Draft Final Strategic Environmental Assessment Report

Deliverable #3

Strategic Environmental Assessment and Carrying Capacity Assessment for Port Royal 2020 Sustainable Master Plan

Resubmitted: August 11, 2023

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Abbreviations and Acronyms

AAJ	Airports Authority of Jamaica
AC	Asbestos-cement
AGRRA	Atlantic and Gulf Rapid Reef Assessment
AIA	Archaeological Impact Assessment
BOD	Biochemical Oxygen Demand
CCA	Crustose Coralline Algae
CCTV	Closed-circuit Television
CDC	Community Development Committee
CI	Cast Iron
CIRP	Coastal Inlets Research Program
CMAS	Caribbean Military Aviation School
CMS	Coastal Modelling System
CMS-Wave model	Coastal Modelling System Wave Model
CMU	Caribbean Maritime University
CoC	Chain of Custody
CSGM	Climate Studies Group Mona
dBA	Decibels
DI	Ductile Iron
DO	Dissolved Oxygen
EHU	Environmental Health Unit
EMS	European Macro-seismic Scale
ENE	East-Northeast
ENSO	El Niño/La Nina Southern Oscillation
EPGFZ	Enriquillo-Plantain Garden Fault Zone
ESE	East-Southeast
ESL	Environmental Solutions Limited

FOG	Fats, Oils and Grease
GCM	General Circulation Model
GOJ	Government of Jamaica
GPS	Global Positioning System
HAJ	Housing Agency of Jamaica
HDPE	High-density Polyethylene
HEART Trust/NSTA	Human Employment and Resource Training/National Service Training Agency
HQI	Housing Quality Index
ICT	Information and Communication Technology
IMAJ	Incorporated Master builders Association of Jamaica
IUCN	International Union for Conservation of Nature
JAMPRO	Jamaica Promotion Corporation
JBDC	Jamaica Business Development Corporation
JCA	Jamaica Customs Agency
JCF	Jamaica Constabulary Force
JCLC	Jamaica Survey of Living Conditions
JDF	Jamaica Defence Force
JFB	Jamaica Fire Brigade
JGQ Ltd.	Jamaica Gypsum and Quarries Limited
JKA	Jamaica Karting Association
JLP	Jamaica Labour Party
JNHT	Jamaica National Heritage Trust
JPSCo	Jamaica Public Service Company Limited
JSLC	Jamaica Survey of Living Conditions
JTB	Jamaica Tourist Board
JUTC	Jamaica Urban Transit Company
KH	Kingston Harbour
KMA	Kingston Metropolitan Area

KMR	Kingston Metropolitan Region
KSA	Kingston and St. Andrew
KSAMC	Kingston and St Andrew Municipal Corporation
LEED	Leadership in Energy and Environmental Designs
LH	Living Heritage
LPG	Liquid Petroleum Gas
m	metre
mg/L	Milligrams per Litre
MMI	Maximum Mercali Intensity
MOH	Ministry of Health
MPN	Most Probable Number
MSL	Mean Sea Level
N	North
NE	Northeast
NEPA	National Environment and Planning Agency
NFA	National Fisheries Authority
NGO	Non-governmental Organization
NMIA	Norman Manley International Airport
NNE	North-Northeast
NOAA	National Oceanic and Atmospheric Administration
NRCA	Natural Resources Conservation Authority
NSWMA	National Solid Waste Management Authority
NUA	New Urban Agenda
NW	Northwest
NWA	National Works Agency
NWC	National Water Commission
ODPEM	Office of Disaster Preparedness and Emergency Management
OHS	Occupational Health and Safety

OUC	Other Urban Centres
PAJ	Port Authority of Jamaica
PCA	Pesticide Control Authority
PIOJ	Planning Institute of Jamaica
PNP	People's National Party
P-PRPA	Palisadoes-Port Royal Protected Area
PRDCL	Port Royal Development Company Limited
PRDMP	Port Royal Development Master Plan
PRML	Port Royal Marine Lab
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
REA	Rapid Ecological Assessment
RTRP	Ridge to Reef Project
s	second
S	South
SDC	Social Development Commission
SE	Southeast
SEA	Strategic Environmental Assessment
SMS	Surface-water Modelling System
SPRMP	Sustainable Port Royal Master Plan
SPRMP	Sustainable Port Royal Master Plan
SSE	South-Southeast
SSW	South-Southwest
SW	Southwest
STATIN	Statistical Institute of Jamaica
SW	Southwest
TA	Turf Algae

TCPA	Town and Country Planning Act
TDS	Total Dissolved Solids
TEF	Tourism Enhancement Fund
The Met Office	Meteorological Office of Jamaica
TOR	Terms of Reference
TPDCo	Tourism Product and Development Company Limited
TSS	Total Suspended Solids
TWA	Time Weighted Average
UDC	Urban Development Corporation
UNESCO	United Nations Educational, Scientific and Cultural Organization
USACE	US Army Corps of Engineers
US-EPA	United States Environmental Protection Agency
UWI	University of the West Indies
VNR	Voluntary National Review
W	West
WH	Wave Heights
WNW	West-Northwest
WRA	Water Resources Authority
WSW	West-Southwest

Executive Summary

Introduction

Port Royal is a unique, multi-faceted land use region located on the south-eastern coast of Jamaica. The area is of historical, environmental, and geographical importance, with undeniable tourism appeal. At present, the town is one of the few places which preserves the ruins and relics of the island's involvement with pirates, buccaneers, and European trade. Surrounding these ruins are several residential communities and just off the coast are various cays and marine ecosystems, including seagrass, sand dune, coral reef, and mangrove communities, all of which encourage tourism, support livelihoods, and sustain the town's characteristically fisherfolk composition. Restoration of some key areas and aspects of Port Royal has already begun, but it is considered necessary to create a Master Plan for the town and its surroundings to help preserve and promote its historical, cultural, environmental, and geographical importance.

ESL Management Solutions Ltd (ESL) has been contracted by UDC to conduct and prepare the Strategic Environmental Assessment (SEA) of the Master Plan, to include carrying capacity and geotechnical analyses. This document represents the Strategic Environmental Assessment Report, Deliverable 3, according to the contractual obligation. The Report has been informed by the Terms of Reference (TOR) accompanying the contract; a literature review of wide-ranging documents, some provided by the UDC as well as other supporting documents gleaned by the consultants; stakeholder consultations; detailed site assessments; and importantly, discussions with UDC; and feedback received on the previously submitted Deliverables 1 and 2.

The Study Area

The study area encompasses the Palisadoes tombolo starting from the roundabout at Harbour View and continuing all the way to the town of Port Royal (See Figure 1). The study area also includes the adjacent mangrove areas within Kingston Harbour and extends southwards to include the nearshore cays outside of Kingston Harbour, to the outer Barrier Reefs. Although the entire area consists primarily of coastal strand, there is great variation in habitats primarily due to differences in human activity and disturbance that has modified or otherwise impacted the type and quality of the habitat. The area has therefore been divided into zones using the same physical areas described in the initial report but including all the cays as separate zones.

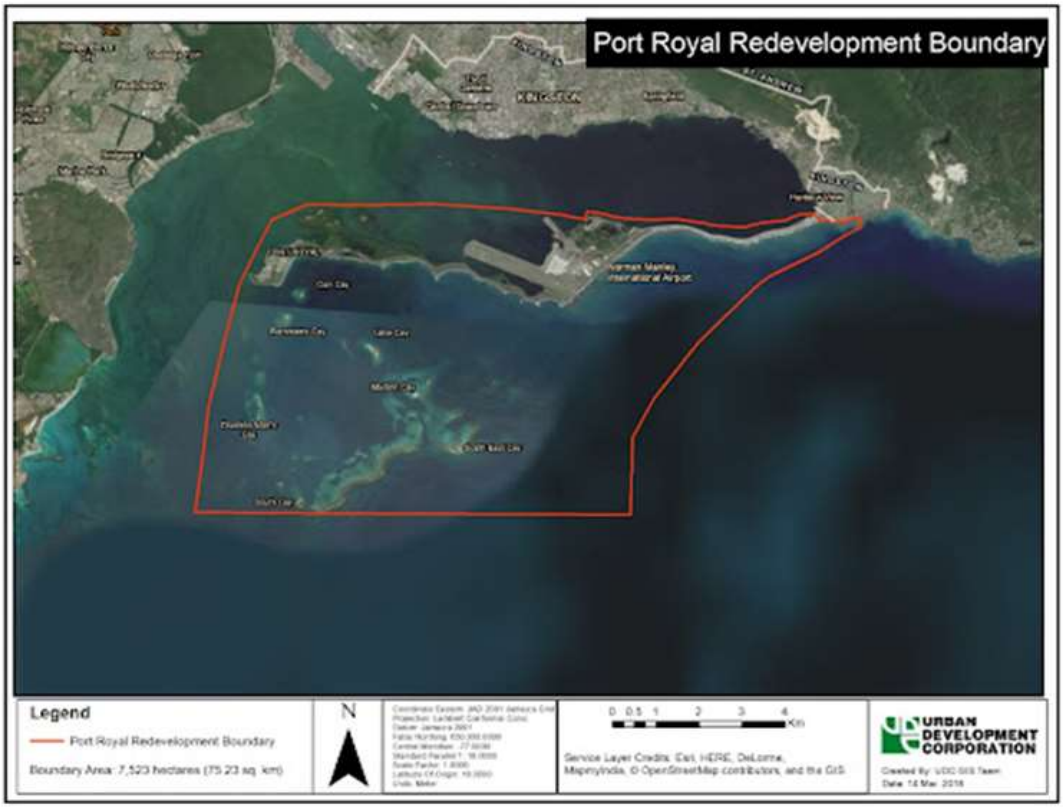


Figure 1: Palisadoes- Port Royal Redevelopment Area (Source: UDC, 2021)

A description of the existing environment was elaborated in the Environmental and Social Baseline Assessment, Deliverable 2 of this project. A summary of the results is provided in Section 4 of this document. The focus of this SEA is to identify and highlight potential impacts associated with the various proposed project investments for the Port Royal Project area. Recommended development guidelines are also provided to minimize the identified impacts with respect to the proposed Port Royal Redevelopment Concept Plan.

Potential Impacts and Development Guidelines

Multiple potential issues were identified for the proposed development within the Port Royal environmental setting. These issues primarily relate to:

- Archaeological Environment
- Physical Environment (e.g., hydrology and drainage, geology and soils, faults and seismicity)
- Physicochemical Conditions (e.g., water quality, air quality and noise)
- Natural Hazard Risks (e.g., earthquakes, hurricanes, storm surges)
- Ecological Impacts (both marine and terrestrial)
- Socioeconomic Issues/Considerations
- Urban Planning and Development

These issues are summarized in Table 1 below with respect to the various proposed investment projects for the Port Royal area:

Table 1: Summary of Potential Issues and Development Guidelines

Proposed Project Investment in Port Royal	Issues	Development Guidelines
Historical Trail, and Historical Sites (Including Fort Charles, Fort Walker, Old Naval Hospital, Lime Street)	**Heritage Sites** The Port Royal area comprises a high density of heritage sites and assets, therefore there is a high risk of destruction of important heritage sites and assets whether inadvertently or intentionally. An increase in visitor traffic can result in damage of heritage assets through touching and/or handling displays, illegal collection of souvenirs from site, graffiti, vandalism, fire (from smoking), damage from camera flash (light) and the weight of people, for example, the weight of people in the Giddy House.	1. The development of tour packages linking a series of related attractions – 'Heritage Trail' is supported, in keeping with the Tourism Action Plan (TAP) to ensure the best exposure and a more fulsome experience. 2. The expansion of linkages to other sites in the corporate area (i.e., Kingston/St. Catherine) is also recommended. 3. Identification of important and/or famous persons and events in Port Royal's history from which to create a festival or special occasions (for e.g., JNHT's Annual Earthquake Awareness, June 6th each year) as a tool to invite the world to participate in Port Royal. Further linkages can be made to other locally already established events so that the richness of the Jamaican culture can be truly experienced. 4. Creation of a Calendar of Events to provide visitors with options around which to plan. A Calendar of Events can also be a valuable marketing tool for greater international exposure and recognition. 5. Similarly, the generation of a daily itinerary of activities developed based on the historical and environmental value of the town. This would be beneficial for both encouraging return visitors as well as increasing demand for lay overs/connections. 6. Daily scheduled enactments and simulations as part of the historic attraction and/or town activities

Proposed Project Investment in Port Royal	Issues	Development Guidelines
		fostering inclusion between residents and tourists/visitors. 7. The creation of gift/souvenir shops for each attraction with handcrafted pieces relating to each site created by the local cottage industry. 8. Employment of residents – Hiring Port Royalists incorporates local stakeholders in the success of the development. 9. Transportation/Movement – Part of the Port Royal experience should include how visitors travel between locations in the town. Unregulated areas of parking and traffic congestion will not be in keeping with the Port Royal experience and can also cause negative environmental impacts. Multi-modal links are instead proposed, as this offers the potential for accessibility via both land and sea (e.g., ferry, shuttling). 10. Close collaboration between project contractors and the JNHT is necessary, and, where possible, the training of contractors is recommended, for example, in rudimentary artefact identification and recovery.
	Artefacts with important heritage/historical considerations Potential invaluable artefacts remain unrecovered, therefore there is risk not only associated with the potential destruction of these artefacts, but also theft of potentially newly discovered artefacts/valuables during project activities.	JNHT must have representatives on site, especially during the construction phases of the project. Some sites may also require additional security measures (for e.g., 24-hr security and/or CCTV) in the event of a major discovery.
	Long-term Impact on Heritage Sites and Assets	The Carrying Capacity Assessments for Port Royal and the offshore cays will help determine the maximum sustainable

