr (completed) SR1-8

ENVIRONMENTAL, TECHNICAL AND ANALYTICAL SERVICES LIMITED
Hope Gardens, P.O. Box 28, Kingston 6
Telephone: 927-1944 Email: etas@cwjamaica.com

Water and Wastewater Report Sheet, Page 1 of 2

REF. #:2210ET1316-1323 **ATTENTION:** Mr. Matthew Lee

COMPANY	C. L. Environmental Co. Ltd.		MEANS OF CONTRACT	Written
DATE RECEIVED	October 5, 2022		DATE REPORTED	October 10, 2022
NO. OF SAMPLES	Eight (8)		SAMPLE VOLUME	Approx. 2L
STARTED	October 5, 2022		SAMPLE TYPE	Marine Water

REF. #	Sample Name	Parameter	Remarks
- - -	- - -	BOD_5, mg/L D. O.	- - -
2210ET1316	SR1	0.5	
2210ET1317	SR2	0.2	
2210ET1318	SR3	0.3	
2210ET1319	SR4	0.2	
2210ET1320	SR5	1.7	
2210ET1321	SR6	0.9	
2210ET1322	SR7	0.3	
2210ET1323	SR8	0.3	

R11	DATE SAMPLED	October 5, 2022		TIME SAMPLED	8:30 AM
R11	DATE RECEIVED	October 5, 2022		TIME RECEIVED	1:20 PM
R11	DATE STARTED	October 5, 2022		TIME STARTED	1:20 PM

CLE 2210ET1316_etc,shr (completed) SR1-8

ENVIRONMENTAL, TECHNICAL AND ANALYTICAL SERVICES LIMITED
Hope Gardens, P.O. Box 28, Kingston 6
Telephone: 927-1944 Email: etas@cwjamaica.com

Water and Wastewater Report Sheet, Page 2 of 2

REF. #:2210ET1316-1323 **ATTENTION:** Mr. Matthew Lee

Parameter	Test Method	Detection Limit	Range
BOD_5, mg/L D. O.	Dilution Method adapted from HACH Method 8043 **and** Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017 (SMEWW) Method 5210.	(Method 1b) Sample unseeded & undiluted: Approx 0.1 mg/L	

Certified By : .... Ryan Warburton, Quality Manager

Certified By : .... Analyst (Name)

.... (Signature)

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Form ET2

CLE 2209ET1217_etc,shr (completed) SR1-8

ENVIRONMENTAL, TECHNICAL AND ANALYTICAL SERVICES LIMITED
Hope Gardens, P.O. Box 28, Kingston 6
Telephone: 927-1944

Water and Wastewater Report Sheet, Page 1 of 2

REF. #:2209ET1217-1224 **ATTENTION:** Mr. Matthew Lee

COMPANY	C. L. Environmental Co. Ltd.		MEANS OF CONTRACT	Written
DATE RECEIVED	September 2, 2022		DATE REPORTED	September 20, 2022
NO. OF SAMPLES	Eight (8)		SAMPLE VOLUME	Approx. 2L
STARTED	September 2, 2022		SAMPLE TYPE	Marine Water

REF. #	Sample Name	Parameter	Remarks
- - -	- - -	BOD_5, mg/L D. O.	- - -
2209ET1217	SR1	0.7	
2209ET1218	SR2	1.0	
2209ET1219	SR3	0.9	
2209ET1220	SR4	0.9	
2209ET1221	SR5	1.0	
2209ET1222	SR6	0.8	
2209ET1223	SR7	0.5	
2209ET1224	SR8	0.8	

R11	DATE SAMPLED	September 1, 2022		TIME SAMPLED	~8:30 AM
R11	DATE RECEIVED	September 1, 2022		TIME RECEIVED	~11:48 AM
R11	DATE STARTED	September 1, 2022		TIME STARTED	~11:48 AM

CLE 2209ET1217_etc,shr (completed) SR1-8

ENVIRONMENTAL, TECHNICAL AND ANALYTICAL SERVICES LIMITED
Hope Gardens, P.O. Box 28, Kingston 6
Telephone: 927-1944

Water and Wastewater Report Sheet, Page 2 of 2

REF. #:2209ET1217-1224 **ATTENTION:** Mr. Matthew Lee

Parameter	Test Method	Detection Limit	Range
BOD_5, mg/L D. O.	Dilution Method adapted from HACH Method 8043 **and** Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017 (SMEWW) Method 5210.	(Method 1b) Sample unseeded & undiluted: Approx 0.1 mg/L	

Certified By : .... Ryan Warburton, Quality Manager

Certified By : .... Analyst (Name)

.... (Signature)

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Form ET2

International Analytical Group (IAG)

REVIEW OF ANALYTICAL REPORT

JOB NUMBER: 400-222765-1
Client Project/Site: Richmond

International Analytical Group, Inc. (IAG) has conducted an independent, third party review of the above referenced analytical report. The samples were analyzed by E u r o f i n s Testamerica Pensacola, a NELAC certified laboratory in Pensacola, Florida.

If you have any questions regarding this analytical report, please contact
Marino Fernandez at marino@iagenvironmental.com

791 SKIVIEW ROAD, SEVEN DEVILS, NC 28604

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ANALYTICAL REPORT

Eurofins Pensacola
3355 McLemore Drive
Pensacola, FL 32514
Tel: (850)474-1001

Laboratory Job ID: 400-222765-1
Client Project/Site: Richmond

For:
CL Environmental
22 Fort George Heights
Stony Hill,
Kingston 8, Jamaica

Attn: Matthew Lee

Mark Swafford

Authorized for release by:
7/18/2022 11:22:12 AM

Mark Swafford, Project Manager II
(850)471-6207
Mark.Swafford@et.eurofinsus.com

Client: CL Environmental
Project/Site: Richmond

Laboratory Job ID: 400-222765-1

Table of Contents

Definitions/Glossary

Client: CL Environmental
Job ID: 400-222765-1
Project/Site: Richmond

Qualifiers

GC Semi VOA

Qualifier	Qualifier Description
*1	LCS/LCSD RPD exceeds control limits.
S1+	Surrogate recovery exceeds control limits, high biased.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Case Narrative

Client: CL Environmental
Job ID: 400-222765-1
Project/Site: Richmond

Job ID: 400-222765-1

Laboratory: Eurofins Pensacola

Narrative

Job Narrative
400-222765-1

Comments
No additional comments.

Receipt
The samples were received on 7/12/2022 9:08 AM. Unless otherwise noted below, the samples arrived in good condition, and where required, properly preserved and on ice. The temperature of the cooler at receipt was 0.9º C.

GC Semi VOA
Method FL-PRO: The RPD of the laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) for preparation batch 400-584687 and analytical batch 400-584757 recovered outside control limits for the following analytes: Total Petroleum Hydrocarbons (C8-C40).

Method FL-PRO: Two surrogates are used for this analysis. The laboratory's SOP allows one of these surrogates to be outside acceptance criteria without performing re-extraction/re-analysis. The following sample contained an allowable number of surrogate compounds outside limits: R3 (400-222765-3). These results have been reported and qualified.

Method FL-PRO: Two surrogates are used for this analysis. The laboratory's SOP allows one of these surrogates to be outside acceptance criteria without performing re-extraction/re-analysis. The following sample contained an allowable number of surrogate compounds outside limits: R1 (400-222765-1). These results have been reported and qualified.

Method FL-PRO: Surrogate recovery for the following sample was outside control limits: R2 (400-222765-2). Evidence of matrix interference is present; therefore, re-extraction and/or re-analysis was not performed.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Organic Prep
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Sample Summary

Client: CL Environmental
Job ID: 400-222765-1
Project/Site: Richmond

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
400-222765-1	R1	Water	07/08/22 08:30	07/12/22 09:08
400-222765-2	R2	Water	07/08/22 08:30	07/12/22 09:08
400-222765-3	R3	Water	07/08/22 08:30	07/12/22 09:08
400-222765-4	R4	Water	07/08/22 08:30	07/12/22 09:08
400-222765-5	R5	Water	07/08/22 08:30	07/12/22 09:08
400-222765-6	R6	Water	07/08/22 08:30	07/12/22 09:08
400-222765-7	R7	Water	07/08/22 08:30	07/12/22 09:08
400-222765-8	R8	Water	07/08/22 08:30	07/12/22 09:08

Client Sample Results

Client: CL Environmental | Job ID: 400-222765-1
Project/Site: Richmond

Client Sample ID: R1 | **Lab Sample ID: 400-222765-1**
Date Collected: 07/08/22 08:30 | **Matrix: Water**
Date Received: 07/12/22 09:08

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	**3.1**	*1	1.1		mg/L		07/13/22 15:52	07/15/22 13:40	1
C8-C10	ND		1.1		mg/L		07/13/22 15:52	07/15/22 13:40	1
C10-C28	**1.9**		1.1		mg/L		07/13/22 15:52	07/15/22 13:40	1
C28-C40	ND		1.1		mg/L		07/13/22 15:52	07/15/22 13:40	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*155*	*S1+*	*40 - 129*	*07/13/22 15:52*	*07/15/22 13:40*	*1*
o-Terphenyl	*132*		*66 - 139*	*07/13/22 15:52*	*07/15/22 13:40*	*1*

Client Sample Results

Client: CL Environmental
Job ID: 400-222765-1
Project/Site: Richmond

Client Sample ID: R2
Lab Sample ID: 400-222765-2
Date Collected: 07/08/22 08:30
Matrix: Water
Date Received: 07/12/22 09:08

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	1.2	*1	1.0	mg/L		07/13/22 15:52	07/15/22 13:57	1
C8-C10	ND		1.0	mg/L		07/13/22 15:52	07/15/22 13:57	1
C10-C28	ND		1.0	mg/L		07/13/22 15:52	07/15/22 13:57	1
C28-C40	ND		1.0	mg/L		07/13/22 15:52	07/15/22 13:57	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*214*	*S1+*	*40 - 129*	*07/13/22 15:52*	*07/15/22 13:57*	*1*
o-Terphenyl	*214*	*S1+*	*66 - 139*	*07/13/22 15:52*	*07/15/22 13:57*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-222765-1

Client Sample ID: R3

Lab Sample ID: 400-222765-3

Date Collected: 07/08/22 08:30

Matrix: Water

Date Received: 07/12/22 09:08

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	50		1.0		mg/L		07/13/22 15:52	07/14/22 20:11	1
C8-C10	ND		1.0		mg/L		07/13/22 15:52	07/14/22 20:11	1
C10-C28	2.9		1.0		mg/L		07/13/22 15:52	07/14/22 20:11	1
C28-C40	55		1.0		mg/L		07/13/22 15:52	07/14/22 20:11	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*165*		*40 - 129*	*07/13/22 15:52*	*07/14/22 20:11*	*1*
o-Terphenyl	*134*		*66 - 139*	*07/13/22 15:52*	*07/14/22 20:11*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental　　Job ID: 400-222765-1
Project/Site: Richmond

Client Sample ID: R4　　**Lab Sample ID: 400-222765-4**
Date Collected: 07/08/22 08:30　　**Matrix: Water**
Date Received: 07/12/22 09:08

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	**47**		1.1		mg/L		07/13/22 15:52	07/14/22 20:27	1
C8-C10	ND		1.1		mg/L		07/13/22 15:52	07/14/22 20:27	1
C10-C28	**2.4**		1.1		mg/L		07/13/22 15:52	07/14/22 20:27	1
C28-C40	**51**		1.1		mg/L		07/13/22 15:52	07/14/22 20:27	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*120*		*40 - 129*	*07/13/22 15:52*	*07/14/22 20:27*	*1*
o-Terphenyl	*117*		*66 - 139*	*07/13/22 15:52*	*07/14/22 20:27*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-222765-1

Client Sample ID: R5
Date Collected: 07/08/22 08:30
Date Received: 07/12/22 09:08