Proposed Project Investment in Port Royal	**Issues**	**Development Guidelines**
	The economic benefits gained from conserving and managing heritage sites can ultimately lead to the deterioration of these areas if they are not well managed. For example, increased in-water activities from boat tours, snorkeling and/or diving can have deleterious effects on sensitive marine ecosystems. Similarly generated pollution from cruise ships and chemicals (for e.g., from cosmetic products like lotions and sunscreen) can affect the water quality and eventually disrupt the reproduction and growth cycles of marine organisms.	use and the level of activities that can be supported without causing significant harm to the heritage sites and surrounding ecosystems. This information can then help guide the development of a management plan for Port Royal based on the findings of the carrying capacity assessments. This plan should outline strategies and measures to ensure the sustainable management and conservation of the heritage sites while maximizing economic benefits. The development of pollution control measures may also be required, particularly in relation to cruise ships and the use of chemicals by visitors. Likewise, the establishment of guidelines for waste management, including the proper disposal of sewage, garbage, and hazardous substances is strongly recommended.
Fort Rocky Entertainment Zone	**Limited parking** Fort Rocky's current location (i.e., along Port Royal's only point of entry/exit) and surrounding environment (i.e., coastal/wetland vegetation in sandy substrate) do not provide for any sort of extensive parking options for patrons/visitors to the venue.	Shuttling to Fort Rocky is strongly recommended. Further consultations are required to determine the viability as well as the potential environmental impact of removing a limited area of the surrounding (mostly coastal scrub) vegetation to facilitate a parking area. Although no removal or any kind of disturbance of the area is preferred, an appropriate parking area is considered necessary to prevent unregulated parking, for example, along the road and/or in ecologically sensitive areas.
Waterfront Experience	**Anthropogenic-induced pollution** Poor water quality resulting from anthropogenic influences including catch and bycatch discard, sewage effluent discharge and garbage from storm water run-off are already issues that exist in this specific area.	i. Regular monitoring of fats, oils and grease ii. Regulations and guidelines for diving and snorkeling iii. Management of boating and yachting activities iv. Reconsideration of motorized vs. non-motorized sports v. Environmental impacts of motorized sports

Proposed Project Investment in Port Royal	Issues	Development Guidelines
	Natural Disasters (Earthquakes, Tsunamis, Hurricanes and Storm Surges) Port Royal, due to its geographic location and historical events, remains highly vulnerable to various natural disasters. The risks associated with these events are further heightened by the impacts of climate change, including sea level rise, global warming, ocean warming, and acidification.	i. Enforcement of general natural hazards adaptation and mitigation measures ii. Development of Hurricane Preparedness Plan(s) iii. Implementation of Climate Change Adaptation Measures (CCAM) iv. Enforcement of earthquake-resistant building codes v. Tsunami warning and education system
Conservation Areas – Port Royal Mangrove, Refuge Cay and most of the Port Royal Cays	**Water Quality** Water quality and pollution in Port Royal is expected to worsen during and after the proposed development, especially if the existing infrastructure is not updated. The water quality data indicated that areas with high levels of anthropogenic activity (for e.g., the Cruise Ship Pier and the Fishing Village) had high contamination by fats, oils and grease, microorganisms, as well as higher levels of turbidity and total suspended solids. Increasing human activities, especially in these areas, is expected to further amplify the contamination of surrounding waters and thus, further deteriorate water quality. Likewise, additional restaurants and other sources of pollution in the area will increase the likelihood of further contamination of the waterfront, particularly with fats, oils and grease, organic loading, and nutrients.	i. Proper management of sewage, trade and surface runoff into the sea is needed, and the possibility of reusing treated effluents to reduce coastal enrichment should be considered. ii. Proper monitoring and enforcement are needed to ensure that regulatory requirements are not breached should they be employed (e.g., the use of oil/water separators or grease traps; regular drain cleaning and maintenance). iii. The impact of an increase in water pollution with respect to the existing historical infrastructure and ecology should be carefully evaluated and the necessary planning done to mitigate any adverse impacts. iv. Preserve sensitive ecological areas such as hypersaline lagoons. The University of the West Indies' Port Royal Marine Laboratory (PRML) currently provides guided tours through the Port Royal mangroves and in Kingston Harbour. There is also a Biodiversity Centre that hosts interactive exhibits to facilitate continued interest and

Proposed Project Investment in Port Royal	Issues	Development Guidelines
	The hypersaline lagoons observed in Port Royal appear to be important ecological habitats for many species, therefore, disturbing these areas is not recommended as this can cause irreversible damage to these unique ecosystems.	learning. The creation of a Palisadoes Marine Park, to operate in conjunction with the PRML, can help bring solutions to any identified ecological problems.
	Insufficient details of proposed designs Design details for proposed conservation areas are not yet available. Detailed designs may entail removal and/or modification of the natural environment including habitats such as wetlands, sea grasses, coral reefs, and woodland areas. If wetland areas are removed/damaged during project activities, this could result in a loss of critical habitat and ecological services. The removal of mangrove forests may also result in the release of years of stored/sequestered carbon into the atmosphere (as CO_2).	i. To comply with the 'no net loss' policy adapted by NEPA, an ecological assessment will be required in areas proposed for removal or modification of wetland areas and/or other marine environments (e.g., seagrass) to support potential boardwalks. ii. Ecotourism activities can be enhanced if floral populations are adequately preserved; this will also lead to faunal populations being maintained. Recommended (sustainable) attractions for the area include establishing bird feeding and watering stations at strategic points to showcase birdlife in the area. Necessary buffers, prohibitive fencing, and signage are also recommended. iii. The treatment of the overall development in a wholistic manner is supported. For example, addressing solid waste, drainage, and sewage issues collectively, can lead to a cumulative benefit of preserving sensitive habits in the project area so that the community can benefit from a myriad of ecosystem functions along with the ecotourism benefit. iv. As with the development of the historic attractions, a body for oversight, approvals and monitoring is necessary to safeguard these initiatives. Consideration should therefore be given to the implementation of management offices for the

Proposed Project Investment in Port Royal	Issues	Development Guidelines
		proposed Marine Park to provide oversight of the natural environment of the protected area implementing both the Zoning and Management Plan of NEPA.
Port Royal Recreational Beach	**Planned Recreational Activities** There are some activities being proposed that may need to be reconsidered. For example, motorized and non-motorized sports such as kayaking/canoeing and jet skiing. These activities are not necessarily safe given the commercial use of the harbour for transshipment; as well as current Jamaican laws that prohibit the use of motorized sports. Similarly, swimming, diving, and snorkeling may also not be viable activities within most of Kingston Harbour.	While this area is not ideal for swimming or water sports, it is definitely an area that is suitable for lyming, picnicking, and other social gatherings. This could be supported by the provision of proper waste receptacles and a proper maintenance program for the cleanup of solid waste and old debris. Possibly, the area can also house a few temporary structures that can facilitate small commercial stalls, shops, or bars as well as park benches and t0ables.
	Transportation to/from beach and cays One potential issue associated with the increased usage of, and transportation between beach areas and the offshore cays, is the potential for an increase in transportation-related pollution. Transportation-related pollution refers to both solid waste pollution directly generated during transport (e.g., between land and cays), as well as air and noise pollution from vessels. Another (indirect) associated impact during transportation includes structural (physical) damage to benthic habitats and ecologically sensitive environments.	General measures recommended with respect to the coastal environment include the following: • Anchor buoys for vessels in key recreational areas (e.g., Lime Cay, Maiden Cay, Port Royal Beach, etc.) to avoid potential damage to the benthic habitats. • Signages to educate visitors on delicate and unique ecosystems as well as to guide visitors away from these sensitive habitats. • Development of proper management guidelines and practices to be implemented. For example, beach safety flags (green, yellow, or red) and marine life (e.g., jellyfish) safety flags (green or purple) could be utilized.

Proposed Project Investment in Port Royal	**Issues**	**Development Guidelines**
		• Adequate and regular garbage collection would be needed, especially with increased traffic on the beach. • Beaching of seaweed tends to be episodic, therefore management plans can be developed to coordinate clean-up efforts when such beaching occurs. • Development and implementation of nature-based ecotourism along the Caribbean-facing sandy beach at Port Royal, as well as several exposed offshore cays. This complements the history and culture-based plan. • Maximization of public and mass transportation or walking, to the beach. • Lifeguards are recommended to ensure swimmer safety.
Gunboat Recreational Beach and Marina Areas	**Recreational Fishing** Recreational fishing, while currently a popular activity in some areas along the Palisadoes strip including Gunboat Beach, can have negative impacts on fish populations and the overall ecosystem within the protected area. Overfishing and/or improper fishing practices, such as using illegal gear or catching undersized fish, can also disrupt ecosystem balance, and eventually lead to the decline of target fish species and other marine organisms.	Recreational fishing is not recommended at Gunboat Beach due to its situation within the Palisadoes-Port Royal Protected Area (P-PRPA). However, if recreational fishing were to be permitted, the following measures are proposed: a. Establish fishing regulations. b. Promote sustainable fishing practices. c. Monitor and enforce compliance
	Poor Water Quality Poor water quality conditions can impede any plans for swimming/diving and can likewise have detrimental effects on the health of marine	a. Enhance monitoring and water quality assessment. b. Improve wastewater management

Proposed Project Investment in Port Royal	**Issues**	**Development Guidelines**
	ecosystems, including coral reefs, seagrass beds, and fish populations.	
	High Boating Traffic High boating traffic can result in physical damage to sensitive habitats, disturbance to marine organisms, and increased risks of accidents or collisions within the protected area.	a. Establish boating regulations. b. Provide boater education and outreach. c. Improve boating infrastructure.
Port Royal Green Spaces	**Loss of critical habitat and services** Port Royal's natural environment includes extensive mangrove wetland forests, seagrass beds, and coral reefs, all of which provide diverse critical services to the area including (but not limited to): i. a habitat for a diversity of organisms (including endemic/threatened species) ii. a nursery/refuge area for larva and juvenile spp. iii. protection from storm surges (e.g., coral reefs and mangroves) iv. important carbon sinks (e.g., mangrove and seagrass) v. a food source for fauna (e.g., seagrass) Any alteration of the naturally occurring environment (for e.g., the loss or removal of such habitats) could therefore impact the critical services/functions they provide.	A mangrove restoration/compensation plan is recommended for development, as guided by the regulators (i.e., NEPA), to mitigate against any mangrove loss including inadvertent removal/destruction. Developers and stakeholders should also be required to conduct thorough environmental impact assessments for any proposed projects or activities in Port Royal. These assessments should evaluate the potential environmental impacts and provide mitigation strategies to minimize negative effects on the surrounding marine ecosystems. Strict adherence to these assessments will help ensure sustainable development practices and the protection of the area's natural resources.
Housing Solutions	**Geology and Soils**	It is recommended that there be full enforcement of both building height restrictions, as well as strictly ***no building*** in

Proposed Project Investment in Port Royal	**Issues**	**Development Guidelines**
	As mentioned in Section 4, the area is dominated by unconsolidated, sandy soil and noteworthy of mention is the considerably shallow (<5m) water table below the surface. This not only places restrictions on potential building designs for the proposed housing solutions, but poorly designed and maintained sanitation systems can potentially contaminate the groundwater resources in the area based on the soil permeability and water table depth. According to the Geotechnical Investigation conducted, most of the sites investigated will undergo minimal risk for the settlement of foundations, where it is expected to be short term and that most of the settlement would occur during the construction phase of the project. However, at borehole 9, in the vicinity of Broad Street and Queen Street (where there are plans to demolish the existing houses and rehabilitate the area), there is a high risk of excessive ground settlement. This excessive settlement poses a negative risk to the proposed construction of three (3) blocks, consisting of eighteen (18) apartments and nine (9) townhouses. The site proposed for the development of housing solution 'D3' could also be at risk of storm water settlement in its current state and poses additional risks relating to the transfer of stormwater to the nearby Port Royal Primary School and adjacent commercial entities. This is primarily due to the	some areas**. The following additional measures should also be considered:** i. Buildings should be appropriately designed to the typical ground acceleration forces anticipated. ii. Unconsolidated soils can have differential settlement during earthquakes and any buildings zoned for these areas will require a detailed site-specific geotechnical assessment to ensure the foundations are appropriately designed. Recommendations from the geotechnical assessment for foundation design should be adhered to. Otherwise, these locations should be avoided or maintained as green/open areas. iii. Groundwork, footings, foundations should all be designed considering geotechnical assessment and applicable building codes for the anticipated earthquake intensity and return period. Similarly, buildings and structures should conform to best practice design and construction for earthquake impact. Building foundations must also consider additional factors including (but not limited to) the general geology of the area, the water table depth, and the conditions of sub-surface materials. Geotechnical investigations should further inform building siting as well as designs. Where the findings of the Geotechnical Investigations warrant additional studies, these should be strongly considered. iv. Recommendations for grading on sites, D3, should be followed to reduce risk to the proposed construction and surrounding properties.

Proposed Project Investment in Port Royal	**Issues**	**Development Guidelines**
	topography, where there is a shallow depression on site and fill material present.	
	Topography The topography of the P-PRA is generally flat, as evidenced by frequent inundation in some areas, stagnant water, and multiple hypersaline ponds especially near low-lying, coastal areas. This, along with the predominantly sandy soil in the area will likely restrict some building designs and types in Port Royal.	The following measures are recommended to ensure that the challenges posed by the flat topography and sandy soil in Port Royal are addressed effectively, resulting in resilient and sustainable housing solutions that harmonize with the natural environment: i. Identify high-risk areas and establish appropriate setback distances to avoid construction in vulnerable zones (e.g., low-lying areas). ii. Engage architects and engineers experienced in working with flat topography and sandy soil conditions and integrate the natural topography into the design and layout of the development. iii. Implement appropriate drainage systems, including stormwater management techniques, to prevent water accumulation and ensure efficient runoff. iv. Since proposed residential housing solution lots are no greater than 4 hectares, lot level and conveyance controls such as roof-top storage, parking lot storage and green-area storage, could be implemented to detain stormwater and reduce peak runoff rates. v. Implement soil stabilization techniques, such as compaction, soil improvement, or reinforcement, to enhance the load-bearing capacity of the predominantly sandy soil. vi. Design and construct foundations that are suitable for the specific soil conditions, considering factors such as settlement, bearing capacity, and lateral stability.