Lab Sample ID: 400-222765-5
Matrix: Water

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	**44**		1.0		mg/L		07/13/22 15:52	07/14/22 20:43	1
C8-C10	ND		1.0		mg/L		07/13/22 15:52	07/14/22 20:43	1
C10-C28	**2.0**		1.0		mg/L		07/13/22 15:52	07/14/22 20:43	1
C28-C40	**48**		1.0		mg/L		07/13/22 15:52	07/14/22 20:43	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*124*		*40 - 129*	*07/13/22 15:52*	*07/14/22 20:43*	*1*
o-Terphenyl	*115*		*66 - 139*	*07/13/22 15:52*	*07/14/22 20:43*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-222765-1

Client Sample ID: R6
Date Collected: 07/08/22 08:30
Date Received: 07/12/22 09:08

Lab Sample ID: 400-222765-6
Matrix: Water

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	**40**		1.1		mg/L		07/13/22 15:52	07/14/22 20:59	1
C8-C10	ND		1.1		mg/L		07/13/22 15:52	07/14/22 20:59	1
C10-C28	**1.7**		1.1		mg/L		07/13/22 15:52	07/14/22 20:59	1
C28-C40	**44**		1.1		mg/L		07/13/22 15:52	07/14/22 20:59	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*128*		*40 - 129*	*07/13/22 15:52*	*07/14/22 20:59*	*1*
o-Terphenyl	*125*		*66 - 139*	*07/13/22 15:52*	*07/14/22 20:59*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-222765-1

Client Sample ID: R7
Date Collected: 07/08/22 08:30
Date Received: 07/12/22 09:08

Lab Sample ID: 400-222765-7
Matrix: Water

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	41		1.1	mg/L		07/13/22 15:52	07/14/22 21:16	1
C8-C10	ND		1.1	mg/L		07/13/22 15:52	07/14/22 21:16	1
C10-C28	2.2		1.1	mg/L		07/13/22 15:52	07/14/22 21:16	1
C28-C40	45		1.1	mg/L		07/13/22 15:52	07/14/22 21:16	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*128*		*40 - 129*	*07/13/22 15:52*	*07/14/22 21:16*	*1*
o-Terphenyl	*127*		*66 - 139*	*07/13/22 15:52*	*07/14/22 21:16*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Job ID: 400-222765-1
Project/Site: Richmond

Client Sample ID: R8
Lab Sample ID: 400-222765-8
Date Collected: 07/08/22 08:30
Matrix: Water
Date Received: 07/12/22 09:08

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	36		1.1		mg/L		07/13/22 15:52	07/14/22 21:32	1
C8-C10	ND		1.1		mg/L		07/13/22 15:52	07/14/22 21:32	1
C10-C28	2.5		1.1		mg/L		07/13/22 15:52	07/14/22 21:32	1
C28-C40	38		1.1		mg/L		07/13/22 15:52	07/14/22 21:32	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*124*		*40 - 129*	*07/13/22 15:52*	*07/14/22 21:32*	*1*
o-Terphenyl	*120*		*66 - 139*	*07/13/22 15:52*	*07/14/22 21:32*	*1*

Eurofins Pensacola

Lab Chronicle

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-222765-1

Client Sample ID: R1

Lab Sample ID: 400-222765-1
Date Collected: 07/08/22 08:30
Matrix: Water
Date Received: 07/12/22 09:08

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3511			584687	07/13/22 15:52	BKL	TAL PEN
Total/NA	Analysis	FL-PRO		1	584984	07/15/22 13:40	LHB	TAL PEN

Client Sample ID: R2

Lab Sample ID: 400-222765-2
Date Collected: 07/08/22 08:30
Matrix: Water
Date Received: 07/12/22 09:08

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3511			584687	07/13/22 15:52	BKL	TAL PEN
Total/NA	Analysis	FL-PRO		1	584984	07/15/22 13:57	LHB	TAL PEN

Client Sample ID: R3

Lab Sample ID: 400-222765-3
Date Collected: 07/08/22 08:30
Matrix: Water
Date Received: 07/12/22 09:08

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3511			584687	07/13/22 15:52	BKL	TAL PEN
Total/NA	Analysis	FL-PRO		1	584866	07/14/22 20:11	LHB	TAL PEN

Client Sample ID: R4

Lab Sample ID: 400-222765-4
Date Collected: 07/08/22 08:30
Matrix: Water
Date Received: 07/12/22 09:08

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3511			584687	07/13/22 15:52	BKL	TAL PEN
Total/NA	Analysis	FL-PRO		1	584866	07/14/22 20:27	LHB	TAL PEN

Client Sample ID: R5

Lab Sample ID: 400-222765-5
Date Collected: 07/08/22 08:30
Matrix: Water
Date Received: 07/12/22 09:08

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3511			584687	07/13/22 15:52	BKL	TAL PEN
Total/NA	Analysis	FL-PRO		1	584866	07/14/22 20:43	LHB	TAL PEN

Client Sample ID: R6

Lab Sample ID: 400-222765-6
Date Collected: 07/08/22 08:30
Matrix: Water
Date Received: 07/12/22 09:08

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3511			584687	07/13/22 15:52	BKL	TAL PEN
Total/NA	Analysis	FL-PRO		1	584866	07/14/22 20:59	LHB	TAL PEN

Lab Chronicle

Client: CL Environmental — Job ID: 400-222765-1
Project/Site: Richmond

Client Sample ID: R7 — Lab Sample ID: 400-222765-7

Date Collected: 07/08/22 08:30 — **Matrix: Water**
Date Received: 07/12/22 09:08

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3511			584687	07/13/22 15:52	BKL	TAL PEN
Total/NA	Analysis	FL-PRO		1	584866	07/14/22 21:16	LHB	TAL PEN

Client Sample ID: R8 — Lab Sample ID: 400-222765-8

Date Collected: 07/08/22 08:30 — **Matrix: Water**
Date Received: 07/12/22 09:08

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3511			584687	07/13/22 15:52	BKL	TAL PEN
Total/NA	Analysis	FL-PRO		1	584866	07/14/22 21:32	LHB	TAL PEN

Laboratory References:

TAL PEN = Eurofins Pensacola, 3355 McLemore Drive, Pensacola, FL 32514, TEL (850)474-1001

Accreditation/Certification Summary

Client: CL Environmental
Job ID: 400-222765-1
Project/Site: Richmond

Laboratory: Eurofins Pensacola

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
ANAB	ISO/IEC 17025	L2471	02-23-23

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
FL-PRO	3511	Water	C10-C28
FL-PRO	3511	Water	C28-C40
FL-PRO	3511	Water	C8-C10
FL-PRO	3511	Water	C8-C40

Method Summary

Client: CL Environmental
Job ID: 400-222765-1
Project/Site: Richmond

Method	Method Description	Protocol	Laboratory
FL-PRO	Florida - Petroleum Range Organics (GC)	FL-DEP	TAL PEN
3511	Microextraction of Organic Compounds	SW846	TAL PEN

Protocol References:

FL-DEP = State Of Florida Department Of Environmental Protection, Florida Administrative Code.

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL PEN = Eurofins Pensacola, 3355 McLemore Drive, Pensacola, FL 32514, TEL (850)474-1001

Eurofins Pensacola
3355 McLemore Drive
Pensacola, FL 32514
Phone: 850-474-1001 Fax: 850-478-2671

Chain of Custody Record

eurofins Environment Testing America

Client Information			
Client Contact: Matthew Lee	Sampler: Matthew Lee	Lab PM: Swafford, Mark H	Carrier Tracking No(s):
Company: CL Environmental	Phone: 772 480 5898	E-Mail: Mark.Swafford@et.eurofinsus.com	State of Origin:
Address: 22 Fort George Heights Stony Hill,	PWSID:		COC No: 400-112279-39339.1
City: Kingston 8	Due Date Requested:		Page: Page 1 of 3
State, Zip: JA,	TAT Requested (days): Standard		Job #:
Phone: 954-966-2454(Tel)	Compliance Project: Δ Yes Δ No		
Email: mlee@clenvironmental.com	PO #: Purchase Order not required		
Project Name: Richmond	WO #:		
Site: Richmond, St. Ann	Project #: 40001189		
	SSOW#:		

Analysis Requested: Field Filtered Sample (Yes or No); Perform MS/MSD (Yes or No); FL_PRO - FLPRO; ~~8010B, 7471A~~; Total Number of containers

Preservation Codes:
A - HCL; B - NaOH; C - Zn Acetate; D - Nitric Acid; E - NaHSO4; F - MeOH; G - Amchlor; H - Ascorbic Acid; I - Ice; J - DI Water; K - EDTA; L - EDA
M - Hexane; N - None; O - AsNaO2; P - Na2O4S; Q - Na2SO3; R - Na2S2O3; S - H2SO4; T - TSP Dodecahydrate; U - Acetone; V - MCAA; W - pH 4-5; Y - Trizma; Z - other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample	Perform MS/MSD	FL_PRO - FLPRO	~~8010B, 7471A~~	Total Number of containers	Special Instructions/Note:
				Preservation Code:	X	X	N	N	X	
R1	07/08/22	8:30am	G	W ~~Solid~~			✓			
R2	"	"	"	W ~~Solid~~			✓			
R3	"	"	"	W ~~Solid~~			✓			
R4	"	"	"	W ~~Solid~~			✓			
R5	"	"	"	W ~~Solid~~			✓			
R6	"	"	"	Water			✓			
R7	"	"	"	Water			✓			
R8	"	"	"	Water			✓			
				Water						
				Water						
				Water						

400-222765 COC

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:		Time:	Method of Shipment:	
Relinquished by: [signature]	Date/Time: 11/7/22 11 24am	Company: CLE.	Received by: [signature]	Date/Time: 908 7/12/22	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks: 0.9 C IR9

Ver: 06/08/2021

Login Sample Receipt Checklist

Client: CL Environmental — Job Number: 400-222765-1

Login Number: 222765 — **List Source: Eurofins Pensacola**
List Number: 1
Creator: Whitley, Adrian

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	0.9°C IR9
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

INTERNATIONAL ANALYTICAL GROUP

REVIEW OF ANALYTICAL REPORT

JOB NUMBER: 400-225449-1
Client Project/Site: Richmond

International Analytical Group, Inc. (IAG) has conducted an independent, third party review of the above referenced analytical report. The samples were analyzed by E u r o f i n s Testamerica Pensacola, a NELAC certified laboratory in Pensacola, Florida.

If you have any questions regarding this analytical report, please contact
Marino Fernandez at marino@iagenvironmental.com

791 SKIVIEW ROAD, SEVEN DEVILS, NC 28604

ANALYTICAL REPORT

Eurofins Pensacola
3355 McLemore Drive
Pensacola, FL 32514
Tel: (850)474-1001

Laboratory Job ID: 400-225449-1
Client Project/Site: Richmond

For:
CL Environmental
22 Fort George Heights
Stony Hill,
Kingston 8, Jamaica

Attn: Matthew Lee

Mark Swafford

Authorized for release by:
9/8/2022 3:17:14 PM

Mark Swafford, Project Manager II
(850)471-6207
Mark.Swafford@et.eurofinsus.com

Client: CL Environmental
Project/Site: Richmond

Laboratory Job ID: 400-225449-1

Table of Contents

Definitions/Glossary

Client: CL Environmental
Job ID: 400-225449-1
Project/Site: Richmond

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Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Case Narrative

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Job ID: 400-225449-1

Laboratory: Eurofins Pensacola

Narrative

Job Narrative
400-225449-1

Comments
No additional comments.

Receipt
The samples were received on 9/6/2022 8:59 AM. The temperature of the cooler at receipt was 27.7º C.

GC Semi VOA
Method FL-PRO: The laboratory control sample (LCS) and / or laboratory control sample duplicate (LCSD) for preparation batch 400-591662 and analytical batch 400-591708 recovered outside control limits for the following analytes: C8-C40. These analytes were biased high in the LCS and were not detected in the associated samples; therefore, the data have been reported.

Method FL-PRO: Two surrogates are used for this analysis. The laboratory's SOP allows one of these surrogates to be outside acceptance criteria without performing re-extraction/re-analysis. The following samples contained an allowable number of surrogate compounds outside limits: SR 1 (400-225449-1), SR 2 (400-225449-2), SR 6 (400-225449-6), (LCS 400-591662/2-A), (LCSD 400-591662/3-A) and (MB 400-591662/1-A). These results have been reported and qualified.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Organic Prep
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Sample Summary

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
400-225449-1	SR 1	Water	09/02/22 08:30	09/06/22 08:59
400-225449-2	SR 2	Water	09/02/22 08:40	09/06/22 08:59
400-225449-3	SR 3	Water	09/02/22 08:50	09/06/22 08:59
400-225449-4	SR 4	Water	09/02/22 09:00	09/06/22 08:59
400-225449-5	SR 5	Water	09/02/22 09:10	09/06/22 08:59
400-225449-6	SR 6	Water	09/02/22 09:20	09/06/22 08:59
400-225449-7	SR 7	Water	09/02/22 09:30	09/06/22 08:59
400-225449-8	SR 8	Water	09/02/22 09:40	09/06/22 08:59

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Client Sample ID: SR 1
Date Collected: 09/02/22 08:30
Date Received: 09/06/22 08:59

Lab Sample ID: 400-225449-1
Matrix: Water

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		1.0		mg/L		09/07/22 13:59	09/07/22 18:46	1
C8-C10	ND		1.0		mg/L		09/07/22 13:59	09/07/22 18:46	1
C10-C28	ND		1.0		mg/L		09/07/22 13:59	09/07/22 18:46	1
C28-C40	ND		1.0		mg/L		09/07/22 13:59	09/07/22 18:46	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*132*		*40 - 129*	*09/07/22 13:59*	*09/07/22 18:46*	*1*
o-Terphenyl	*121*		*66 - 139*	*09/07/22 13:59*	*09/07/22 18:46*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Client Sample ID: SR 2
Date Collected: 09/02/22 08:40
Date Received: 09/06/22 08:59

Lab Sample ID: 400-225449-2
Matrix: Water

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		1.0	mg/L		09/07/22 13:59	09/07/22 19:02	1
C8-C10	ND		1.0	mg/L		09/07/22 13:59	09/07/22 19:02	1
C10-C28	ND		1.0	mg/L		09/07/22 13:59	09/07/22 19:02	1
C28-C40	ND		1.0	mg/L		09/07/22 13:59	09/07/22 19:02	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*132*		*40 - 129*	*09/07/22 13:59*	*09/07/22 19:02*	*1*
o-Terphenyl	*121*		*66 - 139*	*09/07/22 13:59*	*09/07/22 19:02*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental	Job ID: 400-225449-1
Project/Site: Richmond

Client Sample ID: SR 3	**Lab Sample ID: 400-225449-3**
Date Collected: 09/02/22 08:50	**Matrix: Water**
Date Received: 09/06/22 08:59

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		0.99		mg/L		09/07/22 13:59	09/07/22 19:18	1
C8-C10	ND		0.99		mg/L		09/07/22 13:59	09/07/22 19:18	1
C10-C28	ND		0.99		mg/L		09/07/22 13:59	09/07/22 19:18	1
C28-C40	ND		0.99		mg/L		09/07/22 13:59	09/07/22 19:18	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*114*		*40 - 129*	*09/07/22 13:59*	*09/07/22 19:18*	*1*
o-Terphenyl	*114*		*66 - 139*	*09/07/22 13:59*	*09/07/22 19:18*	*1*

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Client Sample ID: SR 4
Date Collected: 09/02/22 09:00
Date Received: 09/06/22 08:59

Lab Sample ID: 400-225449-4
Matrix: Water

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		1.0		mg/L		09/07/22 13:59	09/08/22 10:12	1
C8-C10	ND		1.0		mg/L		09/07/22 13:59	09/08/22 10:12	1
C10-C28	ND		1.0		mg/L		09/07/22 13:59	09/08/22 10:12	1
C28-C40	ND		1.0		mg/L		09/07/22 13:59	09/08/22 10:12	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*89*		*40 - 129*	*09/07/22 13:59*	*09/08/22 10:12*	*1*
o-Terphenyl	*119*		*66 - 139*	*09/07/22 13:59*	*09/08/22 10:12*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Client Sample ID: SR 5
Date Collected: 09/02/22 09:10
Date Received: 09/06/22 08:59

Lab Sample ID: 400-225449-5
Matrix: Water

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		0.98		mg/L		09/07/22 13:59	09/08/22 10:28	1
C8-C10	ND		0.98		mg/L		09/07/22 13:59	09/08/22 10:28	1
C10-C28	ND		0.98		mg/L		09/07/22 13:59	09/08/22 10:28	1
C28-C40	ND		0.98		mg/L		09/07/22 13:59	09/08/22 10:28	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*89*		*40 - 129*	*09/07/22 13:59*	*09/08/22 10:28*	*1*
o-Terphenyl	*114*		*66 - 139*	*09/07/22 13:59*	*09/08/22 10:28*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Client Sample ID: SR 6
Date Collected: 09/02/22 09:20
Date Received: 09/06/22 08:59

Lab Sample ID: 400-225449-6
Matrix: Water

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		1.0		mg/L		09/07/22 13:59	09/08/22 10:45	1
C8-C10	ND		1.0		mg/L		09/07/22 13:59	09/08/22 10:45	1
C10-C28	ND		1.0		mg/L		09/07/22 13:59	09/08/22 10:45	1
C28-C40	ND		1.0		mg/L		09/07/22 13:59	09/08/22 10:45	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*93*		*40 - 129*	*09/07/22 13:59*	*09/08/22 10:45*	*1*
o-Terphenyl	*110*		*66 - 139*	*09/07/22 13:59*	*09/08/22 10:45*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Client Sample ID: SR 7
Date Collected: 09/02/22 09:30
Date Received: 09/06/22 08:59

Lab Sample ID: 400-225449-7
Matrix: Water

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		1.1		mg/L		09/07/22 13:59	09/08/22 11:01	1
C8-C10	ND		1.1		mg/L		09/07/22 13:59	09/08/22 11:01	1
C10-C28	ND		1.1		mg/L		09/07/22 13:59	09/08/22 11:01	1
C28-C40	ND		1.1		mg/L		09/07/22 13:59	09/08/22 11:01	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*105*		*40 - 129*	*09/07/22 13:59*	*09/08/22 11:01*	*1*
o-Terphenyl	*117*		*66 - 139*	*09/07/22 13:59*	*09/08/22 11:01*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Client Sample ID: SR 8
Date Collected: 09/02/22 09:40
Date Received: 09/06/22 08:59

Lab Sample ID: 400-225449-8
Matrix: Water

Method: FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		1.0		mg/L		09/07/22 13:59	09/07/22 20:56	1
C8-C10	ND		1.0		mg/L		09/07/22 13:59	09/07/22 20:56	1
C10-C28	ND		1.0		mg/L		09/07/22 13:59	09/07/22 20:56	1
C28-C40	ND		1.0		mg/L		09/07/22 13:59	09/07/22 20:56	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*121*		*40 - 129*	*09/07/22 13:59*	*09/07/22 20:56*	*1*
o-Terphenyl	*113*		*66 - 139*	*09/07/22 13:59*	*09/07/22 20:56*	*1*

Eurofins Pensacola

Lab Chronicle

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Client Sample ID: SR 1 **Lab Sample ID: 400-225449-1**
Date Collected: 09/02/22 08:30 **Matrix: Water**
Date Received: 09/06/22 08:59

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			591662	JTC	EET PEN	09/07/22 13:59
Total/NA	Analysis	FL-PRO		1	591708	RS	EET PEN	09/07/22 18:46

Client Sample ID: SR 2 **Lab Sample ID: 400-225449-2**
Date Collected: 09/02/22 08:40 **Matrix: Water**
Date Received: 09/06/22 08:59

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			591662	JTC	EET PEN	09/07/22 13:59
Total/NA	Analysis	FL-PRO		1	591708	RS	EET PEN	09/07/22 19:02

Client Sample ID: SR 3 **Lab Sample ID: 400-225449-3**
Date Collected: 09/02/22 08:50 **Matrix: Water**
Date Received: 09/06/22 08:59

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			591662	JTC	EET PEN	09/07/22 13:59
Total/NA	Analysis	FL-PRO		1	591708	RS	EET PEN	09/07/22 19:18

Client Sample ID: SR 4 **Lab Sample ID: 400-225449-4**
Date Collected: 09/02/22 09:00 **Matrix: Water**
Date Received: 09/06/22 08:59

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			591662	JTC	EET PEN	09/07/22 13:59
Total/NA	Analysis	FL-PRO		1	591750	RS	EET PEN	09/08/22 10:12

Client Sample ID: SR 5 **Lab Sample ID: 400-225449-5**
Date Collected: 09/02/22 09:10 **Matrix: Water**
Date Received: 09/06/22 08:59

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			591662	JTC	EET PEN	09/07/22 13:59
Total/NA	Analysis	FL-PRO		1	591750	RS	EET PEN	09/08/22 10:28

Client Sample ID: SR 6 **Lab Sample ID: 400-225449-6**
Date Collected: 09/02/22 09:20 **Matrix: Water**
Date Received: 09/06/22 08:59

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			591662	JTC	EET PEN	09/07/22 13:59
Total/NA	Analysis	FL-PRO		1	591750	RS	EET PEN	09/08/22 10:45

Eurofins Pensacola

Lab Chronicle

Client: CL Environmental Job ID: 400-225449-1
Project/Site: Richmond

Client Sample ID: SR 7 **Lab Sample ID: 400-225449-7**
Date Collected: 09/02/22 09:30 **Matrix: Water**
Date Received: 09/06/22 08:59

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			591662	JTC	EET PEN	09/07/22 13:59
Total/NA	Analysis	FL-PRO		1	591750	RS	EET PEN	09/08/22 11:01

Client Sample ID: SR 8 **Lab Sample ID: 400-225449-8**
Date Collected: 09/02/22 09:40 **Matrix: Water**
Date Received: 09/06/22 08:59

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			591662	JTC	EET PEN	09/07/22 13:59
Total/NA	Analysis	FL-PRO		1	591708	RS	EET PEN	09/07/22 20:56

Laboratory References:
EET PEN = Eurofins Pensacola, 3355 McLemore Drive, Pensacola, FL 32514, TEL (850)474-1001

Accreditation/Certification Summary

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Laboratory: Eurofins Pensacola

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
ANAB	ISO/IEC 17025	L2471	02-23-23

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
FL-PRO	3511	Water	C10-C28
FL-PRO	3511	Water	C28-C40
FL-PRO	3511	Water	C8-C10
FL-PRO	3511	Water	C8-C40

Method Summary

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-225449-1

Method	Method Description	Protocol	Laboratory
FL-PRO	Florida - Petroleum Range Organics (GC)	FL-DEP	EET PEN
3511	Microextraction of Organic Compounds	SW846	EET PEN

Protocol References:

FL-DEP = State Of Florida Department Of Environmental Protection, Florida Administrative Code.