Proposed Project Investment in Port Royal	Issues	Development Guidelines
		vii. Develop a comprehensive flood mitigation strategy that includes measures to minimize the impact of inundation events. viii. Implement coastal protection measures, such as the construction of seawalls or levees, or bioremediation measures (e.g., utilizing mangroves), to safeguard low-lying coastal areas from storm surges and tidal flooding. ix. Incorporate sustainable drainage systems (SuDS) to manage stormwater runoff, reducing the risk of stagnant water and improving coastal water quality. x. Implement strategies for water conservation and reuse to minimize the strain on freshwater resources. xi. Promote the use of permeable surfaces and rainwater harvesting techniques to enhance water infiltration and reduce the burden on drainage systems. xii. Educate residents, developers, and stakeholders about the challenges and opportunities associated with the flat topography and sandy soil.
	Faults and Seismicity Port Royal has experienced an active seismic history, including two major/catastrophic earthquakes in 1692 and 1907. Seismicity mapping in the area has indicated that there is a concentration of seismic activities in Jamaica's eastern parishes of St. Thomas, Portland, and Kingston and St. Andrew. It is unknown whether construction activities may induce further seismic vulnerabilities but based on the seismicity mapping	Building designs should mandatorily include considerations/adaptations for high magnitude earthquakes as well as their potential primary and secondary hazards (i.e., aftershocks, tsunamis). Emergency response plans should also be developed and implemented to guide the management of hazard responses during and after construction activities.

Proposed Project Investment in Port Royal	Issues	Development Guidelines
	conducted in the Baseline Assessment Report, as well as from historical evidence, there is high risk and likelihood of continued seismic activities after redevelopment.	
	Air Quality and Noise Areas with increased vehicular traffic or near main thoroughfares were observed to have higher levels of noise pollution and airborne particulate matter. These forms of pollution can impact the quality of life and health of people in the area. The phased development approach being proposed for the project means that construction may be ongoing in populated zones. It is also expected that there will be an increase in vehicular traffic, as well as commercial and domestic activities (e.g., trucking of construction material and heavy-duty equipment, burning of garbage, etc.). These activities will inevitably lead to an increase in both air and noise pollution.	The following guidelines are recommended to mitigate potential negative impacts on the air and noise quality in Port Royal as a result of the planned construction activities: • Continuous and adequate monitoring is recommended to ensure appropriate mitigative measures are being employed (e.g., dust screening, wetting of areas, etc.). • Designated times for construction activities should be implemented in order to minimize the impact of noise pollution on residents in the area. • Traffic management protocols should likewise be implemented to minimize the impact of both air and noise pollution in the area. • Stockpiles of construction supplies/materials should be covered to prevent airborne particulates, and properly burned where applicable. • Sediment screens may also be placed around areas where stockpiles of (covered) construction material are stored.
	Occupational Health and Safety Improper/Inadequate occupational health and safety measures during the construction and operation phases of the development could be detrimental to workers, employees, visitors, and the public in general. The magnitude of the proposed development presents a statistically higher likelihood of accidents and incidents where safety is at risk and therefore	Safety training must be provided to all construction workers and should be a requirement for all the individual work sites throughout the duration of the project. Most major industrial entities and large contractors in the country apply high safety standards and as such, models for implementation in the Jamaican context are readily available. This is an essential requirement for the

Proposed Project Investment in Port Royal	Issues	Development Guidelines
	warrants that these rules and principles be applied to all aspects of the development.	construction phase of the project and should be required for all entities that will access the project sites. Post construction, all entities must implement OHS protocols and should all have specific programs developed that provide training for the entire workforce. This is important for the safety of visitors and residents during the operational phases when the various tours become readily available for leisure and educational purposes. An Occupational Health and Safety Management Plan should be developed to outline the necessary management actions for both the proposed construction activities as well as the operational phases of the implemented activities. This management plan must be mandated. Appropriate signage should also be in place to identify the various risks and hazards on the site. Provisions of the required personal protective equipment must be made for all workers employed by the developer. Sub-contractors must also ensure that their staff are appropriately outfitted.
Physical Infrastructure	**Sewage and Wastewater Management** The existing sewage treatment plant at Harbour View is currently at maximal capacity, therefore, any new development in this area (i.e., Zone **A1**) must either provide its own treatment facility or expand the capacity of the NWC plant; the latter is recommended to avoid having multiple facilities. Zone **A2** (located along the Palisadoes Strip, between the Harbour View Roundabout and the Airport Roundabout) is regularly utilized by people for exercise and other recreational activities (e.g., cycling, catch-release fishing, etc.), particularly on the	Rather than the typical direct discharge of effluent into the harbour as now occurs at the airport plant, the effluent from the facilities should be discharged through the adjacent wetlands and/or used for irrigation along a practical length of the strip. This would significantly decrease and potentially eliminate any discharge directly into the already eutrophic Kingston Harbour. Discharge into the sea or south side of the strip is not recommended as seen from the example of the hurricane destruction of the outfall at the Harbour View plant.

Proposed Project Investment in Port Royal	Issues	Development Guidelines
	weekends. The parking area opposite the entrance to Gunboat Beach is similarly used for recreational purposes, as well as a waiting area for people awaiting flights but do not necessarily wish to utilize the paid parking system at the airport. There may be a need for public sanitary conveniences in these areas (Zone **A2**). Zone **A3** includes facilities such as the Royal Jamaica Yacht Club, the Caribbean Maritime University, and the now defunct Buccaneer/Gunboat Beach facility. Each facility has its own sewage disposal system including subterranean disposal systems in absorption pits. There are two recommended options for improvement of the disposal of sewage effluent in this zone (Zone **A3).** The airport complex, which represents Zone **A4**, already has its own sewage treatment facility, but could facilitate future expansion to receive additional loads from the adjacent area (Zone **A3**)**.** Fort Rocky, located in Zone **A5,** is approximately 2 km from the Cruise Ship Pier at Port Royal and it would therefore be impractical to pump sewage over such a long distance.	In Zone **A3**, the two options for improvement of the disposal of sewage effluent both recommend consolidating the waste streams and directing them to the same location for treatment. Fort Rocky (Zone **A5**) should have its own treatment system and the effluent could be distributed along the Palisadoes or discharged in a controlled manner through the adjacent wetlands, or used to create a wet area for plants that need higher levels of water than the dry/arid nature that the P-PRA provides. Most of the effluent would otherwise be subject to evapotranspiration. If similar recreational or parking areas are developed (i.e., as present at Zone **A2**), then public sanitary conveniences should also be considered in these areas. For waste disposal on the cays, the implementation of dry toilets is recommended. Dry toilets are both inexpensive and relatively efficient for locations like Port Royal with low water supply. These are commonly used in hunting lodges and in deep rural recreational locations and can be prepped and vented to eliminate the main physical detractions from the use of latrines. Wet disposal of sewage should be prohibited on all the cays as this may cause degradation of the water quality in close proximity; and further, the long-term consideration of emptying such systems when full may not be feasible. Disposing of composted solid waste is a much more practical option. Lastly, the planning authorities, (i.e., NEPA/KSAMC) should conduct an analysis of the projected development in the P-PRA with an aim of extrapolating the sewage management

Proposed Project Investment in Port Royal	Issues	Development Guidelines
		needs in Port Royal in the medium and long term. Subsequent approvals and implementation would then be guided by this analysis.
	Water Supply Port Royal is not connected to the island's central water supply system/network, but instead is essentially located at the end of a single node/line that serves the entire town. Water supply to Port Royal is currently delivered on a scheduled basis, this is further compounded by the absence of an alternate water supply option to Port Royal, therefore resulting in frequent disruptions for the entire area if or when there are water supply issues along any section of the main line.	A new 12-inch high-density polyethylene (HDPE) pipeline is planned for implementation from the Airport Roundabout to Port Royal and was expected to be in service by 2023. This should help to alleviate some of the water supply issues currently being experienced in Port Royal (for e.g., the delivery of potable water on a scheduled basis). The NWC may also wish to consider and prioritize rainwater harvesting and additional water storage regulations for new developments in Port Royal, for example, mandatory adaptations for rainwater harvesting and storage. A detailed Drainage Design and Plan needs to be prepared for Port Royal given the various developments being proposed in the Concept Plan. This should be submitted to the Municipal Corporation for approval to facilitate implementation in tandem with the proposed development activities. It would not be wise to further the construction and upgrade plans without ensuring that the road and drainage infrastructure are improved. The design should take into consideration climate change projections for the area, the inclusion of options for storm water management features as well as careful positioning of drainage outfalls away from sensitive ecological and social locations.
	Hydrology and Drainage	It is recommended that all new buildings constructed in Port Royal incorporate climate adaptation strategies (e.g., building on stilts to prevent flooding; hurricane- and

Proposed Project Investment in Port Royal	Issues	Development Guidelines
	The Palisadoes-Port Royal Area (P-PRA) is generally low-lying and therefore highly susceptible to flooding. To compound this the P-PRA lacks natural surface hydrological features and has a severely deteriorated stormwater runoff drainage system, which currently serves the entire town.	earthquake-resistant construction; etc.). The proposed redevelopment of Port Royal should also address restoring or improving the existing (deteriorated) drainage infrastructure in the town.
	Solid Waste Solid waste pollution is already an issue in Port Royal, and this is expected to be exacerbated during project activities. The main considerations relate to the collection of construction and related material, as well as domestic litter and waste from restaurants and shops.	These issues may be addressed with the placement of litter bins throughout the town in conjunction with regular collection, proper commercial disposal containers (waste skips) and the consideration of a transfer station on the outskirts of the town with waste compactors. This would not require regular trips by compactor trucks, which are frequently in inadequate supply, but instead, a transfer station with an appropriate number of storage bins and 'roll on, roll off' compactors that could significantly help address the needs of the town. An intensive program of plastic bottle separation and collection should be implemented as this would greatly help to improve the management of solid waste. The current proposal for solid waste in the Concept Plan includes improvements in collection, placement of receptacles and recycling. However, with a project of this magnitude, outside of these well needed improvements, there is an opportunity for using integrated waste management approaches such as composting, waste separation and recycling, and this needs to be considered at the design stage so that the necessary infrastructure or space requirements can be put in place. This waste management approach can also be integrated into any improvements of the drainage design for the town of Port

Proposed Project Investment in Port Royal	Issues	Development Guidelines
		Royal, to include grills over open drains to prevent the clogging of drains, which is currently an issue. Solid waste collection is not only required at various points throughout the town but also to ensure there are receptables located along the Palisadoes Strip, between the Harbour View Roundabout and the Airport Roundabout, which is regularly utilized by people for exercise and other recreational activities.
	Underground Lines for Electricity Supply Overall, the plan for electricity upgrades is a positive one for Port Royal. In laying underground lines, there are potential issues that can be associated with impeding pedestrian road users and vehicular traffic, potential concerns with health and safety of workers and road users as well as potential concerns with air quality and noise nuisance.	The upgrades anticipated for the area will require excavation to lay lines underground. It is important that the proper traffic management, stakeholder engagement, air quality measures are implemented and health and safety protocols, typical for construction operations are employed to ensure the safety of workers, community members and visitors as well as nearby business operators and residents.
	Telecommunications There has been no reports of telecommunication issues within the area. Residents have options for internet access within their homes as long as they can afford it. No issues were identified with the telecommunications plans for the area, but considerations are provided below to enhance access to locals and visitors.	Considerations could be made for the library service to be enhanced to house an internet café for persons who may not be able to afford laptops and internet service on a consistent basis. This would be particularly useful for students. Alternatively, as the area develops, commercial businesses could offer wi-fi services to customers, which would be useful for visitors in the area especially as cruise ship passengers are expected to increase.
Social Infrastructure improvements to: ➢ Community Centre	**Safety and Security** Port Royal is currently considered one of the safest communities in the KMA. Residents expressed concern that this could change with an influx of	The Police Station will most likely require increased manpower and improved infrastructure as the officers seek to serve, protect, and reassure both residents and visitors.

Proposed Project Investment in Port Royal	**Issues**	**Development Guidelines**
➢ Public Library ➢ Customs ➢ Post Office ➢ Schools ➢ Transportation	'outsiders' (i.e., non-residents). Another concern was the likelihood of increased small level crimes that will require increased police presence to assure the public that the community is just as safe as it was prior to the development.	
	Location of Emergency Services There is a Police Station and a Fire Brigade Station (with no operational fire truck at the time of report) located along Port Royal's southwestern coastline. This location, at the prime waterfront of the community, has long been challenged by the PRDCL as it compromises the heritage veneer of the community in that location.	Although redesigned and still relatively new, these services are recommended for relocation to occupy a more centralized area.
	Vehicular Traffic/Congestion It is likely that road use will increase significantly creating potentially negative cumulative impacts associated with safety, noise, air quality, and traffic management. There are unknowns related to expected visitor traffic once the additional housing accommodations are constructed, the waterfront experience and boardwalk are established, the historical sites are fully upgraded to increase tours and the ferry is re-established as another means of transportation.	Traffic impacts will require detailed assessments for both the construction and operations phases of the project. These assessments will need to be conducted and a Traffic Management Plan prepared to guide and inform the transportation and upgrade plans for the town. Controlled parking can also be considered in the Traffic Management Plan. Traffic volumes and patterns may also need reassessment once the entire project is completed.
	Parking Parking in Port Royal may become increasingly more challenging as the development occurs and the town itself receives more visitors. This may create a negative impact on the daily lives of existing residents when they need parking for their own domestic events (for e.g., birthdays, weddings, and other gatherings).	Remote parking should be introduced and enforced to reduce or eliminate vehicular traffic in the town, with only exceptions for Port Royal residents, employees, deliveries, and emergency vehicles. The existing commercial spaces can be used as overflow parking areas for residents, but all other visitors to PR should utilize the proposed shuttle service. Such a shuttle system could be carried out by

Proposed Project Investment in Port Royal	Issues	Development Guidelines
	The use of the roadways by children may also become less safe with a high volume of visitor traffic.	shuttle buses, wheeled trams, or a small rail system which would become part of the attraction of the town. Sidewalk and side street parking should be prohibited.
	Availability of Local Labourers Redeveloping a community such as Port Royal will require both the construction of new buildings, as well as renovation or refurbishment of existing infrastructure (e.g., housing, pipelines, sewage, etc.). This will therefore require both skilled and unskilled labour, and it would be prudent – and perhaps more efficient – to employ and involve local (PR) labourers for the project. The surveys conducted in the community however highlighted the 'reluctance' of many residents to become involved in non-fishing related employment. This viewpoint was observed and expressed across multiple age ranges and both sexes. Additionally, multiple business owners reiterated that they rely on 'drift coconuts' (i.e., outsiders) for their labour supply as residents are either unwilling to work or have poor work ethics. Another related issue pertaining to local labour is the potential for contention between residents and outsiders over job preference and availability.	v. Preference should be given to Port Royal residents, where possible, for both skilled and unskilled labour needs pertaining to the project. vi. The use of mostly local labour could also help alleviate already existing parking issues in the town as fewer outsiders (e.g., non-resident labourers) would require parking spaces inside the town. vii. During project activities, consideration should be given to transporting outside workers into Port Royal, for example, using designated buses. Likewise, construction of temporary structures should be considered to house labourers and help reduce the cost of transporting workers to and from location, over the long term.
	Impact on Local Businesses and Community Amenities The redevelopment of Port Royal is not only expected to increase daily traffic into the community (e.g., from visitors as well as labourers), but such an influx of people will ultimately need to be fed and provided for. This is expected to increase demands on the mostly small and medium-sized businesses in the community,	viii. The establishment of a liaison officer to communicate labourer/worker needs with various business owners is recommended. Involving community residents in decision-making could help to reduce the negative impact that may result from not having access to key recreational areas. It is important to encourage participation as residents can assist with alternate options.