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EET PEN = Eurofins Pensacola, 3355 McLemore Drive, Pensacola, FL 32514, TEL (850)474-1001

Eurofins Pensacola
3355 McLemore Drive
Pensacola, FL 32514
Phone: 850-474-1001 Fax: 850-478-2671

Chain of Custody Record

eurofins Environment Testing America

Client Information	Sampler: CLE	Lab PM: Swafford, Mark H	Carrier Tracking No(s):
Client Contact: Matthew Lee	Phone: 876 877 0108	E-Mail: Mark.Swafford@et.eurofinsus.com	State of Origin:
Company: CL Environmental	PWSID:		COC No: 400-112279-39339.2
Address: 22 Fort George Heights Stony Hill,	Due Date Requested:		Page: Page 2 of 3
City: Kingston 8	TAT Requested (days):		Job #:
State, Zip: JA,	Compliance Project: Δ Yes Δ No		
Phone: 954-966-2454(Tel)	PO #: Purchase Order not required		
Email: mlee@clenvironmental.com	WO #:		
Project Name: Richmond	Project #: 40001189		
Site: Drax Hall	SSOW#:		

Analysis Requested

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	FL_PRO - FLPRO	6010B, 7471A	Total Number of containers	Special Instructions/Note:
				Preservation Code:			N	N		
SR 1	2/9/22	8:36am	G	Water			✓			
" 2	"	8:40am	G	Water			✓			
" 3	"	8:50am	G	Water			✓			
" 4	"	9:00am	G	Water			✓			
" 5	"	9:10am	G	Water			✓			
" 6	"	9:20am	G	Water			✓			
" 7	"	9:30am	G	Water			✓			
" 8	"	9:40am	G	Water			✓			
				Water						
				Water						
				Water						

400-225449 COC

Preservation Codes:
A - HCL
B - NaOH
C - Zn Acetate
D - Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA
M - Hexane
N - None
O - AsNaO2
P - Na2O4S
Q - Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Y - Trizma
Z - other (specify)
Other:

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date: 2/9/22	Time: 12:44pm	Method of Shipment: Fedex	
Relinquished by: Alec Silvera	Date/Time: 2/9/22	Company: CLE	Received by: Fedex	Date/Time: 2/9/22 · Company: Fedex
Relinquished by:	Date/Time:	Company	Received by: MO	Date/Time: 2/10/22 859 · Company: ETA
Relinquished by:	Date/Time:	Company	Received by:	Date/Time: · Company
Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:		Cooler Temperature(s) °C and Other Remarks: 2.7 7°C IR8	

Ver: 06/08/2021

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Login Sample Receipt Checklist

Client: CL Environmental

Job Number: 400-225449-1

Login Number: 225449
List Number: 1
Creator: DeKlerk, Michaela

List Source: Eurofins Pensacola

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	
Cooler Temperature is acceptable.	N/A	
Cooler Temperature is recorded.	True	27.7°C IR8
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

REVIEW OF ANALYTICAL REPORT

JOB NUMBER: 400-226905-1
Client Project/Site: Richmond

International Analytical Group, Inc. (IAG) has conducted an independent, third party review of the above referenced analytical report. The samples were analyzed by E u r o f i n s Testamerica Pensacola, a NELAC certified laboratory in Pensacola, Florida.

If you have any questions regarding this analytical report, please contact Marino Fernandez at marino@iagenvironmental.com

791 SKIVIEW ROAD, SEVEN DEVILS, NC 28604

ANALYTICAL REPORT

Eurofins Pensacola
3355 McLemore Drive
Pensacola, FL 32514
Tel: (850)474-1001

Laboratory Job ID: 400-226905-1
Client Project/Site: Richmond

For:
CL Environmental
22 Fort George Heights
Stony Hill,
Kingston 8, Jamaica

Attn: Matthew Lee

Authorized for release by:
10/10/2022 3:09:02 PM

Isabel Enfinger, Project Manager I
(850)471-6237
isabel.enfinger@et.eurofinsus.com

Designee for

Mark Swafford, Project Manager II
(850)471-6207
Mark.Swafford@et.eurofinsus.com

Table of Contents

Definitions/Glossary

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Qualifiers

GC Semi VOA

Qualifier	Qualifier Description
S1+	Surrogate recovery exceeds control limits, high biased.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Case Narrative

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Job ID: 400-226905-1

Laboratory: Eurofins Pensacola

Narrative

Job Narrative
400-226905-1

Receipt
The samples were received on 10/6/2022 9:10 AM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was 1.4°C

GC Semi VOA
Method FL_PRO: Two surrogates are used for this analysis. The laboratory's SOP allows one of these surrogates to be outside acceptance criteria without performing re-extraction/re-analysis. The following samples contained an allowable number of surrogate compounds outside limits: SR 3 (400-226905-3), SR 4 (400-226905-4), SR 5 (400-226905-5), SR 6 (400-226905-6), SR 7 (400-226905-7) and SR 8 (400-226905-8). These results have been reported and qualified.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Sample Summary

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
400-226905-1	SR 1	Water	10/05/22 09:00	10/06/22 09:10
400-226905-2	SR 2	Water	10/05/22 09:15	10/06/22 09:10
400-226905-3	SR 3	Water	10/05/22 09:10	10/06/22 09:10
400-226905-4	SR 4	Water	10/05/22 09:20	10/06/22 09:10
400-226905-5	SR 5	Water	10/05/22 08:48	10/06/22 09:10
400-226905-6	SR 6	Water	10/05/22 08:40	10/06/22 09:10
400-226905-7	SR 7	Water	10/05/22 09:50	10/06/22 09:10
400-226905-8	SR 8	Water	10/05/22 08:30	10/06/22 09:10

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Client Sample ID: SR 1
Date Collected: 10/05/22 09:00
Date Received: 10/06/22 09:10

Lab Sample ID: 400-226905-1
Matrix: Water

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		0.99		mg/L		10/07/22 08:59	10/08/22 03:22	1
C8-C10	ND		0.99		mg/L		10/07/22 08:59	10/08/22 03:22	1
C10-C28	ND		0.99		mg/L		10/07/22 08:59	10/08/22 03:22	1
C28-C40	ND		0.99		mg/L		10/07/22 08:59	10/08/22 03:22	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*118*		*40 - 129*	*10/07/22 08:59*	*10/08/22 03:22*	*1*
o-Terphenyl	*102*		*66 - 139*	*10/07/22 08:59*	*10/08/22 03:22*	*1*

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Client Sample ID: SR 2
Date Collected: 10/05/22 09:15
Date Received: 10/06/22 09:10

Lab Sample ID: 400-226905-2
Matrix: Water

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		0.99		mg/L		10/07/22 08:59	10/08/22 03:38	1
C8-C10	ND		0.99		mg/L		10/07/22 08:59	10/08/22 03:38	1
C10-C28	ND		0.99		mg/L		10/07/22 08:59	10/08/22 03:38	1
C28-C40	ND		0.99		mg/L		10/07/22 08:59	10/08/22 03:38	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*118*		*40 - 129*	*10/07/22 08:59*	*10/08/22 03:38*	*1*
o-Terphenyl	*105*		*66 - 139*	*10/07/22 08:59*	*10/08/22 03:38*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Client Sample ID: SR 3
Date Collected: 10/05/22 09:10
Date Received: 10/06/22 09:10

Lab Sample ID: 400-226905-3
Matrix: Water

1 2 3 4 5 6 7 8 9 10 11

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		0.94		mg/L		10/07/22 08:59	10/08/22 04:10	1
C8-C10	ND		0.94		mg/L		10/07/22 08:59	10/08/22 04:10	1
C10-C28	ND		0.94		mg/L		10/07/22 08:59	10/08/22 04:10	1
C28-C40	ND		0.94		mg/L		10/07/22 08:59	10/08/22 04:10	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*134*	*S1+*	*40 - 129*	*10/07/22 08:59*	*10/08/22 04:10*	*1*
o-Terphenyl	*109*		*66 - 139*	*10/07/22 08:59*	*10/08/22 04:10*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Client Sample ID: SR 4
Date Collected: 10/05/22 09:20
Date Received: 10/06/22 09:10

Lab Sample ID: 400-226905-4
Matrix: Water

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		1.0	mg/L		10/07/22 08:59	10/08/22 04:26	1
C8-C10	ND		1.0	mg/L		10/07/22 08:59	10/08/22 04:26	1
C10-C28	ND		1.0	mg/L		10/07/22 08:59	10/08/22 04:26	1
C28-C40	ND		1.0	mg/L		10/07/22 08:59	10/08/22 04:26	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*148*	*S1+*	*40 - 129*	*10/07/22 08:59*	*10/08/22 04:26*	*1*
o-Terphenyl	*112*		*66 - 139*	*10/07/22 08:59*	*10/08/22 04:26*	*1*

Eurofins Pensacola

10/10/2022

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Client Sample ID: SR 5
Date Collected: 10/05/22 08:48
Date Received: 10/06/22 09:10

Lab Sample ID: 400-226905-5
Matrix: Water

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		0.95		mg/L		10/07/22 08:59	10/08/22 04:42	1
C8-C10	ND		0.95		mg/L		10/07/22 08:59	10/08/22 04:42	1
C10-C28	ND		0.95		mg/L		10/07/22 08:59	10/08/22 04:42	1
C28-C40	ND		0.95		mg/L		10/07/22 08:59	10/08/22 04:42	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*136*	*S1+*	*40 - 129*	*10/07/22 08:59*	*10/08/22 04:42*	*1*
o-Terphenyl	*106*		*66 - 139*	*10/07/22 08:59*	*10/08/22 04:42*	*1*

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Client Sample ID: SR 6
Date Collected: 10/05/22 08:40
Date Received: 10/06/22 09:10

Lab Sample ID: 400-226905-6
Matrix: Water

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		0.96		mg/L		10/07/22 08:59	10/08/22 04:58	1
C8-C10	ND		0.96		mg/L		10/07/22 08:59	10/08/22 04:58	1
C10-C28	ND		0.96		mg/L		10/07/22 08:59	10/08/22 04:58	1
C28-C40	ND		0.96		mg/L		10/07/22 08:59	10/08/22 04:58	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*146*	*S1+*	*40 - 129*	*10/07/22 08:59*	*10/08/22 04:58*	*1*
o-Terphenyl	*103*		*66 - 139*	*10/07/22 08:59*	*10/08/22 04:58*	*1*

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Client Sample ID: SR 7
Lab Sample ID: 400-226905-7
Date Collected: 10/05/22 09:50
Matrix: Water
Date Received: 10/06/22 09:10

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		1.0		mg/L		10/07/22 08:59	10/08/22 05:14	1
C8-C10	ND		1.0		mg/L		10/07/22 08:59	10/08/22 05:14	1
C10-C28	ND		1.0		mg/L		10/07/22 08:59	10/08/22 05:14	1
C28-C40	ND		1.0		mg/L		10/07/22 08:59	10/08/22 05:14	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*138*	*S1+*	*40 - 129*	*10/07/22 08:59*	*10/08/22 05:14*	*1*
o-Terphenyl	*109*		*66 - 139*	*10/07/22 08:59*	*10/08/22 05:14*	*1*

Eurofins Pensacola

10/10/2022

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Client Sample ID: SR 8
Date Collected: 10/05/22 08:30
Date Received: 10/06/22 09:10

Lab Sample ID: 400-226905-8
Matrix: Water

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		0.96		mg/L		10/07/22 09:00	10/08/22 05:30	1
C8-C10	ND		0.96		mg/L		10/07/22 09:00	10/08/22 05:30	1
C10-C28	ND		0.96		mg/L		10/07/22 09:00	10/08/22 05:30	1
C28-C40	ND		0.96		mg/L		10/07/22 09:00	10/08/22 05:30	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*152*	*S1+*	*40 - 129*	*10/07/22 09:00*	*10/08/22 05:30*	*1*
o-Terphenyl	*110*		*66 - 139*	*10/07/22 09:00*	*10/08/22 05:30*	*1*

Lab Chronicle

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Client Sample ID: SR 1 — **Lab Sample ID: 400-226905-1**
Date Collected: 10/05/22 09:00 — **Matrix: Water**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			595407	JTC	EET PEN	10/07/22 08:59
Total/NA	Analysis	FL-PRO		1	595539	RS	EET PEN	10/08/22 03:22

Client Sample ID: SR 2 — **Lab Sample ID: 400-226905-2**
Date Collected: 10/05/22 09:15 — **Matrix: Water**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			595407	JTC	EET PEN	10/07/22 08:59
Total/NA	Analysis	FL-PRO		1	595539	RS	EET PEN	10/08/22 03:38

Client Sample ID: SR 3 — **Lab Sample ID: 400-226905-3**
Date Collected: 10/05/22 09:10 — **Matrix: Water**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			595407	JTC	EET PEN	10/07/22 08:59
Total/NA	Analysis	FL-PRO		1	595539	RS	EET PEN	10/08/22 04:10

Client Sample ID: SR 4 — **Lab Sample ID: 400-226905-4**
Date Collected: 10/05/22 09:20 — **Matrix: Water**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			595407	JTC	EET PEN	10/07/22 08:59
Total/NA	Analysis	FL-PRO		1	595539	RS	EET PEN	10/08/22 04:26

Client Sample ID: SR 5 — **Lab Sample ID: 400-226905-5**
Date Collected: 10/05/22 08:48 — **Matrix: Water**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			595407	JTC	EET PEN	10/07/22 08:59
Total/NA	Analysis	FL-PRO		1	595539	RS	EET PEN	10/08/22 04:42

Client Sample ID: SR 6 — **Lab Sample ID: 400-226905-6**
Date Collected: 10/05/22 08:40 — **Matrix: Water**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			595407	JTC	EET PEN	10/07/22 08:59
Total/NA	Analysis	FL-PRO		1	595539	RS	EET PEN	10/08/22 04:58

Lab Chronicle

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Client Sample ID: SR 7 — **Lab Sample ID: 400-226905-7**
Date Collected: 10/05/22 09:50 — **Matrix: Water**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			595407	JTC	EET PEN	10/07/22 08:59
Total/NA	Analysis	FL-PRO		1	595539	RS	EET PEN	10/08/22 05:14

Client Sample ID: SR 8 — **Lab Sample ID: 400-226905-8**
Date Collected: 10/05/22 08:30 — **Matrix: Water**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3511			595407	JTC	EET PEN	10/07/22 09:00
Total/NA	Analysis	FL-PRO		1	595539	RS	EET PEN	10/08/22 05:30

Laboratory References:
EET PEN = Eurofins Pensacola, 3355 McLemore Drive, Pensacola, FL 32514, TEL (850)474-1001

Accreditation/Certification Summary

Client: CL Environmental | Job ID: 400-226905-1

Project/Site: Richmond

Laboratory: Eurofins Pensacola

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
ANAB	ISO/IEC 17025	L2471	02-23-23

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
FL-PRO	3511	Water	C10-C28
FL-PRO	3511	Water	C28-C40
FL-PRO	3511	Water	C8-C10
FL-PRO	3511	Water	C8-C40

Method Summary

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226905-1

Method	Method Description	Protocol	Laboratory
FL-PRO	Florida - Petroleum Range Organics (GC)	FL-DEP	EET PEN
3511	Microextraction of Organic Compounds	SW846	EET PEN

Protocol References:

FL-DEP = State Of Florida Department Of Environmental Protection, Florida Administrative Code.
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EET PEN = Eurofins Pensacola, 3355 McLemore Drive, Pensacola, FL 32514, TEL (850)474-1001

Eurofins Pensacola
3355 McLemore Drive
Pensacola, FL 32514
Phone: 850-474-1001 Fax: 850-478-2671

Chain of Custody Record

eurofins | Environment Testing America

Client Information	Sampler: Alec Silver	Lab PM: Swafford, Mark H	Carrier Tracking No(s):	COC No: 400-112280-39340.2
Client Contact: Matthew Lee	Phone: 876 8970108	E-Mail: Mark.Swafford@et.eurofinsus.com	State of Origin:	Page: Page 2 of 3
Company: CL Environmental	PWSID:			Job #:
Address: 22 Fort George Heights Stony Hill,	Due Date Requested:			
City: Kingston 8	TAT Requested (days):			
State, Zip: JA,	Compliance Project: Δ Yes Δ No			
Phone: 954-966-2454(Tel)	PO #: Purchase Order not required			
Email:	WO #:			
Project Name: [redacted] Richmond	Project #: 40001189			
Site:	SSOW#:			

Analysis Requested

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA
M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Y - Trizma, Z - other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	FL_PRO - FLPRO	6010B, 7471A	6010B, SM2340B	350.1 - Nitrogen, Ammonia	310.1, 325.2	SM4500_SO4_E - Sulfate, Total	Total Number of containers	Special Instructions/Note:
			Preservation Code:				N	N	N	N	N	N		
SR 1	5/10/22	8:00am	G	Water			✓							
SR 2	"	9:15am	"	Water			✓							
SR 3	"	9:10am	"	Water			✓							
SR 4	"	9:20am	"	Water			✓							
SR 5	"	8:48am	"	Water			✓							
SR 6	"	8:40am	"	Water			✓							
SR 7	"	9:50am	"	Water			✓							
SR 8	"	8:30am	"	Water			✓							
				Water										
				Water										
				Water										

400-226905 COC

Possible Hazard Identification
☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☑ Disposal By Lab ☐ Archive For ________ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date: 5/10/22		Time:		Method of Shipment: Fedex	
Relinquished by: Alec Silver	Date/Time: 5/10/22	Company: CLE	Received by: Fedex		Date/Time: 5/10/22	Company: Fedex
Relinquished by:	Date/Time:	Company	Received by:		Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:		Date/Time: 11-6-22 / 900	Company
Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:		Cooler Temperature(s) °C and Other Remarks: 1.4°C IR8			

Ver: 06/08/2021

Login Sample Receipt Checklist

Client: CL Environmental

Job Number: 400-226905-1

Login Number: 226905
List Number: 1
Creator: Whitley, Adrian

List Source: Eurofins Pensacola

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	1.4°C IR8
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Sediment Results

INTERNATIONAL ANALYTICAL GROUP

REVIEW OF ANALYTICAL REPORT

JOB NUMBER: 400-226907-1
Client Project/Site: Richmond

International Analytical Group, Inc. (IAG) has conducted an independent, third party review of the above referenced analytical report. The samples were analyzed by E u r o f i ns Testamerica Pensacola, a NELAC certified laboratory in Pensacola, Florida.

If you have any questions regarding this analytical report, please contact
Marino Fernandez at marino@iagenvironmental.com

INTERNATIONAL ANALYTICAL GROUP 1998 "Excellence since 1998"

791 SKIVIEW ROAD, SEVEN DEVILS, NC 28604

ANALYTICAL REPORT

Eurofins Pensacola
3355 McLemore Drive
Pensacola, FL 32514
Tel: (850)474-1001

Laboratory Job ID: 400-226907-1
Client Project/Site: Richmond

For:
CL Environmental
22 Fort George Heights
Stony Hill,
Kingston 8, Jamaica

Attn: Matthew Lee

Mark Swafford

Authorized for release by:
10/21/2022 7:42:57 AM

Mark Swafford, Project Manager II
(850)471-6207
Mark.Swafford@et.eurofinsus.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Client: CL Environmental
Project/Site: Richmond

Laboratory Job ID: 400-226907-1

Table of Contents

Definitions/Glossary

Client: CL Environmental | Job ID: 400-226907-1
Project/Site: Richmond

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Eurofins Pensacola

Case Narrative

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226907-1

Job ID: 400-226907-1

Laboratory: Eurofins Pensacola

Narrative

Job Narrative
400-226907-1

Comments
No additional comments.

Receipt
The samples were received on 10/6/2022 9:10 AM. Unless otherwise noted below, the samples arrived in good condition, and where required, properly preserved and on ice. The temperature of the cooler at receipt was 1.4º C.

GC Semi VOA
Method FL-PRO: Two surrogates are used for this analysis. The laboratory's SOP allows one of these surrogates to be outside acceptance criteria without performing re-extraction/re-analysis. The following samples contained an allowable number of surrogate compounds outside limits: (400-226907-A-1-B MS) and (400-226907-A-1-C MSD). These results have been reported and qualified.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Metals
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Organic Prep
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Sample Summary

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226907-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
400-226907-1	S 1	Solid	10/05/22 09:00	10/06/22 09:10
400-226907-2	S 2	Solid	10/05/22 09:10	10/06/22 09:10
400-226907-3	S 3	Solid	10/05/22 09:20	10/06/22 09:10
400-226907-4	S 4	Solid	10/05/22 09:50	10/06/22 09:10
400-226907-5	S 5	Solid	10/05/22 10:00	10/06/22 09:10

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226907-1

Client Sample ID: S 1
Date Collected: 10/05/22 09:00
Date Received: 10/06/22 09:10

Lab Sample ID: 400-226907-1
Matrix: Solid
Percent Solids: 65.9

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		29		mg/Kg	☼	10/10/22 11:13	10/11/22 12:34	1
C8-C10	ND		29		mg/Kg	☼	10/10/22 11:13	10/11/22 12:34	1
C10-C28	ND		29		mg/Kg	☼	10/10/22 11:13	10/11/22 12:34	1
C28-C40	ND		29		mg/Kg	☼	10/10/22 11:13	10/11/22 12:34	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*85*		*36 - 132*	*10/10/22 11:13*	*10/11/22 12:34*	*1*
o-Terphenyl	*81*		*66 - 136*	*10/10/22 11:13*	*10/11/22 12:34*	*1*

Method: SW846 6010B - RCRA Metals

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	**3.5**		1.6		mg/Kg	☼	10/16/22 11:23	10/17/22 20:07	1
Cadmium	ND		0.79		mg/Kg	☼	10/16/22 11:23	10/17/22 20:07	1
Lead	**2.5**		1.6		mg/Kg	☼	10/16/22 11:23	10/17/22 20:07	1

Method: SW846 7471A - Mercury

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.045**		0.019		mg/Kg	☼	10/18/22 10:29	10/20/22 12:57	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	**34.1**		0.01		%			10/08/22 12:10	1

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226907-1

Client Sample ID: S 2
Date Collected: 10/05/22 09:10
Date Received: 10/06/22 09:10

Lab Sample ID: 400-226907-2
Matrix: Solid
Percent Solids: 70.4

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		28		mg/Kg	☼	10/10/22 11:13	10/11/22 13:25	1
C8-C10	ND		28		mg/Kg	☼	10/10/22 11:13	10/11/22 13:25	1
C10-C28	ND		28		mg/Kg	☼	10/10/22 11:13	10/11/22 13:25	1
C28-C40	ND		28		mg/Kg	☼	10/10/22 11:13	10/11/22 13:25	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*84*		*36 - 132*	*10/10/22 11:13*	*10/11/22 13:25*	*1*
o-Terphenyl	*91*		*66 - 136*	*10/10/22 11:13*	*10/11/22 13:25*	*1*

Method: SW846 6010B - RCRA Metals

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	**6.8**		1.5		mg/Kg	☼	10/16/22 11:23	10/17/22 20:11	1
Cadmium	ND		0.75		mg/Kg	☼	10/16/22 11:23	10/17/22 20:11	1
Lead	**1.8**		1.5		mg/Kg	☼	10/16/22 11:23	10/17/22 20:11	1

Method: SW846 7471A - Mercury

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.049**		0.018		mg/Kg	☼	10/18/22 10:29	10/20/22 12:58	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	**29.6**		0.01		%			10/08/22 12:10	1

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226907-1

Client Sample ID: S 3 **Lab Sample ID: 400-226907-3**
Date Collected: 10/05/22 09:20 **Matrix: Solid**
Date Received: 10/06/22 09:10 **Percent Solids: 34.9**

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		55		mg/Kg	☼	10/10/22 11:13	10/11/22 13:42	1
C8-C10	ND		55		mg/Kg	☼	10/10/22 11:13	10/11/22 13:42	1
C10-C28	ND		55		mg/Kg	☼	10/10/22 11:13	10/11/22 13:42	1
C28-C40	ND		55		mg/Kg	☼	10/10/22 11:13	10/11/22 13:42	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*83*		*36 - 132*	*10/10/22 11:13*	*10/11/22 13:42*	*1*
o-Terphenyl	*84*		*66 - 136*	*10/10/22 11:13*	*10/11/22 13:42*	*1*

Method: SW846 6010B - RCRA Metals

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	**9.5**		3.1		mg/Kg	☼	10/16/22 11:23	10/17/22 20:23	1
Cadmium	ND		1.5		mg/Kg	☼	10/16/22 11:23	10/17/22 20:23	1
Lead	**3.2**		3.1		mg/Kg	☼	10/16/22 11:23	10/17/22 20:23	1

Method: SW846 7471A - Mercury

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.10**		0.042		mg/Kg	☼	10/17/22 10:10	10/20/22 13:00	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	**65.1**		0.01		%			10/08/22 12:10	1

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226907-1

Client Sample ID: S 4 — **Lab Sample ID: 400-226907-4**
Date Collected: 10/05/22 09:50 — **Matrix: Solid**
Date Received: 10/06/22 09:10 — **Percent Solids: 51.4**

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		37		mg/Kg	☼	10/10/22 11:13	10/11/22 13:59	1
C8-C10	ND		37		mg/Kg	☼	10/10/22 11:13	10/11/22 13:59	1
C10-C28	ND		37		mg/Kg	☼	10/10/22 11:13	10/11/22 13:59	1
C28-C40	ND		37		mg/Kg	☼	10/10/22 11:13	10/11/22 13:59	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*77*		*36 - 132*	*10/10/22 11:13*	*10/11/22 13:59*	*1*
o-Terphenyl	*83*		*66 - 136*	*10/10/22 11:13*	*10/11/22 13:59*	*1*