Proposed Project Investment in Port Royal	Issues	Development Guidelines
	as well as the already limited amenities/infrastructure (for e.g., public bathrooms). There was a similar situation in the past following the opening of CMU's Port Royal campus, which resulted in a scarcity of (cooked) food and water inside the town, especially during select hours (e.g., midday to 2 p.m.).	ix. Another measure for consideration is to ensure that not all development activities that will impact access to recreational spaces and activities occur at the same time. This is important so that visitors may have the opportunity to engage in leisure and/or physical activities. x. The development of a niche goods/services market is recommended to cater to specific needs within the town (for both residents and workers) during the various phases of project activities.
	Awareness of the Proposed Plans The surveys conducted in the community indicated that 92% of respondents were not aware of the Port Royal development plan. Of those who reported awareness, 25% were able to state three things they knew about the plan. Residents further indicated that no housing development plan was provided, and that they learnt about the development plan either from another resident or the Community Development Committee. If residents are not made aware and kept updated of the plans for the community, this could negatively impact the activities associated with the development.	The planners should liaise with the community groups such as the Benevolent Society, the schools, and churches to keep residents informed on a regular basis until the plans have been implemented. It may also become necessary to: i) set up Notice Boards around the community, ii) establish social media groups, if they don't already exist, as well as iii) place paper notices in mailboxes or under doors. Information dissemination should be consistent before, during, and after project activities.

Positive Impacts

The proposed redevelopment of the Port Royal area is expected to significantly contribute to the tourism product in Jamaica by improving well-needed infrastructure as well as marketing recreational activities that highlight the area's unique history and culture. The predominant goal for Port Royal's redevelopment is predicated on "retention, sensitive restoration and careful repair". The Sustainable Master Plan seeks to achieve multiple objectives which include:

- Improving/upgrading critical infrastructure (e.g., sewage, stormwater drains, etc.).
- Developing a niche tourism market.
- Marketing leisure activities highlighting the community's unique heritage and culture.
- Attracting tourism investment that will enhance the existing community assets; and
- Developing products that will attract residents to stay in the small community and visitors to return.
- Housing solution serves to improve living conditions for residents.
- The project investments will also result in the aesthetical enhancement to the project environment.

The following are some positive impacts expected from the development proposed for the Port Royal project area, based on the multidisciplinary studies conducted:

i. Based on the coastal dynamics study, particularly the numerical wave modelling, the sandy beach (near Foreshore Road) is well protected by the barrier reef and offshore cays, with waves typically lower than 0.5 m. The beach is also quite wide (notably wider than most beaches on Jamaica's south- and north- coasts) and can be characterized as stable to accretionary, with no apparent trend of erosion under existing conditions.

ii. The offshore cays, including Lime Cay and Maiden Cay, are in relatively close proximity to the mainland and therefore can potentially provide recreational amenities such as swimming, snorkelling/SCUBA diving and ecotourism. The relatively large Lime Cay especially is potentially capable of accommodating a considerable number of visitors however these exact numbers will be determined during the concurrent carrying capacity assessment.

iii. No mitigation measures are needed to widen/stabilize the (Foreshore Road) beach at present, however, adequate maintenance and safeguarding may be needed in the near future (for e.g., lifeguards and ancillary staff). Such maintenance and supporting activities could also potentially provide much needed employment for Port Royal residents.

iv. Grassy verges, in conjunction with the conservation of mangrove wetland forests will help enhance surface percolation and shoreline protection respectively. Fulfilment of setback requirements for shoreline facilities should also help mitigate against risks from storm surge and wave action. Sedimentation control devices can also help reduce/control the levels of siltation in nearshore coastal waters.

v. An integrated water management approach will facilitate consideration of water consumption, sewage disposal, recycling, and reuse as part of water use efficiency and pollution prevention in the project area.

vi. With respect to the biological environment, improving/ upgrading the sewage network system will have beneficial impacts on the marine environment through the reduction of land-based pollution. The maintenance of mangrove wetland forest areas, including large diameter trees will continue to provide critical ecological services including as a habitat, food source and for carbon storage. These measures are highly beneficial for habitat protection, aesthetic appeal, and watershed management.

vii. The opportunity exists for entrepreneurs within the community to 'set up shop'. In other words, opportunities exist for micro and small businesses to become established so that both residents and outsiders may benefit. This will require assessing the needs of those who will be residing and or working in Port Royal when project activities commence.

viii. Most residents are in favour of the proposed development plans for the community, according to the socio-economic survey that was conducted in 2022. This is a positive reflection of their acceptance of the Master Concept Plan.

Other Environmental Requirements

In addition to the legislative and regulatory framework that will need to be adhered to, the Consultants further recommend advanced preparation to ensure the developers are aware of the potential planning and environmental requirements that may arise during the proposed phases of the project. There is a list of Government Agencies that need to be contacted to follow through with the development plans as well as a list of permits and licences that will need to be acquired to facilitate some of the project investments. The key approvals necessary are listed in Table 2 below.

Table 2: Indicative List of Environmental Approvals, Permits and/or Licences

Agency	Approval, Permit and/or Licence
Ministry of Security	Immigration and Customs Facilities
NEPA	Beach Licences (for foreshore modification, dredging and coastal works, recreational use)
NEPA	Licence to Construct Sewage Treatment Facility
NEPA	Licence to Discharge Treated (Sewage or Trade) Effluent
NEPA	Licence for Storage of Petroleum Products
NEPA	Mangrove Modification/ Reclamation Permit
Parish Council	Subdivision Approval

1 Introduction

1.1 Contextual Background

Port Royal is a unique, multi-faceted land use region located on the south-eastern coast of Jamaica. The area is of historical, environmental, and geographical importance, with undeniable tourism appeal. At present, the town is one of the few places which preserves the ruins and relics of the island's involvement with pirates, buccaneers, and European trade. Surrounding these ruins are several residential communities and just off the coast are various cays and marine ecosystems, including seagrass, sand dune, coral reef, and mangrove communities, all of which encourage tourism, support livelihoods, and sustain the town's characteristically fisherfolk composition. Restoration of some key areas and aspects of Port Royal has already begun, but it is considered necessary to create a Master Plan for the town and its surroundings to help preserve and promote its historical, cultural, environmental, and geographical importance.

To protect the area in its entirety and uphold its natural value, the area was demarcated as the Palisadoes-Port Royal Protected Area (P-PRPA) in 1998 (Natural Resources Conservation Palisadoes-Port Royal Order, 1998), and subsequently designated as a Wetland of International Importance (i.e., Ramsar Site) and Waterfowl Habitat in 2005. Historical sites including the *Sunken City*, Fort Charles and the Old Naval Hospital are also protected under the Jamaica National Heritage Trust (JNHT).

1.2 Purpose

In 2018, several significant initiatives for Port Royal were announced, including construction of a new Port of Call by the Port Authority of Jamaica (PAJ); application for the designation of Port Royal as a UNESCO World Heritage Site; and initiation of new investments in Morgan's Harbour Hotel. Against this background, the Government of Jamaica (GOJ) mandated the Urban Development Corporation (UDC) to create a Master Plan for Port Royal and the larger Palisadoes area to guide the redevelopment of this critical zone.

ESL Management Solutions Ltd (ESL) has been contracted by UDC to conduct and prepare the Strategic Environmental Assessment (SEA) of the Master Plan, to include carrying capacity and geotechnical analyses. This document represents the Strategic Environmental Assessment Report, Deliverable 3, according to the contractual obligation. The Report has been informed by the Terms of Reference (TOR) accompanying the contract; a literature review of wide-ranging documents, some provided by the UDC as well as other supporting documents gleaned by the consultants; stakeholder consultations; detailed site assessments; and importantly, discussions with UDC; and feedback received on the previously submitted Deliverables 1 and 2.

1.3 The Consultant's Mandate

The Terms of Reference provided to the Consultants state that the primary objectives of the consultancy are as follows:

1. To undertake a Strategic Environmental Assessment (SEA) that will include a Social Impact Assessment of the Sustainable Port Royal Concept Plan.

2. To conduct a carrying capacity study of various zones within the Port Royal and Palisadoes area based on the Sustainable Port Royal Master Plan.
3. To conduct a geotechnical assessment and density studies within the Port Royal area.

The main activities to be undertaken by the Consultants during the SEA include the following:

1. Identify issues of concern through the collection of baseline data, which will include environmental, social, heritage, cultural and economic considerations.
2. Evaluate the public's perception of the proposed concept plan for the Port Royal-Palisadoes area.
3. Assess the Legislations and Regulations (national and international) relevant to the project's implementation.
4. Extrapolate the likely impacts of developments (for example, the Port of Call) on the Port Royal and Palisadoes area, including direct, indirect, and cumulative impacts, in conjunction with their relative significance to the physical, ecological, cultural, and socioeconomic environments.
5. Identify mitigation action(s) to minimize adverse impacts, both natural and anthropogenic.
6. Quantify the associated costs for implementation of proposed mitigation action(s).
7. Identify the specific climate change impacts that will affect each historical site (including the sunken city) and recommend possible adaptation measures that should be implemented to ensure resilience.
8. Design a Monitoring Plan which should ensure adherence to the mitigation plan.
9. Describe the alternatives to the Sustainable Port Royal Concept Plan that could be considered within the study site (including 'no-action').
10. Assess the impact expected from an influx of tourists in the town as a result of cruise ship vessels with a capacity of 2,500–3,000 passengers at the proposed Port of Call.

The carrying capacity study will specifically include:

1. Assessments as follows:
    a. **Physical Carrying Capacity**: This is a measure of the number of persons that an area can physically accommodate within a given time.
    b. **Ecological Carrying Capacity**: This is defined as the stress that an ecosystem and its resources can withstand in terms of the number of visitors or activities before its ecological value becomes negatively impacted.
    c. **Social Carrying Capacity**: This is a measure of the crowding tolerance, i.e., the maximum visitor density at which patrons will feel comfortable and uncrowded, which also affects visitor satisfaction.
    d. **Economic Carrying Capacity**: This measures the extent to which an area can be altered before the economic activities that occur in the areas are adversely affected.
2. Identification of the existing and potential impacts of recreational and associated activities on the natural resources in the proposed development area and mitigation measures based on activities that currently operate within the Port Royal community while also highlighting the impacts of the future planned developments within Port Royal.

3. Indication of the optimal physical, ecological, and social carrying capacity for recreational and associated activities, and limits of acceptable change within Port Royal considering the proposed increase in visitors to the area (e.g., cruise ship passengers, etc.).
4. Preparation of guidelines, strategies, and actions for the effective management of the current and planned recreational and associated activities within the proposed development area.
5. Identification and collation of all available technical information and data of the proposed development area and the preparation of a report identifying the gaps in data and information required to conduct the carrying environmental capacity study.
6. Review of current visitor data (where available) and determination of numbers during peak/off-peak periods.
7. Review of the environmental baseline analysis and public perception assessment prepared from the undertaking of the SEA with a view of making recommendations to the proposed comprehensive development plan.
8. Conduct an inventory of the occurrence, numbers, patterns, and concentration of recreational and associated activities in the proposed development area. The inventory will be conducted during regular and peak use periods (for example, weekends, public holidays, and potential cruise ship days) as well as during special events.
9. Review the profile of recreational and other uses of the proposed development area, including proposed development with a view to:
    a. Determining perceptions of crowding, risk, and safety, natural resource, and economic impacts, quality, and degree of satisfaction with recreational and associated activities for the proposed development area.
    b. Identifying and examining the current management, institutional arrangements/ responsibilities, and existing and potential impacts of recreational and associated activities on the natural resources of the proposed development area and providing recommendations for mitigation measures.
10. Design and administer survey instruments to obtain opinions from operators, visitors, and management agencies regarding implementation of mitigation measures and/or management strategies to improve services within the proposed development area.
11. Identify the number of existing businesses and also visitors to the area.
12. Identify indicators of environmental, social, and economic conditions which should reflect changes in the use of the proposed development area.
13. Identify the potential range of recreational/commercial opportunity zones within the proposed development area.

1.4 The Sustainable Port Royal Master Plan (SPRMP)

Development of the SPRMP has been taking place over a few years and this iteration has encapsulated aspects of previous Master Plans which were produced between 1964 and 2009 with the **1993** and **2009** plans being the main reference documents. The SPRMP is being informed by the Sustainable Port Royal

Concept Plan which was the first output of the planning phase and outlines the goals and objectives of the SPRMP.