Method: SW846 6010B - RCRA Metals

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	**5.8**		2.0		mg/Kg	☼	10/16/22 11:23	10/17/22 20:27	1
Cadmium	ND		1.0		mg/Kg	☼	10/16/22 11:23	10/17/22 20:27	1
Lead	**3.3**		2.0		mg/Kg	☼	10/16/22 11:23	10/17/22 20:27	1

Method: SW846 7471A - Mercury

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.084**		0.030		mg/Kg	☼	10/17/22 10:10	10/20/22 13:02	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	**48.6**		0.01		%			10/08/22 12:10	1

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226907-1

Client Sample ID: S 5 — **Lab Sample ID: 400-226907-5**
Date Collected: 10/05/22 10:00 — **Matrix: Solid**
Date Received: 10/06/22 09:10 — **Percent Solids: 47.0**

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		42		mg/Kg	☼	10/10/22 11:13	10/11/22 14:16	1
C8-C10	ND		42		mg/Kg	☼	10/10/22 11:13	10/11/22 14:16	1
C10-C28	ND		42		mg/Kg	☼	10/10/22 11:13	10/11/22 14:16	1
C28-C40	ND		42		mg/Kg	☼	10/10/22 11:13	10/11/22 14:16	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*79*		*36 - 132*	*10/10/22 11:13*	*10/11/22 14:16*	*1*
o-Terphenyl	*85*		*66 - 136*	*10/10/22 11:13*	*10/11/22 14:16*	*1*

Method: SW846 6010B - RCRA Metals

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	**4.5**		2.2		mg/Kg	☼	10/16/22 11:23	10/17/22 20:31	1
Cadmium	ND		1.1		mg/Kg	☼	10/16/22 11:23	10/17/22 20:31	1
Lead	**3.4**		2.2		mg/Kg	☼	10/16/22 11:23	10/17/22 20:31	1

Method: SW846 7471A - Mercury

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.080**		0.031		mg/Kg	☼	10/17/22 10:10	10/20/22 13:09	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	**53.0**		0.01		%			10/08/22 12:10	1

Eurofins Pensacola

Lab Chronicle

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226907-1

Client Sample ID: S 1 | **Lab Sample ID: 400-226907-1**
Date Collected: 10/05/22 09:00 | **Matrix: Solid**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	595567	MD	EET PEN	10/08/22 12:10

Client Sample ID: S 1 | **Lab Sample ID: 400-226907-1**
Date Collected: 10/05/22 09:00 | **Matrix: Solid**
Date Received: 10/06/22 09:10 | **Percent Solids: 65.9**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			595671	LH	EET PEN	10/10/22 11:13
Total/NA	Analysis	FL-PRO		1	595761	RS	EET PEN	10/11/22 12:34
Total/NA	Prep	3050B			596488	JL	EET PEN	10/16/22 11:23 - 10/16/22 14:26 [1]
Total/NA	Analysis	6010B		1	596694	LSS	EET PEN	10/17/22 20:07
Total/NA	Prep	7471A			596656	NET	EET PEN	10/18/22 10:29 - 10/18/22 13:59 [1]
Total/NA	Analysis	7471A		1	597169	NET	EET PEN	10/20/22 12:57

Client Sample ID: S 2 | **Lab Sample ID: 400-226907-2**
Date Collected: 10/05/22 09:10 | **Matrix: Solid**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	595567	MD	EET PEN	10/08/22 12:10

Client Sample ID: S 2 | **Lab Sample ID: 400-226907-2**
Date Collected: 10/05/22 09:10 | **Matrix: Solid**
Date Received: 10/06/22 09:10 | **Percent Solids: 70.4**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			595671	LH	EET PEN	10/10/22 11:13
Total/NA	Analysis	FL-PRO		1	595761	RS	EET PEN	10/11/22 13:25
Total/NA	Prep	3050B			596488	JL	EET PEN	10/16/22 11:23 - 10/16/22 14:26 [1]
Total/NA	Analysis	6010B		1	596694	LSS	EET PEN	10/17/22 20:11
Total/NA	Prep	7471A			596656	NET	EET PEN	10/18/22 10:29 - 10/18/22 13:59 [1]
Total/NA	Analysis	7471A		1	597169	NET	EET PEN	10/20/22 12:58

Client Sample ID: S 3 | **Lab Sample ID: 400-226907-3**
Date Collected: 10/05/22 09:20 | **Matrix: Solid**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	595567	MD	EET PEN	10/08/22 12:10

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Lab Chronicle

Client: CL Environmental
Project/Site: Richmond

Job ID: 400-226907-1

Client Sample ID: S 3 — **Lab Sample ID: 400-226907-3**
Date Collected: 10/05/22 09:20 — **Matrix: Solid**
Date Received: 10/06/22 09:10 — **Percent Solids: 34.9**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			595671	LH	EET PEN	10/10/22 11:13
Total/NA	Analysis	FL-PRO		1	595761	RS	EET PEN	10/11/22 13:42
Total/NA	Prep	3050B			596488	JL	EET PEN	10/16/22 11:23 - 10/16/22 14:26 [1]
Total/NA	Analysis	6010B		1	596694	LSS	EET PEN	10/17/22 20:23
Total/NA	Prep	7471A			596570	NET	EET PEN	10/17/22 10:10 - 10/17/22 13:55 [1]
Total/NA	Analysis	7471A		1	597169	NET	EET PEN	10/20/22 13:00

Client Sample ID: S 4 — **Lab Sample ID: 400-226907-4**
Date Collected: 10/05/22 09:50 — **Matrix: Solid**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	595567	MD	EET PEN	10/08/22 12:10

Client Sample ID: S 4 — **Lab Sample ID: 400-226907-4**
Date Collected: 10/05/22 09:50 — **Matrix: Solid**
Date Received: 10/06/22 09:10 — **Percent Solids: 51.4**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			595671	LH	EET PEN	10/10/22 11:13
Total/NA	Analysis	FL-PRO		1	595761	RS	EET PEN	10/11/22 13:59
Total/NA	Prep	3050B			596488	JL	EET PEN	10/16/22 11:23 - 10/16/22 14:26 [1]
Total/NA	Analysis	6010B		1	596694	LSS	EET PEN	10/17/22 20:27
Total/NA	Prep	7471A			596570	NET	EET PEN	10/17/22 10:10 - 10/17/22 13:55 [1]
Total/NA	Analysis	7471A		1	597169	NET	EET PEN	10/20/22 13:02

Client Sample ID: S 5 — **Lab Sample ID: 400-226907-5**
Date Collected: 10/05/22 10:00 — **Matrix: Solid**
Date Received: 10/06/22 09:10

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	595567	MD	EET PEN	10/08/22 12:10

Client Sample ID: S 5 — **Lab Sample ID: 400-226907-5**
Date Collected: 10/05/22 10:00 — **Matrix: Solid**
Date Received: 10/06/22 09:10 — **Percent Solids: 47.0**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			595671	LH	EET PEN	10/10/22 11:13
Total/NA	Analysis	FL-PRO		1	595761	RS	EET PEN	10/11/22 14:16
Total/NA	Prep	3050B			596488	JL	EET PEN	10/16/22 11:23 - 10/16/22 14:26 [1]
Total/NA	Analysis	6010B		1	596694	LSS	EET PEN	10/17/22 20:31
Total/NA	Prep	7471A			596570	NET	EET PEN	10/17/22 10:10 - 10/17/22 13:55 [1]
Total/NA	Analysis	7471A		1	597169	NET	EET PEN	10/20/22 13:09

[1] Completion dates and times are reported or not reported per method requirements or individual lab discretion.

Eurofins Pensacola

Lab Chronicle

Client: CL Environmental
Job ID: 400-226907-1

Project/Site: Richmond

Laboratory References:

EET PEN = Eurofins Pensacola, 3355 McLemore Drive, Pensacola, FL 32514, TEL (850)474-1001

Accreditation/Certification Summary

Client: CL Environmental
Job ID: 400-226907-1
Project/Site: Richmond

Laboratory: Eurofins Pensacola

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
ANAB	ISO/IEC 17025	L2471	02-23-23

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
FL-PRO	3546	Solid	C10-C28
FL-PRO	3546	Solid	C28-C40
FL-PRO	3546	Solid	C8-C10
FL-PRO	3546	Solid	C8-C40
Moisture		Solid	Percent Moisture

Eurofins Pensacola

Method Summary

Client: CL Environmental
Job ID: 400-226907-1
Project/Site: Richmond

Method	Method Description	Protocol	Laboratory
FL-PRO	Florida - Petroleum Range Organics (GC)	FL-DEP	EET PEN
6010B	RCRA Metals	SW846	EET PEN
7471A	Mercury	SW846	EET PEN
Moisture	Percent Moisture	EPA	EET PEN
3050B	Preparation, Metals	SW846	EET PEN
3546	Microwave Extraction	SW846	EET PEN
7471A	Preparation, Mercury	SW846	EET PEN

Protocol References:

EPA = US Environmental Protection Agency

FL-DEP = State Of Florida Department Of Environmental Protection, Florida Administrative Code.

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EET PEN = Eurofins Pensacola, 3355 McLemore Drive, Pensacola, FL 32514, TEL (850)474-1001

Eurofins Pensacola
3355 McLemore Drive
Pensacola, FL 32514
Phone: 850-474-1001 Fax: 850-478-2671

Chain of Custody Record

eurofins | Environment Testing America

Client Information				
Client Contact: Matthew Lee	Sampler: Alec Silver	Lab PM: Swafford, Mark H	Carrier Tracking No(s):	COC No: 400-112279-39339.3
Company: CL Environmental	Phone: 876 897 0108	E-Mail: Mark.Swafford@et.eurofinsus.com	State of Origin:	Page: Page 3 of 3
Address: 22 Fort George Heights Stony Hill,	PWSID:			Job #:
City: Kingston 8	Due Date Requested:			
State, Zip: JA,	TAT Requested (days):			
Phone: 954-966-2454(Tel)	Compliance Project: Δ Yes Δ No			
Email:	PO #: Purchase Order not required			
Project Name: Richmond	WO #:			
Site:	Project #: 40001189			
	SSOW#:			

Analysis Requested

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA
M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Y - Trizma, Z - other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	FL_PRO - FLPRO	6010B, 7471A	As	Cd	Hg	Pb	TPH	Total Number of containers	Special Instructions/Note:
			Preservation Code:				N	N							
				Water											
				Water											
				Water											
				Water											
S 1	5/10/22	9:00am	G	Soil			✓		✓	✓	✓	✓	✓		
S 2	"	9:10am	"	Soil			✓		✓	✓	✓	✓	✓		
S 3	"	9:20am	"	Soil			✓		✓	✓	✓	✓	✓		
S 4	"	9:50am	"	Soil			✓		✓	✓	✓	✓	✓		
S 5	"	10:00am	"	Soil			✓		✓	✓	✓	✓	✓		

400-226907 COC

Possible Hazard Identification
☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☑ Disposal By Lab ☐ Archive For ________ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by: Alec Silver		Date: 5/10/22	Time:		Method of Shipment: Fedex	
Relinquished by: Alec Silver	Date/Time: 5/10/22	Company: CLE	Received by: Fedex	Date/Time: 5/10/22	Company: Fedex	
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company	
Relinquished by:	Date/Time:	Company	Received by:	Date/Time: 10-6-22 / 910	Company	
Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:		Cooler Temperature(s) °C and Other Remarks: 1-4°C IR8			

Ver: 06/08/2021

Login Sample Receipt Checklist

Client: CL Environmental

Job Number: 400-226907-1

Login Number: 226907
List Number: 1
Creator: Whitley, Adrian

List Source: Eurofins Pensacola

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	1.4°C IR8
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Appendix 10 – Detailed In-Situ Water Quality Data

Table 12-2 Water Quality Run 1 – July 2022

STATION	DEPTH (m)	TEMP. ˚C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)
1	0	28.5	55.03	36.54	8.07	6.42	0	35.22	348
	1	28.51	55	36.52	8.07	6.42	0	35.2	341
	2	28.51	55.02	36.53	8.07	6.41	0	35.21	263
	3	28.5	55.03	36.54	8.06	6.41	0	35.22	233
	4	28.51	55.01	36.53	8.06	6.41	0	35.21	221
	5	28.51	55.02	36.53	8.06	6.4	0	35.21	208
	6	28.51	55	36.52	8.06	6.38	0	35.21	185
	7	28.51	55.01	36.53	8.06	6.32	0	35.21	166
	8	28.51	55	36.52	8.06	6.34	0	35.2	155
	9	28.51	54.99	36.51	8.06	6.42	0	35.2	146
	10	28.51	55	36.52	8.06	6.44	0	35.2	137
	15	28.51	54.99	36.51	8.06	6.4	0	35.2	120
	20	28.51	54.99	36.51	8.06	6.42	0	35.2	105
	Average	**28.51**	**55.01**	**36.52**	**8.06**	**6.40**	**0.0**	**35.21**	**202.15**
2	0	28.48	54.92	36.46	8.05	6.39	0.7	35.5	520
	1	28.48	54.91	36.46	8.06	6.28	0.6	35.15	367
	2	28.49	54.94	36.47	8.06	6.31	1.3	35.16	386
	Average	**28.48**	**54.92**	**36.46**	**8.06**	**6.33**	**0.9**	**35.27**	**424.33**
3	0	28.32	55.06	36.56	8.07	7.17	0	35.24	1102
	1	28.32	55.06	36.56	8.07	7.38	0	35.24	371
	Average	**28.32**	**55.06**	**36.56**	**8.07**	**7.28**	**0.0**	**35.24**	**736.50**
4	0	28.54	55.26	36.71	8.12	8.13	0	35.37	
	Average	**28.54**	**55.26**	**36.71**	**8.12**	**8.13**	**0.0**	**35.37**	**#DIV/0!**
5	0	28.46	55.04	36.55	8.04	6.31	0	35.23	1055
	1	28.45	55.04	36.55	8.05	6.23	0	35.23	350
	2	28.44	55.04	36.55	8.04	6.25	0	35.23	244
	3	28.45	55.02	36.54	8.04	6.27	0	35.22	242
	4	28.44	55.04	36.55	8.04	6.28	0	35.22	241
	5	28.44	55.04	36.55	8.04	6.29	0	35.23	262

	6	28.44	55.04	36.55	8.04	6.3	0	35.24	241
	7	28.42	55.05	36.55	8.04	6.34	0	35.23	203
	Average	**28.44**	**55.04**	**36.55**	**8.04**	**6.28**	**0.0**	**35.23**	**354.75**
6	0	25.72	0.0754	1.76	8.03	8.1	81.1	2.085	645
	1	28.48	54.98	36.5	8.03	5.82	0	35.19	461
	2	28.48	55	36.52	8.02	5.84	0	35.2	340
	3	28.47	54.99	36.51	8.01	5.82	0	35.19	248
	Average	**27.79**	**41.26**	**27.82**	**8.02**	**6.40**	**20.3**	**26.92**	**423.50**
7	0	28.41	55	36.52	8.03	6.49	0.1	35.21	632
	1	28.31	54.94	36.47	8.03	6.47	0	35.16	188
	Average	**28.36**	**54.97**	**36.50**	**8.03**	**6.48**	**0.1**	**35.19**	**410.00**
8	0	28.4	54.94	36.48	8.04	6.49	0	35.15	512
	1	28.4	54.96	36.49	8.04	6.39	0	35.18	370
	2	28.41	54.98	36.51	8.03	6.3	0	35.19	357
	3	28.4	55.01	36.52	8.03	6.28	0	35.21	266
	4	28.4	55	36.52	8.03	6.21	0	35.2	265
	5	28.42	54.98	36.51	8.03	6.18	0	35.19	242
	Average	**28.41**	**54.98**	**36.51**	**8.03**	**6.31**	**0.0**	**35.19**	**335.33**

Light Extinction Coefficient

Station	Depth 1	PAR	Depth 2	PAR	**EC**
1	0	348	20	105	**0.0598**
2	0	520	2	386	**0.1488**
3	0	1102	1	371	**1.0875**
4	0	0	0	35	-
5	0	1055	7	203	**0.2352**
6	0	645	3	248	**0.3182**
7	0	632	1	188	**1.2111**
8	0	512	5	242	**0.1497**

Table 12-3 Water Quality Run 2 – September 2022

STATION	DEPTH (m)	TEMP. °C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)
1	0	29.37	55.19	36.67	8.16	6.41	0.00	35.34	509
	1	29.38	55.19	36.66	8.16	6.36	0.00	35.32	360
	2	29.38	55.21	36.67	8.15	6.27	0.00	35.34	310
	3	29.39	55.21	36.68	8.15	6.37	0.00	35.33	324
	4	29.40	55.21	36.67	8.15	6.37	0.00	35.34	324
	5	29.39	55.20	36.67	8.14	6.37	0.00	35.32	318
	6	29.40	55.20	36.67	8.14	6.30	0.00	35.33	252
	7	29.40	55.21	36.66	8.14	6.33	0.00	35.33	265
	8	29.40	55.20	36.65	8.14	6.39	0.00	35.32	225
	9	29.40	55.19	36.65	8.14	6.38	0.00	35.32	218
	10	29.41	55.19	36.66	8.14	6.37	0.00	35.32	191
	15	29.38	55.16	36.63	8.13	6.29	0.00	35.30	152
	20	29.38	55.15	36.63	8.13	6.22	0.00	35.30	121
	Average	**29.39**	**55.19**	**36.66**	**8.14**	**6.34**	**0.00**	**35.32**	**275**
2	0	29.13	55.06	36.57	8.11	6.13	0.00	35.23	857
	1	29.14	55.05	36.56	8.10	6.12	0.00	35.23	724
	2	29.14	55.06	36.56	8.10	6.15	0.00	35.24	619
	Average	**29.14**	**55.06**	**36.56**	**8.10**	**6.13**	**0.00**	**35.23**	**733.33**
3	0	28.55	54.73	36.33	7.95	3.94	0.00	35.04	1307
	1	28.36	54.75	36.32	7.93	3.85	0.00	35.04	729
	Average	**28.46**	**54.74**	**36.33**	**7.94**	**3.90**	**0.00**	**35.04**	**1018**
4	0	29.64	55.190	36.65	8.19	7.93	0.00	35.33	1735
	0.5								1508
	Average	**29.64**	**55.190**	**36.65**	**8.19**	**7.93**	**0.00**	**35.330**	**1622**
5	0	29.22	55.16	36.63	8.11	6.46	0.00	35.29	634
	1	29.22	55.15	36.62	8.12	6.42	0.00	35.30	498
	2	29.24	55.13	36.62	8.11	6.43	0.00	35.29	397
	3	29.21	55.14	36.62	8.11	6.32	0.00	35.29	303
	4	29.20	55.14	36.61	8.10	6.21	0.00	35.27	305
	5	29.19	55.12	36.60	8.10	6.19	0.00	35.27	299
	Average	**29.21**	**55.14**	**36.62**	**8.11**	**6.34**	**0.00**	**35.29**	**406**
6	0	29.38	55.19	36.66	8.14	6.17	0.00	35.31	646
	1	29.38	55.10	36.65	8.14	6.19	0.00	35.32	628

	2	29.38	55.19	36.66	8.13	6.15	0.00	35.32	563
	3	29.38	55.19	36.66	8.13	6.16	0.00	35.32	613
	4	29.38	55.18	36.65	8.13	6.16	0.00	35.32	644
	5	29.38	55.18	36.65	8.13	6.14	0.00	35.31	515
	6	29.38	55.18	36.66	8.13	6.15	0.00	35.31	514
	7	29.38	55.18	36.65	8.13	6.19	0.00	35.31	474
	8	29.38	55.17	36.64	8.13	6.21	0.00	35.30	389
	Average	**29.38**	**55.17**	**36.65**	**8.13**	**6.17**	**0.00**	**35.31**	**554**
7	0	29.35	55.14	36.63	8.14	6.73	0.00	35.29	1178
	1	29.35	55.14	36.62	8.14	6.69	0.00	35.30	862
	2	29.35	55.13	36.62	8.13	6.74	0.00	35.29	753
	Average	**29.35**	**55.14**	**36.62**	**8.14**	**6.72**	**0.00**	**35.29**	**931.00**
8	0	29.34	55.16	36.63	8.10	6.31	0.00	35.31	206
	1	29.34	55.17	36.65	8.11	6.25	0.00	35.34	186
	2	29.34	55.22	36.68	8.12	6.23	0.00	35.31	159
	3	29.35	55.20	36.67	8.12	6.21	0.00	35.32	146
	4	29.36	55.19	36.67	8.12	6.19	0.00	35.32	133
	5	29.37	55.20	36.65	8.11	6.19	0.00	35.32	127
	6	29.37	55.19	36.65	8.11	6.17	0.00	35.32	112
	Average	**29.35**	**55.19**	**36.66**	**8.11**	**6.22**	**0.00**	**35.32**	**153**

Light Extinction Coefficient

Station	Depth 1	PAR	Depth 2	PAR	EC
1	0	509	20	121	**0.0718**
2	0	857	2	619	**0.1625**
3	0	1307	1	729	**0.5832**
4	0	1735	1	1508	**0.2801**
5	0	634	5	299	**0.1502**
6	0	646	8	389	**0.0633**
7	0	1178	2	753	**0.2235**
8	0	206	6	112	**0.1014**

Table 12-4 Water Quality Run 3 – October 2022

STATION	DEPTH (m)	TEMP. °C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)
1	0	29.72	54.23	35.94	8.19	6.43	0.00	34.69	1336
	1	29.71	54.22	35.95	8.10	62.00	0.00	34.68	972
	2	29.70	54.29	36.06	8.19	6.36	0.00	34.75	611
	3	29.71	54.32	36.01	8.19	6.32	0.00	34.75	717
	4	29.73	54.32	36.01	8.19	6.27	0.00	34.76	729
	5	29.72	54.37	36.05	8.18	6.22	0.00	34.79	503
	6	29.74	54.67	36.21	8.18	6.15	0.00	34.92	442
	7	29.74	54.70	36.23	8.18	6.18	0.00	34.97	406
	8	29.98	54.71	36.30	8.18	6.08	0.00	35.00	381
	9	30.03	54.75	36.35	8.17	5.94	0.00	35.04	328
	15	30.03	54.84	36.38	8.17	6.03	0.00	35.06	248
	20	30.02	54.85	36.40	8.13	6.05	0.00	35.09	191
	Average	**29.82**	**54.52**	**36.16**	**8.17**	**10.84**	**0.00**	**34.88**	**572**
2	0	29.88	53.86	35.66	8.09	5.14	0.00	34.44	1393
	1	29.88	53.50	36.04	8.14	7.11	0.00	34.81	835
	Average	**29.88**	**53.68**	**35.85**	**8.12**	**6.13**	**0.00**	**34.63**	**1114**
3	0	30.20	53.79	35.78	8.04	4.10	4.60	34.50	1298
	1	30.26	53.71	35.56	8.04	4.14	8.30	34.36	1061
	Average	**30.23**	**53.75**	**35.67**	**8.04**	**4.12**	**6.45**	**34.43**	**1180**
4	0	29.88	53.770	35.59	8.07	7.36	0.00	34.80	1183
	0.5								983
	Average	**29.88**	**53.770**	**35.59**	**8.07**	**7.36**	**0.00**	**34.800**	**1083**
5	0	29.81	54.44	36.09	8.16	5.78	0.00	34.84	1181
	1	29.81	54.46	36.18	8.15	5.19	0.00	34.89	1061
	2	29.85	54.53	36.18	8.13	5.33	0.00	34.89	1010
	3	29.87	54.60	36.21	8.14	5.29	0.00	34.93	829
	4	29.92	54.51	36.18	8.14	5.10	0.00	34.86	636
	5	29.72	54.48	36.18	8.10	4.80	0.00	34.86	492
	6	29.81	54.55	36.19	8.11	4.92	0.00	34.93	504
	Average	**29.83**	**54.51**	**36.17**	**8.13**	**5.20**	**0.00**	**34.89**	**816**
6	0	29.71	54.28	35.99	8.19	6.34	0.00	34.75	1184
	1	29.73	54.41	36.01	8.16	6.18	0.00	34.83	1056
	2	29.82	54.58	36.10	8.17	6.01	0.00	34.81	818