1.4.1 Redevelopment Goals and Objectives

The redevelopment of Port Royal will be aligned to the goals and objectives that were outlined in the Downtown Kingston and Port Royal Redevelopment Plan 2030, which was completed by the UDC in 2013. These goals and objectives include:

- Arresting physical and social blight within the development area and beyond
- Improving the economic and social conditions of the citizens
- Defining the capital city's status as the seat of government while establishing Port Royal's well-deserved importance to Jamaica and the world in general
- Improving the existing environmentally sensitive infrastructure
- Implementing mitigation and adaptation measures to guarantee resilience to natural and anthropogenic climate change.
- Creating the impetus for public/private investments
- Creating an environment that is safe and secure.
- Implementing measures to facilitate open participation of Port Royal residents, citizens at home and in the diaspora, and other stakeholders, in the redevelopment process.
- Protecting, preserving, and promoting the cultural heritage assets for use by present and future generations
- Protecting and preserving the natural environment
- Creating an inclusive and diverse atmosphere with amenities to attract both locals and visitors.

1.4.2 Specific Objectives – Sustainable Port Royal 2020

The specific objectives have the following targets:

- To develop a niche tourism market to include leisure travel, cultural tourism and ecotourism.
- To market leisure activities that highlight the area's unique heritage, culture, culinary, and natural resources
- To attract tourism investment to guarantee year-round product offerings that will augment the existing community and visitor assets.
- To develop existing products, services, and activities to retain residents and keep visitors continually returning.

It is important to note that the SPRMP is aligned to Vision 2030 Jamaica – National Development Plan and specifically to Goal 4 which addresses a healthy natural environment for Jamaica.

1.5 Summary of the Sustainable Port Royal Concept Plan

The UDC has reviewed the past plans and various assessments for Port Royal and has developed and finalized the comprehensive **Sustainable Port Royal Concept Plan** guided by "*the best of what was proposed for Port Royal in the past*". This final Concept Plan seeks *to "facilitate sustainable investments in Port Royal's heritage attractions, natural environment, and the town of Port Royal including its residents, to transform the town into a viable* ***Cultural Heritage Town****".* As indicated in the TOR, to facilitate this,

there have been proposed upgrades of infrastructure, public amenities, housing, and the generation of greater economic activity while focusing on the sensitivity of the environment. Attention will also be given to potential areas for entertainment, supporting a Port of Call, and a comprehensive look at mobility options for the area, subject to carrying capacities and environmental impacts.

The Plan outlines the area of development, the redevelopment objectives and goals, and the principles underpinning the projected sustainable outcome. The commitment to Heritage Tourism is emphasized, and key issues of Port Royal's existing realities are presented in terms of both the natural and built environment.

The *Outline Development* for the P-PRPA is highlighted from perspectives of proposed land use, port development, historic sites and attractions, housing, ecotourism, other economic activity and very importantly, the infrastructural upgrade of public amenities. The approach to development oversight, including conservation, governance, and management of core heritage and natural assets, has been defined, and the Legislative Framework outlined.

Short-term aspects of the sustainable transformation of Port Royal have already begun to materialize, one such example being the opening of a floating dock system for the Port of Call by the Port Authority of Jamaica (PAJ) in 2019. This has allowed for the return of cruise ships to the Kingston Harbour, taking account of the ecological preservation of the sensitive Port Royal marine system, as well as the archaeological treasure of the *Sunken City.* Restoration of Fort Charles has also been successfully undertaken with added facilities for increased visitor traffic.

2 Legal and Regulatory Considerations

This section presents the legislations and regulations pertinent to the proposed Port Royal redevelopment. A list of key legislation and their relevance to the project are presented below. Further details of the review for each legislation are presented in Appendix I.

National Legislation – Natural Environment

- Flood-Water Control Act (1958)
- Watersheds Protection Act (1963)
- The Port Authority Act (1974)
- National Heritage Site (1999) under the Jamaica National Heritage Trust Act of 1985
- Natural Resources Conservation Authority Act (NRCA) (1991)
- Natural Resources Conservation (Ambient Air Quality Standards) Regulations (1996)
- Water Resources Act (1996)
- National Solid Waste Management Act (2001)
- Natural Resources Conservation (Wastewater and Sludge) Regulations (2013)
- Disaster Risk Management Act (2014)
- Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) (Amendment) Order (2015)
- Natural Resources Conservation (Permits and Licences) (Amendment) Regulations (2015)

- Climate Change Policy (2021)
- Master Plan for Sustainable Tourism Development (2002)
- Building Act (2016)

National Legislation – Built Environment

- The Port Royal Brotherhood Act (1952)
- Parish Council Building Act (1952)
- Town and Country Planning Act (1958)
- Land Development and Utilization Act (1966)
- Urban Development Corporation Act (1968)
- Housing Act (1968)
- The National Solid Waste Management Authority Act (2001)
- Building Operations and Works of Engineering Construction (Safety, Health, and Welfare) Regulations (1968)
- Public Health Act (1985)
- Public Health (Nuisance) Regulations (1995)

International Legislative and Regulatory Considerations

- Wetlands of International Importance (under RAMSAR Convention of 1971) (2005)
- UNESCO World Heritage Site Nomination (2019)
- Cartagena Convention (Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region) (1983)
- Biodiversity Convention

3 General Approach and Methodology

A multi-disciplinary team of key experts, including scientists (e.g., ecologists, archaeologists), engineers, urban planners, and socioeconomic specialists, was assembled to conduct the necessary gap analysis, which included resource assessment, generation of baseline data, determination of potential impacts, and recommendations for mitigation measures and development guidelines. The team utilized the Charette-style approach towards data gathering, analyses, and interpretation, whereby iterative investigations and discussions among the respective professionals, stakeholders, and primarily the UDC, helped to inform critical elements of the data analyses and interpretation. The detailed methodology for the Baseline Assessment has been elaborated below.

3.1 Project Inception

The project inception phase was useful for gathering valuable data as it was conducted Charrette-style by the entire project team, followed by a reconnaissance tour of the project area. Observations within the project area and *ad hoc* field consultations were likewise helpful for providing a general understanding of the project area.

3.1.1 Site Reconnaissance

Figure *3-1* below shows the entire Port Royal redevelopment boundary area as proposed by the UDC, which spans from the roundabout at Harbour View to as far seaward to include the various (coral) cays, namely: Gun Cay, Rackham's Cay, Lime Cay, Drunkenman's Cay, Maiden Cay, South Cay, and Southeast Cay.

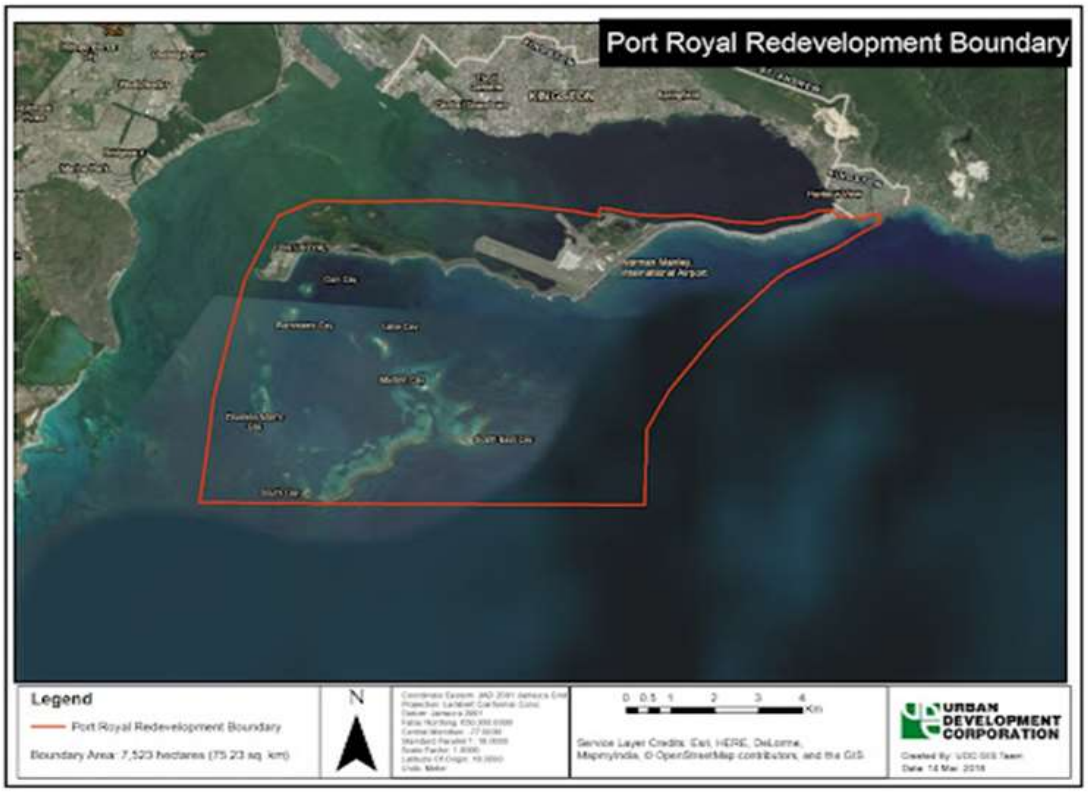


Figure 3-1: Palisadoes-Port Royal Redevelopment Area (Image source: UDC, 2021)

The site reconnaissance with the full consulting team was conducted on a Friday, June 17, 2022, between the hours of 10 a.m. and 4 p.m., which can be considered non-peak hours. The following locations were selected as strategic stops for observation and preliminary assessment along the P-PRPA.

Strategic Stops (chronologically as visited):

1. Roundabout by the Aggregate Company (Gypsum Pier)
2. Jogging trail and mangroves replanted area.
3. Gunboat Beach
4. Fort Rocky
5. Mangroves – Fort Rocky Lagoon
6. Old Naval Graveyard/Burial Site
7. Cruise Ship Pier*
8. New central sewage treatment plant*

9. Old Naval Dockyard
10. Port Royal (Morgan's Harbour) Hotel
11. Port Royal Brotherhood housing areas
12. Old Goal (women's jail)
13. Vacant lot at Love Lane/New Street
14. Vacant lot at Michelin Avenue
15. Gloria's (old & new)
16. Beach area by rocks and down past Gloria's (Foreshore Road)
17. St. Peter's Anglican Church
18. Old Naval Hospital
19. UWI Port Royal Marine Lab (PRML)
20. Fort Charles
21. Giddy House
22. South-East housing area (Foreshore Road) and Housing Agency of Jamaica (HAJ) lands

*-unable to access

3.2 Assessing the Existing Environment/Baseline Study

Following the project inception, the Consultants conducted detailed literature review and field assessments to examine the existing characteristics of the physical, biological, and socioeconomic environment in an attempt to document baseline conditions within the project boundary. Extensive studies have already been undertaken in the P-PRPA, which includes the Palisadoes tombolo, Kingston Harbour, and the offshore cays. Appendix II shows a list of some of the related key literature reviewed for this assessment.

Additionally, relevant legislation, regulations and standards were identified and reviewed with regard to the proposed redevelopment. National and local laws and standards governing environmental quality, development, safety and health, protection of sensitive areas, protection of endangered species, siting and land use control, land acquisition, among others, were reviewed and the relevant aspects reported on. The approach is further detailed below.

3.2.1 Physical Environment

3.2.1.1 Site and Situation

The location of the proposed development relative to geographic indices, existing developments and major transportation arteries was determined in order to identify the site and situational context of the Project. This was done using maps, plans, photographs and through a site reconnaissance.

3.2.1.2 Hydrology

Historical data on surface and ground water regimes were investigated using existing data from the Water Resources Authority (WRA) and other data sources where available. Aerial photographs were also examined to determine the nature and extent of the hydrology and drainage network in the area.

3.2.1.3 Coastal Dynamics Analysis

The Coastal Engineer undertook the following activities as part of the detailed assessment of the project area to determine the nature of its coastal dynamics:

1. A site investigation of the beach along the Norman Manley Highway was completed.
2. A site investigation of the barrier reef and two reef islands, i.e., Maiden Cay and Lime Cay, was completed.
3. Offshore wave conditions from 2005 to 2018 were extracted from the US National Oceanic and Atmospheric Administration (NOAA) WAVEWATCH III Caribbean-basin numerical wave-generation model.
4. Tide conditions in Kingston Harbour were extracted from a global numerical tide model.
5. Historical tropical storm data were extracted from the US NOAA historical hurricane track database. Initial analysis was conducted.
6. A numerical wave model extending seaward of the barrier reef was constructed.

7. A numerical water-level and flow model including the entire Kingston Harbour and the offshore areas was constructed.
8. A coupled wave and current model capable of computing sediment transport and morphology change was constructed.
9. Progressive model runs were conducted to simulate wave field in the study area.
10. Progressive model runs were conducted to simulate tidal circulation within the Kingston Harbour.
11. Progressive coupled wave-current model runs were conducted to simulate longshore current and sediment transport along the beach extending from Harbour View (east end) to Port Royal (west end).
12. Systemic numerical model runs.
13. The wave and flow patterns within Kingston Harbour were quantified.
14. Sediment transport along the Norman Manley Highway beach was measured.
15. Hydrodynamic and sediment processes at the reef islands (i.e., Lime Cay and Maiden Cay) were conducted.

3.2.1.4 Natural Hazard Risk

Assessment of natural hazard risks (e.g., flooding, hurricanes, seismicity, climate change and extreme weather events) were carried out through a review of relevant literature pertaining to climate, soils, geology and drainage, site assessment, and anecdotal reports on historical events from residents in the community. Some of the reports included but were not limited to reports produced by The UWI Mona's Seismic Unit and Climate Studies Research Groups.

3.2.1.5 Climate and Climatic Change

Data for Jamaica and the parish of Kingston and St. Andrew were compiled to present an overview of the typical climatic parameters in the project area. Precipitation, relative humidity, ambient temperatures, wind speed and direction, sea level rise, and storm surge impacts were assessed based on data from the Meteorological Service of Jamaica. Climate change projections as they related to rainfall characteristics were also examined.