	3	29.98	54.60	36.22	8.15	5.61	0.00	34.94	726
	4	29.98	54.61	36.22	8.15	5.59	0.00	34.96	668
	5	30.01	54.63	36.25	8.15	5.64	0.00	34.95	616
	6	30.00	54.65	36.25	8.15	5.73	0.00	34.91	607
	7	30.01	54.66	36.26	8.16	5.81	0.00	34.96	393
	8	30.01	54.67	36.28	8.16	5.86	0.00	34.99	321
	Average	**29.92**	**54.57**	**36.18**	**8.16**	**5.86**	**0.00**	**34.90**	**710**
7	0	30.17	54.59	36.21	8.14	6.60	0.00	34.92	1473
	1	30.12	54.51	36.16	8.14	6.57	0.00	34.90	859
	Average	**30.15**	**54.55**	**36.16**	**8.14**	**6.59**	**0.00**	**34.91**	**1166**
8	0	29.76	54.23	35.91	8.19	6.33	0.00	34.74	1162
	1	29.78	54.29	35.99	8.20	6.33	0.00	34.75	1076
	2	29.80	54.32	36.01	8.10	6.36	0.00	34.76	860
	3	29.83	54.34	36.03	8.19	6.39	0.00	34.77	679
	4	29.80	54.33	36.01	8.19	6.37	2.60	34.77	646
	Average	**29.79**	**54.30**	**35.99**	**8.17**	**6.36**	**0.52**	**34.76**	**885**

Light Extinction Coefficient

Station	Depth 1	PAR	Depth 2	PAR	**EC**
1	0	1336	20	191	**0.0971**
2	0	1393	1	835	**0.5112**
3	0	1298	1	1061	**0.2014**
4	0	1183	1	983	**0.3700**
5	0	1181	6	504	**0.1418**
6	0	1184	8	321	**0.1630**
7	0	1473	1	859	**0.5387**
8	0	1162	4	646	**0.1466**

Table 12-5 Water Quality Run 4 – December 2022

STATION	DEPTH (m)	TEMP. °C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)
1	0	28.63	54.72	36.31	8.31	6.48	0.00	35.03	333
	1	28.62	54.71	36.32	8.31	6.45	0.00	35.02	329
	2	28.64	54.70	36.32	8.31	6.42	0.00	35.01	248
	3	28.64	54.72	36.31	8.30	6.44	0.00	35.02	252
	4	28.62	54.70	36.30	8.30	6.43	0.00	35.02	256
	5	28.65	54.71	36.31	8.29	6.43	0.00	35.03	225
	6	28.64	54.73	36.31	8.29	6.43	0.00	35.02	212
	7	28.64	54.70	36.30	8.29	6.44	0.00	35.02	178
	8	28.64	54.68	36.30	8.29	6.43	0.00	35.01	172
	9	28.64	54.71	36.30	8.29	6.45	0.00	35.01	162
	10	28.64	54.71	36.30	8.29	6.43	0.00	35.01	154
	15	28.61	54.70	36.30	8.29	6.42	0.00	35.01	137
	20	28.48	54.64	36.28	8.28	6.37	0.00	35.01	90
	Average	**28.62**	**54.70**	**36.30**	**8.30**	**6.43**	**0.00**	**35.02**	**211**
2	0	28.21	54.71	36.31	8.30	6.78	0.00	35.02	379
	1	28.20	54.70	36.31	8.30	6.75	0.00	35.02	369
	2	28.19	54.70	36.30	8.30	6.74	0.00	35.01	241
	3	28.17	54.47	36.13	8.29	6.77	0.00	35.02	266
	Average	**28.21**	**54.71**	**36.26**	**8.30**	**6.76**	**0.00**	**35.02**	**314**
3	0	28.88	54.71	36.31	8.23	7.07	0.00	35.02	395
	1	27.88	54.72	36.31	8.31	7.09	0.80	35.02	232
	Average	**28.38**	**54.72**	**36.31**	**8.27**	**7.08**	**0.40**	**35.02**	**314**
4	0	27.02	54.710	36.34	8.20	6.31	0.00	35.03	291
	0.5								232
	Average	**27.02**	**54.710**	**36.34**	**8.20**	**6.31**	**0.00**	**35.030**	**262**
5	0	28.27	54.74	36.35	8.30	6.62	0.00	35.03	280
	1	28.30	54.73	36.31	8.30	6.68	0.00	35.02	153
	2	28.31	54.71	36.30	8.30	6.68	0.00	35.02	145
	3	28.31	54.70	36.29	8.29	6.69	0.00	35.01	187
	4	28.37	54.70	36.31	8.29	6.70	0.00	35.01	162
	Average	**28.31**	**54.72**	**36.31**	**8.30**	**6.67**	**0.00**	**35.02**	**185**
6	0	28.49	54.70	36.31	8.31	6.45	0.00	35.01	330
	1	28.49	54.71	36.30	8.31	6.44	0.00	35.01	250

	2	28.49	54.70	36.29	8.30	6.43	0.00	35.01	210
	3	28.49	54.66	36.29	8.30	6.43	0.00	35.00	219
	4	28.48	54.70	36.29	8.29	6.48	0.00	35.00	247
	5	28.48	54.68	36.29	8.29	6.48	0.00	35.00	233
	6	28.48	54.70	36.29	8.29	6.48	0.00	35.01	201
	Average	**28.49**	**54.69**	**36.29**	**8.30**	**6.46**	**0.00**	**35.01**	**241**
7	0	28.28	54.70	36.30	8.30	6.90	0.00	35.01	466
	1	28.30	54.71	36.24	8.31	6.93	0.00	35.01	245
	Average	**28.29**	**54.71**	**36.24**	**8.31**	**6.92**	**0.00**	**35.01**	**356**
8	0	28.30	54.61	36.23	8.30	6.57	0.00	34.89	577
	1	28.33	54.62	36.23	8.31	6.50	0.00	34.96	379
	2	28.27	54.63	36.25	8.30	6.54	0.00	34.98	332
	3	28.29	54.66	36.25	8.30	6.55	0.00	34.96	303
	4	28.35	54.64	36.26	8.30	6.45	0.00	34.97	255
	Average	**28.31**	**54.63**	**36.24**	**8.30**	**6.52**	**0.00**	**34.95**	**369**

Light Extinction Coefficient

Station	Depth 1	PAR	Depth 2	PAR	**EC**
1	0	333	20	90	**0.0653**
2	0	379	3	266	**0.1179**
3	0	395	1	232	**0.5316**
4	0	291	1	232	**0.4527**
5	0	280	4	162	**0.1366**
6	0	330	6	201	**0.0825**
7	0	466	1	245	**0.6422**
8	0	577	4	255	**0.2039**

Table 12-6 Water Quality Run 5 – January 2023

STATION	DEPTH (m)	TEMP. °C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)
1	0	27.91	53.33	35.31	8.29	6.41	0.40	34.16	400
	1	27.93	53.90	35.71	8.29	6.44	0.00	34.51	280
	2	27.95	54.03	35.79	8.29	6.46	0.00	34.56	304
	3	27.97	54.01	35.79	8.29	6.46	0.00	34.58	267
	4	27.97	54.02	35.79	8.30	6.48	0.00	34.55	732
	5	27.97	54.04	35.80	8.29	6.46	0.00	34.58	619
	6	27.97	54.06	35.80	8.30	6.40	0.00	34.60	660
	7	27.93	54.09	35.79	8.29	6.41	0.00	34.60	370
	8	27.96	54.08	35.82	8.20	6.40	0.00	34.61	286
	9	27.96	54.05	35.80	8.30	6.40	0.00	34.62	208
	10	27.95	54.03	35.81	8.29	6.40	0.00	34.58	232
	15	27.96	54.07	35.85	8.30	6.43	0.00	34.59	269
	20	27.98	54.10	35.85	8.30	6.46	0.00	34.63	77
	Average	**27.95**	**53.99**	**35.76**	**8.29**	**6.43**	**0.03**	**34.55**	**362**
2	0	27.99	52.84	34.96	8.29	6.90	1.00	33.85	885
	1	28.00	53.34	35.37	8.30	7.46	0.90	34.18	749
	2	28.04	53.44	35.35	8.32	7.63	1.00	34.23	621
	Average	**28.01**	**53.21**	**35.23**	**8.30**	**7.33**	**0.97**	**34.09**	**751.67**
3	0	28.27	51.69	34.10	8.31	9.22	1.20	33.12	1082
	1	27.63	52.48	34.66	8.32	8.46	1.60	33.60	669
	1.5	27.61	52.47	34.67	8.30	7.98	7.20	33.59	884
	Average	**27.95**	**52.09**	**34.48**	**8.31**	**8.55**	**3.33**	**33.44**	**878**
4	0	28.35	53.000	33.03	8.11	7.76	0.00	33.90	496
	0.5								247
	Average	**28.35**	**53.000**	**33.03**	**8.11**	**7.76**	**0.00**	**33.900**	**372**
5	0	28.54	53.50	35.38	8.40	8.83	0.00	34.19	1355
	1	28.10	53.42	35.37	8.39	8.28	0.00	34.17	1345
	2	27.87	53.31	35.49	8.33	7.22	0.00	34.34	916
	3	27.88	53.70	35.60	8.32	7.02	0.00	34.36	915
	4	27.89	53.80	35.63	8.32	6.98	0.00	34.45	678
	Average	**28.06**	**53.55**	**35.49**	**8.35**	**7.67**	**0.00**	**34.30**	**1042**
6	0	27.91	53.95	35.73	8.29	6.52	0.00	34.51	1569
	1	27.91	53.98	35.76	8.29	6.52	0.00	34.50	1321

	2	27.91	53.92	35.77	8.29	6.54	0.00	34.54	850
	3	27.90	53.99	35.80	8.29	6.44	0.00	34.58	223
	4	27.89	54.04	35.75	8.28	6.43	0.00	34.56	198
	5	27.88	54.00	35.77	8.28	6.43	0.00	34.57	169
	6	27.89	53.97	35.76	8.28	6.42	0.00	34.55	147
	7	27.88	54.00	35.75	8.28	6.45	0.00	34.55	140
	8	27.88	54.00	35.80	8.28	6.46	0.00	34.54	130
	Average	**27.89**	**53.98**	**35.77**	**8.28**	**6.47**	**0.00**	**34.54**	**527**
7	0	28.16	53.94	35.73	8.33	7.35	0.20	34.54	1024
	1	28.16	53.98	35.74	8.35	7.34	0.00	34.52	199
	1.5	28.13	53.96	35.75	8.33	7.27	0.00	34.54	178
	Average	**28.15**	**53.96**	**35.74**	**8.34**	**7.32**	**0.07**	**34.53**	**467.00**
8	0	28.07	53.92	35.73	8.32	6.82	0.50	34.52	717
	1	28.08	53.93	35.74	8.33	7.01	0.20	34.53	705
	2	28.09	53.95	35.73	8.32	7.00	0.00	34.53	323
	3	28.07	53.96	35.75	8.32	6.96	0.00	34.55	450
	4	28.04	54.02	35.80	8.31	6.87	0.00	34.59	248
	5	28.04	54.02	35.81	8.31	6.85	0.00	34.56	259
	Average	**28.07**	**53.97**	**35.76**	**8.32**	**6.92**	**0.12**	**34.55**	**450**

Light Extinction Coefficient

Station	Depth 1	PAR	Depth 2	PAR	EC
1	0	400	20	77	0.0823
2	0	885	2	621	0.1769
3	0	1082	1.5	884	0.1346
4	0	496	0.5	247	1.3928
5	0	1355	4	678	0.1729
6	0	1569	8	130	0.3110
7	0	1024	1.5	178	1.1651
8	0	717	5	259	0.2034