3.2.1.6 Air Quality, Noise and Water Quality

An assessment of the physical environment was conducted in and around the Port Royal community to determine the direct and indirect project-related risks and impacts related to water, wastewater, air, and noise. Sampling and assessments were conducted at various points within the proposed project development area. Several water quality sampling sites were taken within the Kingston Harbour, within the Port Royal community, along the coast of the Palisadoes peninsula, and offshore around the surrounding cays. Noise and air assessments were done at sites within and around the Port Royal community including at the Old Naval Hospital, the Port Royal police station, the Grand Hotel Excelsior, the Port Royal Primary and Infant School, Fort Charles, the Port Royal Pier, Seascape Guard House, 1 Sea

Way Drive (beside the Port Royal 7th Day Adventist Church), the Port Royal Cruise Ship Pier and the Harbour View Roundabout.

The environmental assessment included the quantification of particulate matter (PM_{10}), NO_x, SO_x levels, noise surveys and water quality assessments for several physical, chemical, and microbiological parameters.

3.2.1.6.1 Quality Assurance

For all water samples, a quality assurance (QA) and quality control (QC) plan involving all aspects of the proposed project was instituted. This QA/QC plan forms an essential first step in generating data of the highest quality and reliability. The program comprised the care and calibration of field equipment, as well as the collection and preservation of the samples collected. Information on the description, location, and Global Positioning System (GPS) coordinates of all water samples was documented, along with the ambient conditions at the time of collection or at the beginning of the sample exercise.

The quality control procedures used in the laboratory for the analyses of water samples included the testing of blanks, reference standards and duplicates, as well as the utilization of verified standard analytical methods. In all cases, appropriate Chain of Custody (CoC) records were prepared and maintained for analytical samples. All containers were properly labelled, individually packaged, stored, and transported in a cooler, maintained at the appropriate temperature.

Where parameters were not analyzed in-house, laboratories with similar QA/QC regimes were engaged and were also monitored to ensure that data of the highest quality were received.

For the air quality assessment and noise survey, all equipment was calibrated prior to and after use and, where applicable, field blanks were used for quality control purposes. Monitoring devices were placed away from any known sources of pollutants to prevent bias in the data collected. Detailed observations were made at all sampling stations, which were georeferenced for traceability and for all monitoring requirements.

3.2.1.6.2 Water Quality

Water quality assessments were conducted to determine the existing quality of the marine, surface, and wastewater in and around the Port Royal area prior to the execution of the redevelopment project. These assessments were also used to identify and assess impacts to the waterway and any environmental receptors which would be in the sphere of influence of the proposed development.

A total of thirty-five (35) grab water samples were collected during the sampling exercise and analyzed for the following parameters listed in *Table 3-1*.

Table 3-1 Water quality parameters assessed for Port Royal sampling sites.

Parameter (units)	Code	Parameter (units)	Code
Total Nitrogen (mg N/L)	**TN**	**Arsenic (µg as/L)**	**As**
Nitrates (mg NO_3^-/L)	**NO_3^-**	**Chromium (µg Cr/L)**	**Cr**
Total Phosphorous (mg P/L)	**TP**	**Cadmium (µg Cd/L)**	**Cd**
Orthophosphates (mg PO_4^{3-}/L)	**PO_4^{3-}**	**Copper (µg Cu/L)**	**Cu**
Biochemical Oxygen Demand (mg O_2/L)	**BOD**	**Mercury (µg Hg/L)**	**Hg**
Faecal Coliforms (MPN/100mL)	**FC**	**Lead (µg Pb/L)**	**Pb**
Faecal Enterococci (MPN/100mL)	**F. Ent**	**Zinc (µg Zn/L)**	**Zn**
Total Suspended Solids (mg/L)	**TSS**	**pH (pH units)**	**pH**
Turbidity (NTU)	**Tur**	**Dissolved Oxygen (mg O2/L)**	**DO**
Fats, Oil & Grease (mg/L)	**FOG**	**Total Dissolved Solids (mg/L)**	**TDS**
Total Alkalinity (mg $CaCO_3$/L)	**Alk**	**Salinity (ppt)**	**Sal**
Chlorophyll a from Phytoplankton *(Only conducted for water collected from cays)*		**Conductivity (mS/cm)**	**Cond**

The water quality sampling sites were selected as outlined in the proceeding section (see Sampling Methodology below), and the assessment had the following major objectives:

1. To assess the current water quality along the coast surrounding the Palisadoes peninsula, as well as surrounding the neighbouring cays
2. To assess the impact of current activities (e.g., agricultural, fisheries, residential and tourist) on the aquatic environment in Port Royal prior to the proposed redevelopment activities
3. To make recommendations for monitoring and management of existing water resources in Port Royal based on the proposed project activities.

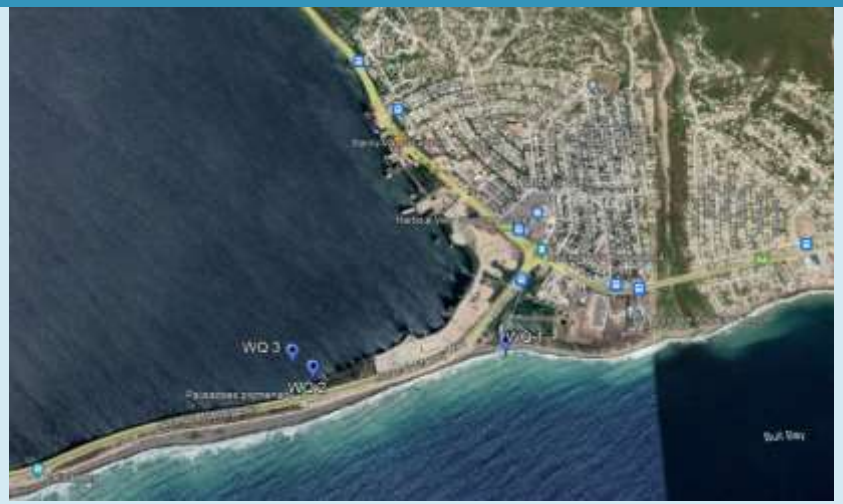
Limitations

The team was unable to access the site: 'WQ4' due to extensive/dense mangrove coverage, which prevented access to the interior forest where the site was located. Similarly, water quality conditions at Southeast Cay were not assessed due to unfavorable weather (sea) conditions during the sampling exercise. Lastly, the data generated from the Total Nitrogen analyses for the marine samples will not be presented or discussed due to significant matrix interferences which would require further investigation.

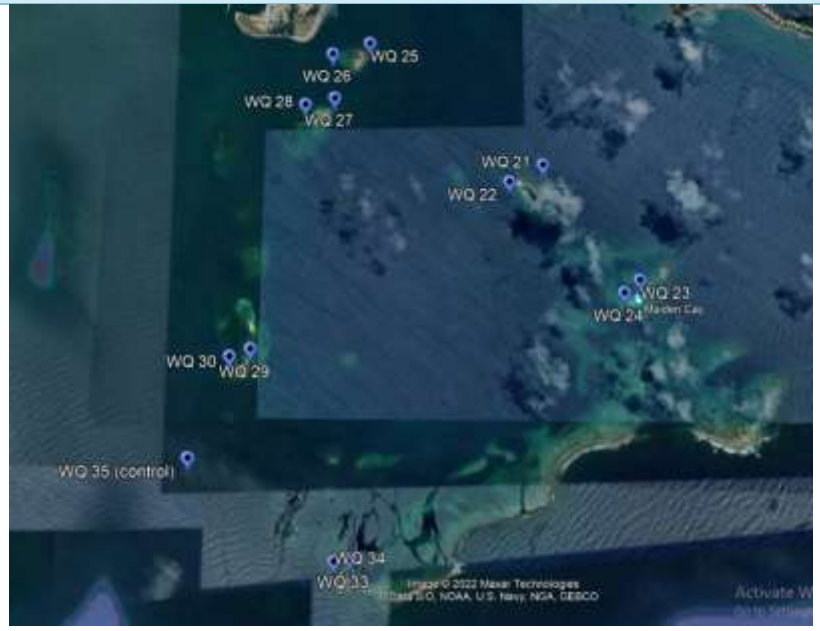
Sampling Methodology

Field observations and *in situ* measurements were made with respect to smell, colour, pH, dissolved oxygen (DO), salinity, conductivity, total dissolved solids, and (surface) water temperature at each site. Salinity, temperature, conductivity, total dissolved solids, pH, and dissolved oxygen were measured using a YSI ProPlus Model Multi-parameter system (MPS). All samples collected were kept between 0-4°C and transported to the internationally accredited (ISO/IEC 17025:2017) Quality and Environmental Health Laboratory at Environmental Solutions Ltd. for analyses, with consideration for the analysis hold time for each test parameter. Water quality results were compared to Jamaica's National Resource and Conservation Authority's (NRCA) Ambient Water Quality Standard - Marine Water [1] and Sewage Quality [2] Guidelines. The location and general description for the water quality sites are provided in Table 3-2 below.

Table 3-2: Location and general description of water quality sites

General Description	Location of Water Quality Sites
• Located offshore, south of the existing sewage plant near Harbour View Roundabout (WQ1) • Mouth of drain entering Kingston Harbour area to the north of Palisadoes promenade (WQ2) • Bay area north of Palisadoes promenade (WQ3)	
• Tidal Pond/upwelling area south of Old Cemetery on Norman Manley Highway (WQ4 and WQ5)	

General Description	Location of Water Quality Sites
• Tidal pond/upwelling area south of new Cruise Ship Pier (WQ6, WQ7 and WQ8) • Bay area north of Norman Manley Highway near suspected discharge area from sewage treatment plant (WQ9) • Bay area immediately surrounding Port Royal Cruise Ship Pier (WQ10) • Bay area to the north of Grand Excelsior Hotel, Port Royal (WQ11)	
• Drain/gully in the south of Port Royal community (WQ12) • Sewage discharge wetland in the north of Port Royal community (WQ13) • Offshore to the south-east of Port Royal Beach (WQ14) • Offshore Naval Hospital south of Sunken Pirate City Area (WQ15) – Extensive algal growth observed in water. • Offshore Coast Guard Facility (WQ16) • Offshore fishing area north of Sunken Pirate City (WQ17)	

General Description	Location of Water Quality Sites
• Offshore to the west of Port Royal Point (WQ18) • Offshore southeast of Port Royal Point (WQ19) • Further offshore southwest of Port Royal Point area – control sample (WQ20)	
• Offshore to the East and West of all cays (WQ21–WQ34) • Further offshore Southwest of the cays – control sample (WQ35)	

3.2.1.6.3 Air Quality

An air quality assessment was conducted to collect data on concentration of respirable particulates (PM_{10}), nitrogen oxides (NO_x) and sulphur oxides (SO_x) in the proposed project area. Air quality measurements were taken at eight (8) sites along main routes leading to and from the proposed project site, as well as at other strategic locations within the Port Royal community. Locations with a strong likelihood of being affected by changes in air quality (i.e., sites considered sensitive receptors such as schools, health centres, historic/tourist sites, and residential areas) were considered for this exercise.

Particulate Matter, NO_x, and SO_x

Particulate matter refers to small solid or liquid particles suspended in either a gas or liquid medium. The size of these suspended particles not only determines their lifespan in the atmosphere, but also the possible effects if particulates are inhaled by individuals. The particle size range of greatest concern to human health lies between 0.1–10µm and is referred to as respirable particulates (PM_{10}). The effects of the exposure of PM_{10} on human health include, but are not limited to, adverse impacts to the respiratory system, damage to lung tissue, cancer, and premature death. The extent of these effects can be influenced by different factors including the age and health of the affected individuals, as well as the period of exposure. To minimize the potential impact of particulate matter on the health of people and the environment, the United States Environmental Protection Agency (US-EPA) [3] and the National Environment and Planning Agency (NEPA) [4] have published air quality standards that outline recommended maximum daily concentration limits (i.e., values should not exceed 150 µg/m^3).

Particulate matter was measured using calibrated air pumps (with flow rates between 2–15L/min), attached to pre-weighed Polyvinyl Chloride (PVC) filters. The pumps were calibrated before use with a factory calibrated primary flow meter from Bios International Corporation. In the field, the pumps were placed at the approximate respiratory height of the individual/s for a 24 (± 4-hour) period. After the 24-hour sampling period, the pumps were collected, and the filters returned to the laboratory where they were then stabilized and weighed to determine a Time Weighted Average (TWA) value for the particulates.

Variation in the air quality within the project areas was expected due to factors which may include, but are not limited to activities such as:

- an increase in vehicular activities
- an increase in construction, commercial and industrial activities.

As such, the placement of the pumps was varied based on the type of information required. For example, some pumps were placed in locations such as (atop) residential rooftops – to capture what would be the direct exposure to individuals – while others were situated to capture the population/general exposure, such as at schools and in communal areas along the roadways. Results generated were compared to the aforementioned (NEPA and US EPA) Ambient Air Quality Standards.

Concentrations for the oxides of sulphur, nitrogen, and carbon monoxide were measured actively using a calibrated GrayWolf Advanced Sense Pro IAQ Plus Indoor Air Quality Survey & Monitoring Kit, with DirectSense II Probe, retrofitted with the following sensors: SEN-SMT-VOC-PPB smart PID TVOCs, SEN-SMTX-CO2 smart, NDIR Carbon Dioxide, SEN-SMTA4-CO smart EC Carbon Monoxide and SEN-SMT-TRH3 °C/°F, %RH, Nitrogen Dioxide Sensor and Sulphur Dioxide Sensor.[5]

3.2.1.6.4 Noise

Noise measurements were collected from seven (7) sites in the proposed project area; these were located along the main routes leading to and from the proposed project site, as well as in residential areas. The sites most likely to be impacted by noise were similar to those selected for air quality assessment (i.e., sites deemed as sensitive receptors).

Noise measurements were assessed using a calibrated Quest SoundPro SE/DL series sound level meter, which conforms to the IEC 616721-1-2002 Class 2, Sound Level Meter Type 2, ANSI S1.4 – 1983 (R2001) Octave Band &1/3 Octave Band Filter Class 1, IEC 61260:2001 Octave Band & 1/3 Octave Band Filter Class 1, ANSIS1-11-2004 and ANSI S1.43 -1997 (R2002) Type 2 Standards.[6] The average noise level readings were recorded over 3-minute intervals, in decibels (dBA). Wind direction and any unusual local noise sources were documented at each sampling location. In addition, before and after the survey, the instrument was checked with a calibrator, pre-calibrated from factory. Results at the end of the sampling period were compared against NEPA's Noise Standards [7] (i.e., 55dBA for residential areas). No night-time noise assessments were conducted. The locations for air and noise quality assessments are presented in Figure 3-2 and Figure 3-3 below.

Figure 3-2: Air quality and noise assessment sites selected within the Port Royal community.

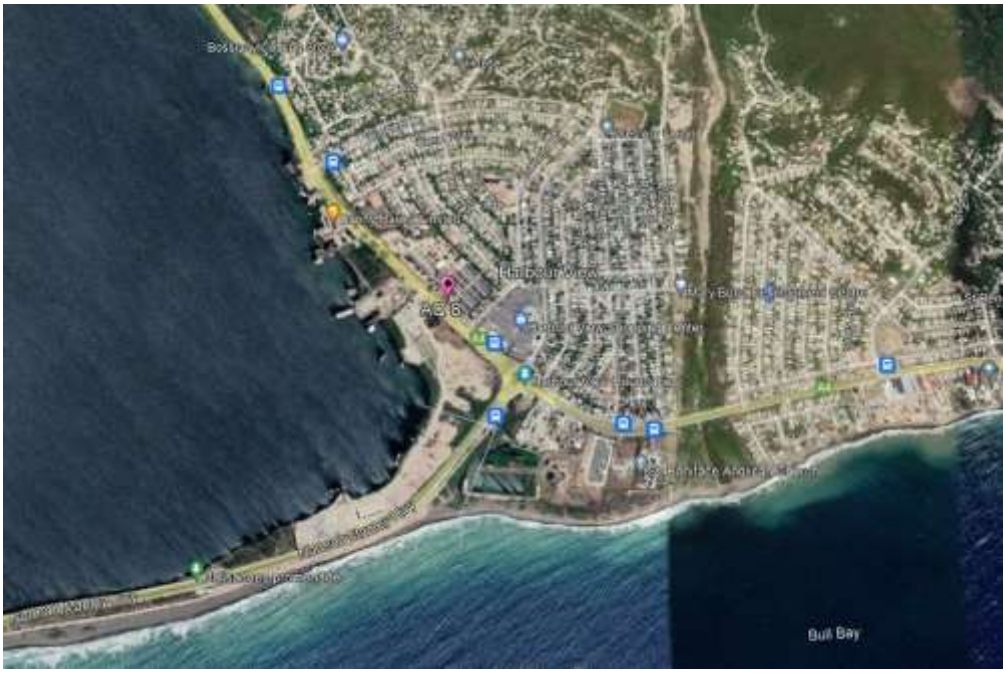


Figure 3-3: Air quality and noise assessment sites selected within the Harbour View area.

3.2.2 Ecology

The Palisadoes-Port Royal Protected Area (P-PRPA) consists of both marine and terrestrial areas that function together to form the complete (and indeed critical) ecosystem in the area today. The project area extends from the Harbour View Roundabout, along the Palisadoes tombolo and includes the Port Royal community as well as the Port Royal Cays and the protective southern barrier reef crest (see Figure 3-4). The proceeding sections (3.2.2.1 and 3.2.2.2) outline the ecological methodologies employed to assess both flora and fauna in key sections of the P-PRPA.

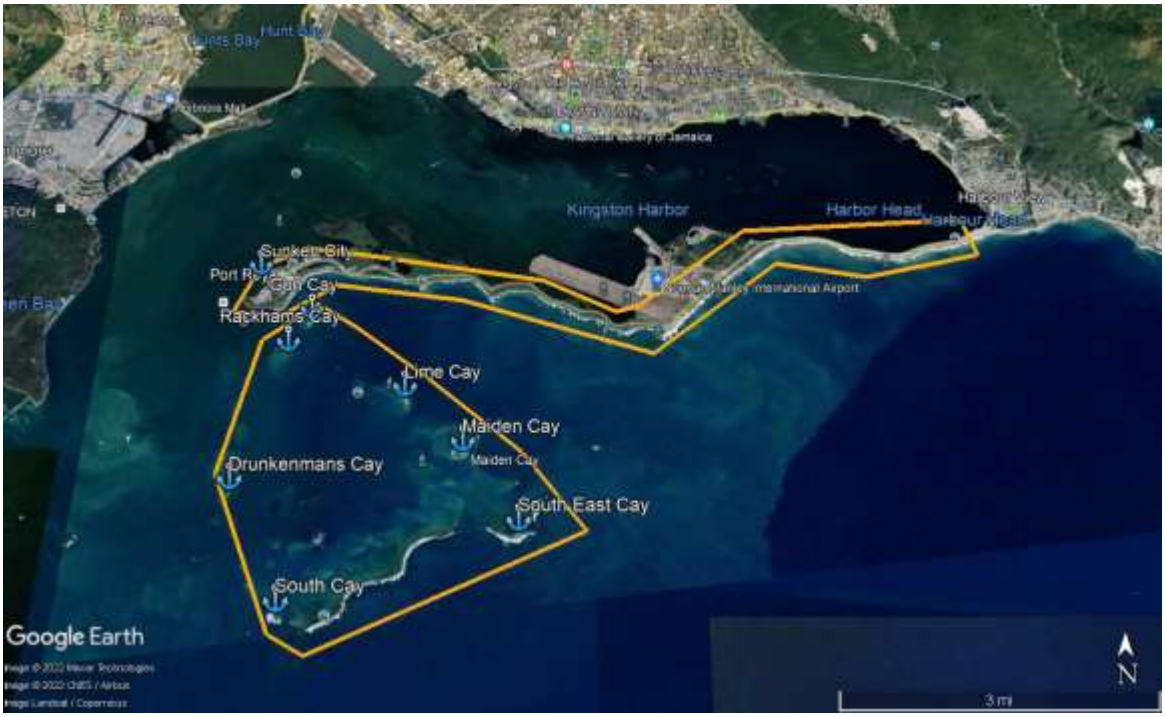


Figure 3-4: Sites where ecological assessments were conducted within the P-PRPA

3.2.2.1 Marine Assessment

The marine assessment methodology entailed utilization of the Atlantic and Gulf Rapid Reef Assessment (AGRRA) surveys at select cays as well as Rapid Ecological Assessments (REA) of the vegetated cays (inclusive of associated avifauna). The select locations for marine assessment as presented in this Baseline Report include:

1. Palisades Strip
2. Sunken City
3. Port Royal Cays:
   i. Gun Cay
   ii. Rackham's Cay
   iii. Lime Cay
   iv. Drunkenman's Cay
   v. Maiden Cay
   vi. South Cay
   vii. Southeast Cay

4. Southern Barrier
5. Refuge Cay

3.2.2.2 Terrestrial Assessment

The assessment of terrestrial areas within the study site was slightly modified among sites due to the unique nature of the P-PRPA which consists of mostly highly disturbed coastal vegetation along the seaward areas, and less impacted mangrove wetlands within Kingston Harbour, as well as on several of the nearshore coral cays. The terrestrial assessment was conducted in consideration of the physical zones defined for the P-PRA (i.e., Zones A1-A6), however the methodology was modified by location due to various physical constraints. For instance, it was not practical to conduct Standard Point Counts for birds however an estimate of abundance for the entire area was created using the DAFOR scale/ranking based on all field visits including previous reports and observations for the locations.

All the cays (including Refuge Cay) were small enough to accommodate a walk-through/roving survey of the entire area; this was conducted (where necessary) in addition to identification of all floral species and any bird or other species observed. On some of the smaller cays no birds were observed during field visits however this did not necessarily mean they are never present, but instead was most likely attributed to the limited observation times and possibly the time of day and/or season of the survey. In the disturbed coastal habitats, most plants observed were also recorded and segregated by zone however within the built environment, several horticultural species planted and maintained by humans that are not known to be native to the habitat (or were not found outside of the well-maintained/landscaped plot) were noted but not included in the generated species lists. Observations or reports of other species of terrestrial animals (for e.g., butterflies and other insects) are also included in the Appendices. Where such species were not directly observed during field visits, they are noted/ reported in the sections dedicated to their relevant groups. Observations of floral species were segregated by physical zone and a total for each site is presented in tabular format (see Appendices). Results from all locations are presented in Section 4.2 of this document.

3.2.3 Socioeconomic Environment

The project team engaged in a Charette-style consultation process based on the multipurpose and vast historical, geographical, and cultural significance of the Port Royal area. This involved the engagement of a wide range of stakeholders including experts, local civil society groups, non-governmental organizations (NGOs), fisherfolk in the community, government officials across sectors including in the Tourism and Health Ministries, researchers in nearby academic institutions via virtual zoom meetings, focus group discussions, roundtable consultations and interviews.

The objectives of the consultations were as follows:

a) To share information on the proposed project
b) To incorporate community perspectives and knowledge of the area into the development plan
c) To understand public sentiment and opinion with respect to the proposed project and design area
d) To identify perceptions of impacts and discuss issues relating to the proposed development and the area's natural resources.

Feedback from both virtual (Zoom) and in-person consultations with businesses operators, residents and fisherfolk helped to inform the socioeconomic and cultural assessment for the area, and was considered in conjunction with other primary and secondary data resources, for example, the Statistical Institute of

Jamaica Census, (STATIN, 2011); the Planning Institute of Jamaica commissioned Jamaica Survey of Living Conditions (PIOJ, 2012; 2017; and 2019), and the Community Profile for Port Royal commissioned by the Social Development Commission (SDC, 2009). This was supplemented with data collected from Port Royal residents using a survey administered via the digital Kobo Collect Toolbox platform. Figure 3-5 below shows the GPS coordinates of the selected respondents within the community.

Figure 3-5: Image showing location of surveys in the Palisadoes Port Royal Protected Area

The survey assessed the Port Royal community via the convenient sampling technique. Seventy-nine (79) individuals representing approximately 6% of the population in the area were surveyed. Survey interviews were conducted with respondents from ages ranging from eighteen (18) years to over sixty-five years (65) old. Most respondents surveyed were males in the forty-five (45) to fifty-four (54) age group who have lived in Port Royal for over thirty (30) years.

Key Informant Interviews were also conducted, wherein business owners and other key community stakeholders from the Port Royal community were interviewed. Stakeholder consultations occurred over a three-month period and involved the ESL project team engaging different groups both in person and virtually (via Zoom platform) to ascertain their views regarding the proposed development. The specific questions asked are presented below:

1. Do you know about the Port Royal Concept Plan?
2. How long has your business been operating in Port Royal?
3. What role do you play in Port Royal?
4. How do you engage with the Port Royal community?
5. How are you involved in the economic activities of Port Royal?
6. What do you think are the three most urgent issues to be addressed in Port Royal?
7. What would you like to see in an improved Port Royal?
8. How would you like to benefit from the proposed development?
9. What do you think of Port Royal as a whole?
10. What goals/ideas would you include in the plan?

3.2.4 Archaeology

The Archaeological Impact Assessment (AIA) involved the conduct of desk research and a literature review to determine the existing historical and archeological assets in the area, as well as associated pertinent concerns. The National Library, the Jamaica National Heritage Trust, along with the Port Royal Museum served as important data repositories for literature of archaeological significance.

The literature review examined historical documentation, maps, plans, estate accounts, published or unpublished narratives, photographs and other data. The review was supplemented by ground truthing field investigations. The results of the AIA are presented in Section 4.5 of this document.

3.3 Impact Analysis and Determination of Development Guidelines

This document represents the Strategic Environmental Assessment of the Port Royal 2020 Sustainable Master Plan results, wherein the impacts were identified using the results of the Baseline Assessment. The impacts have been evaluated with respect to their direction, duration, magnitude, and type.

- Direction defines whether the impact is positive or negative.
- Duration defines whether an impact is a short-term, long term, intermittent or continuous.
- Magnitude defines an impact as minor, moderate, major or significant.
- Type defines an impact as reversible or irreversible.

Impacts were identified based on the factors in Table 3-3.

Table 3-3: Impact Assessment Criteria

IMPACT ASSESSMENT CHARACTERISTIC	
Direction of impact	
Rank	**Definition**
Positive	• Impacts of the project on the environment and vice versa are likely to be good
Negative	• Impacts of the project on the environment and vice versa are likely to be bad
Magnitude of impact	
Rank	**Definition –** one/the combination of
Low	• Little or negligible action and/or control are useful, but not required in the short term, review in the future is useful. • Exceeding of threshold value in case of operating problems (abnormal conditions) and low effect and low probability of occurrence and/or high probability of detection. • Minimal effect • Limited probability of occurrence • "Aspect" controlled under normal conditions. • High knowledge of "Aspect"
Moderate	• Action and/or control are required in the near future. • Exceeding of threshold values in case of operating problems (abnormal conditions) and above • Average high probability of occurrence and/or low probability of detection. • Financial threat

IMPACT ASSESSMENT CHARACTERISTIC	
	• Effect likely to increase under planned activities. • Rising concern of shareholders • Emergency situation would cause a large environmental impact. • Complaint likely to be received. • "Aspect" not fully controlled under normal conditions
High	• Immediate Action and/or control is mandatory. • "Aspect" is currently not controlled under normal operations. • Could break legal or policy documents. • In breach of legislation • Sensitive environment (groundwater proximity, conservation area, residential area) • Repeated complaints
Impact Duration	
Short term	Occurring infrequently or during one project phase
Medium term	Occurring frequently during a few project phases
Long term	Occurring frequently during most or all project phases
Types of Impacts	
Reversible	Effects that are reversible and diminish when activities cease or over time.
Irreversible	Effects that are not reversible and do not diminish even if the activity ceases to occur, and do not diminish with time.
Cumulative	Effects of an action are added to or interact with other effects in a particular place and within a particular time
Probability of Impacts	
Low	An impact which is unlikely to occur
Moderate	An impact which may occur
High	An impact which is very likely to occur

The potential impacts have been identified and evaluated for each of the proposed project investments. Development guidelines have been recommended for each area to enhance what has been proposed and where negative impacts are identified, to reduce or eliminate where possible, potentially negative repercussions from the respective proposed development.

3.4 Study Limitations

Baseline assessments were conducted to garner and confirm data relevant to the assessment of various aspects and impacts of the proposed Port Royal (re)development. Consideration was given to (rainfall) seasonality; however, due to the 6-month data collection timeline of the project, some assessments were only possible during a single (wet or dry) season.

The primary data used to guide the demographic assessment is quite dated, for example, the (2009) Social Development Commission's Community Profile, and the (2011) Census data produced by the Statistical Institute of Jamaica (STATIN). Although such outdated statistical information may present some challenges with accuracy, this was accepted as the most reliable, available data. To further supplement

these data, the socioeconomic survey administered sought to capture some of the relevant demographic data in an attempt to bridge the gap.

The ESL team contacted representatives from key (Government and Non-Government) Agencies, Ministries, Organizations, and Institutions in attempts to engage in stakeholder consultations, however, the team had little success in securing meetings in most cases. Agencies/Organizations/Institutions considered included the National Solid Waste Management Authority (NSWMA), the Pesticide Control Authority (PCA), the National Fisheries Authority (NFA), the National Environment and Planning Agency (NEPA), the Office of Disaster Preparedness and Emergency Management (ODPEM), the Meteorological Office of Jamaica (The Met Office), the Queen's Warehouse, the Jamaica Customs Agency (JCA), Plumb Point Lighthouse (Management), the Jamaica National Heritage Trust (JNHT), the Jamaica Gypsum and Quarries Limited (JGQ Ltd), the National Water Commission (NWC), the Airports Authority of Jamaica (AAJ), the Port Authority of Jamaica (PAJ), the Jamaica Urban Transit Company (JUTC), the National Works Agency (NWA), the Jamaica Public Service Company Limited (JPSCo), eGov Jamaica Limited, FLOW, Digicel, the Caribbean Military Aviation School CMAS), the Tourism Product and Development Company Limited (TPDCo), the Jamaica Tourist Board (JTB), the Tourism Enhancement Fund (TEF), Loose Canon Tours, the Jamaica Karting Association (JKA), the Port Royal Brotherhood, the Jamaica Promotion Corporation (JAMPRO), the Jamaica Business Development Corporation (JBDC), the Housing Agency of Jamaica Limited (HAJ), the Jamaica Defence Force (JDF) the JDF Coastguard, the Jamaica Fire Brigade (JFB) Port Royal, the Kingston and St Andrew Municipal Corporation (KSAMC), the People's National Party (PNP) and the Jamaica Labour Party (JLP). Contact was also made with the permanent secretaries from the following ministries: the Ministry of Health; the Ministry of Tourism; the Ministry of Culture, Gender, Entertainment and Sport; the Ministry of Economic Growth and Creation; the Ministry of Science, Energy and Technology; the Ministry of Justice; and the Ministry of National Security. These Agencies and Ministries will also be invited to participate in the stakeholder consultations to share the findings of the SEA. As such, there will be another opportunity for them to add their contribution to this Project.

4 Summary of Description of Existing Environment

This section presents the summary of the results of the assessment of the existing physical, ecological, socioeconomic, and archaeological environment respectively. These sections were elaborated in detail in the Environmental and Social Baseline Assessment Report, which was Deliverable 2 under this project.

4.1 The Study Area

The study area encompasses the Palisadoes tombolo starting from the roundabout at Harbour View and continuing all the way to the town of Port Royal (Figure *3-1*). The study area also includes the adjacent mangrove areas within Kingston Harbour and extends southwards to include the nearshore Cays outside of Kingston Harbour, to the outer Barrier Reefs. Although the entire area consists primarily of coastal strand, there is great variation in habitats primarily due to differences in human activity and disturbance that has modified or otherwise impacted the type and quality of the habitat. The area has therefore been divided into zones using the same Physical Areas described in the initial report but including all the Cays as separate zones.

The winds predominate from a south-easterly direction and much of the coast on the mainland consists of sandy beaches with large sand dunes and associated coastal vegetation. However, unlike on the Cays where the sand is 'creamy white', the sand on the mainland is notably darker – almost uniformly grey. This indicates that the sand on the Cays likely originated from weathered corals (i.e., carbonate sand), whereas the mainland (clastic) sand in Port Royal is primarily derived from weathered rocks from the mountains. The latter would have been eroded from mountain ranges such as the Port Royal Mountains, the Blue and John Crow Mountains, and also by rivers, and later deposited on the coast where the predominant marine currents would transport it to the west. This action is largely responsible for the creation of the entire Palisadoes tombolo.

The Palisadoes Complex Spit is situated within the project area on the south-eastern coast of Jamaica, with Port Royal on the western end of the tombolo. The terrain of the Palisadoes is flat, with elevation ranging from 3–4 m above sea level, which is notably lower compared to other south and south-eastern areas on the island; and also compared to the adjacent Kingston and St. Andrew areas (Figure 4-1).

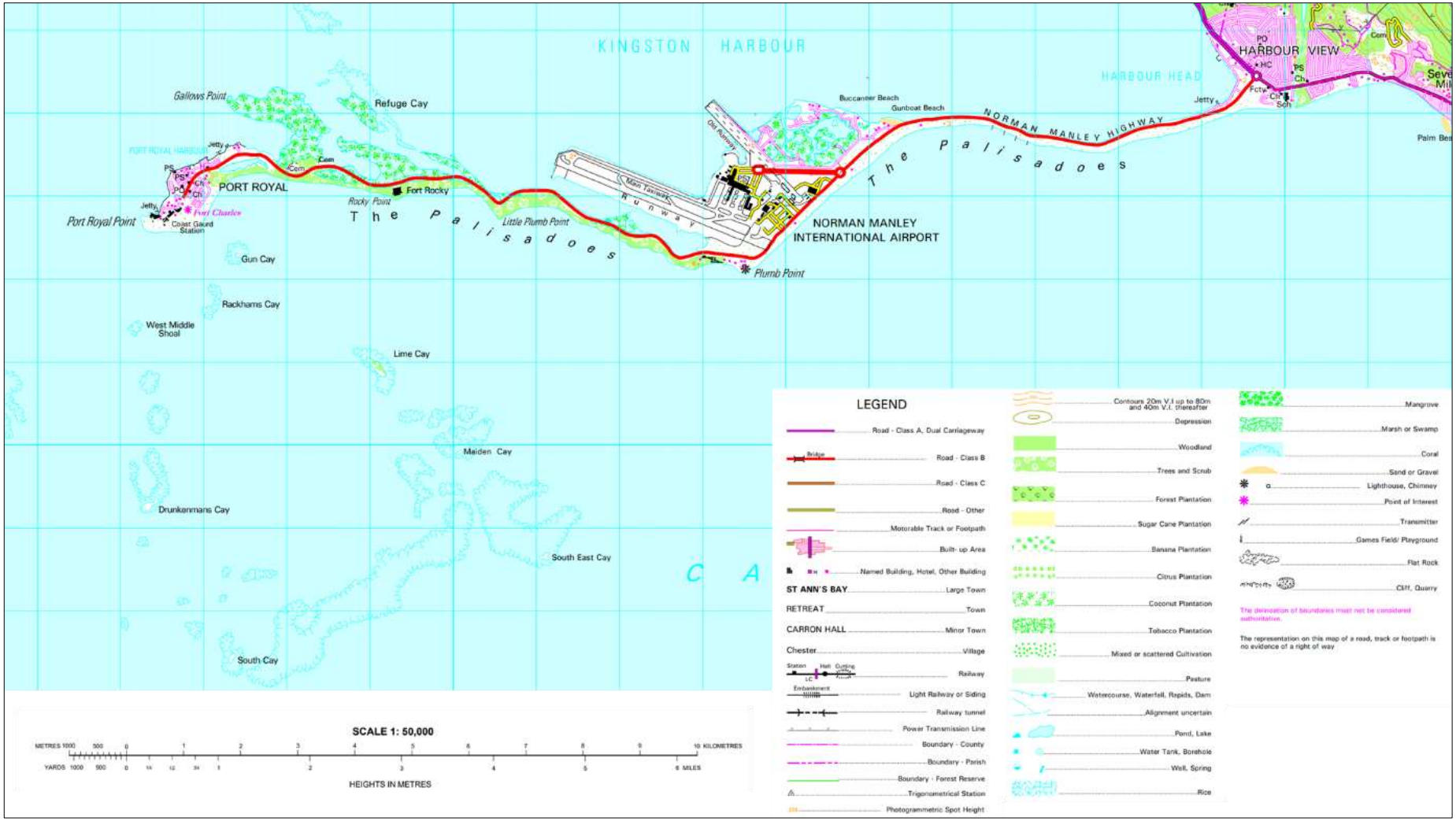


Figure 4-1 Topographic map of Port Royal (Adapted from Sheet 18 Metric Series, 2011)

4.2 Physical Environment

4.2.1 Geology and Climate

The terrain of the P-PRA is flat, with elevation ranging from 3- 4 m above sea level, notably lower than the parishes of Kingston and St. Andrew. The geology of the general area largely consists of discontinuous coral reefs connected by sand and gravel, deposited by longshore drift from the estuaries of the Hope, Cane, Yallahs, and Morant Rivers to the east of Kingston. The area is primarily comprised of Pleistocene fine sand and gravel, while the overlying soil texture for the entire area is classified as gravelly clay loam. A geotechnical investigation conducted revealed that the areas under consideration for the housing strategy are comprised of silts, sands, gravel, and Fill material.

According to recent climate projections for Jamaica by the Climate Studies Group Mona (CSGM, 2017), the island may become up to 21% drier by the end of the century, with the late rainfall season being the primary driver of the drying trend. This drying trend is expected to be more severe in the south and east of the island- where the study area is located. Additionally, sea level rise is projected to be between 0.58-1.04 meters by the end of the century, with the south coast again being particularly vulnerable to its impacts. These changes in climatic conditions are likely to have significant impacts on Port Royal's economy and social systems, particularly sectors such as tourism, and infrastructure.

4.2.2 Natural Hazards

Natural hazards that pose significant threats to the Port Royal project area include tropical cyclones and seismic activity. Jamaica's location within the Atlantic hurricane belt makes it vulnerable to tropical cyclones, with over 30 storms impacting the island in the past 75 years. Southern parishes like Kingston and St. Andrew are especially vulnerable, and the small size and location of Port Royal make it particularly susceptible to the impacts of tropical cyclone hazards. Regarding historical hurricanes and storms that have impacted the Kingston Harbour area, 47 such storms have passed within 100km of the harbour since 1848, with Hurricane Gilbert in 1988 noted to cause the most significant damage to the island, particularly in the Kingston Harbour area. Other noteworthy hurricanes that generated high waves in the study area over the period include Hurricane Sandy, Hurricane Emily, and Hurricane Matthew. Although there may not be a significant change in the frequency of hurricanes, a projected shift is expected towards stronger storms, with a potential increase in intensity ranging from 2-11%, more intense rainfall rates between 5-25%, and a median increase of 13% in the proportion of very intense storms (i.e., Categories 4 and 5).

Regarding seismic activity, Jamaica is highly susceptible to earthquakes due to its location on the Caribbean Plate margin. The eastern parishes (St. Thomas, Portland, Kingston, and St. Andrew) have the number of seismic activities and these parishes have been affected by many of Jamaica's most damaging earthquakes. The Port Royal area has experienced two major catastrophic earthquakes in 1692 and 1907. Although the Kingston Metropolitan Area (KMA) is typically affected by low-intensity earthquakes, studies have indicated that ground acceleration values in areas of hard rock have a 10% probability of exceedance in 50 years. Therefore, while low-intensity earthquakes may not cause significant structural damage, the potential for stronger earthquakes in the KMA (including Port Royal) cannot be ruled out. The Geotechnical Investigation revealed that the upper surficial material is susceptible to deformation under seismic loading and at risk of possible ground failure and/or liquefaction as experienced during the 1962 Port Royal Earthquake. However, the extent of this is highly dependent on the magnitude of the

earthquake, soil characteristics, depth of groundwater, the thickness of the deposit, depth, and distance of earthquake epicentre.

4.2.3 Coastal Dynamics

The coastal dynamics chapter of the baseline assessment focuses on describing the physical morphology and coastal processes occurring in the study area; quantifying tidal-driven and wind-driven circulation, as well as wave-driven longshore currents; and the influence of the barrier reef and reef islands on nearshore wave fields. Dominating parameters including the wave field, current field, and sediment transport induced by both waves and currents were computed and quantified using numerical modelling. The Coastal Modelling System (CMS) model was used in the study, which is an integrated suite of numerical models for simulating flow, waves, sediment transport, and morphology change in coastal areas. Results of wave modelling, including radiation stress, breaking wave height, and breaking wave angle, are passed to the CMS-Flow module for the computation of wave-driven longshore current and wave-induced sediment suspension and transport, as well as morphology change. Wave conditions were computed using the WAVEWATCHIII numerical model, which provides reasonably accurate wave information for the study area since 2005. Wave conditions obtained from WAVEWATCHIII represent offshore waves seaward of the barrier reef in deep waters.

The general morphology of the beach along the Norman Manley Highway is controlled by the constant westward longshore sand transport driven by the persistent longshore current to the west due to the highly unidirectional incident wave approaching the coast from ESE and SE directions. The beach is separated into an eastern section and a western section, with the latter having a relatively wide and healthy beach area and a wide dune field landward. The western section, where Port Royal is located, illustrates a series of broad headland-and-embayment configurations with a dune field developed along the entire stretch, and the Norman Manley Highway extending landward of the dune field. The longshore current computed by the coupled wave-flow model was found to be up to 30 cm/s and was associated with energetic wave conditions associated with storms. The magnitude of the longshore current was also controlled by local shoreline orientation changes, resulting in stronger longshore current at the secondary headlands and weaker currents in the middle of the embayment beaches. The persistent westward longshore sand transport has implications for designing shore-protection structures, as structures such as groins may artificially interrupt this nearly unidirectional longshore sand transport, resulting in severe and persistent erosion along the downdrift (west) side of the coast. The chapter also describes important (physical) coastal features along the Palisadoes strip (I.e., the eastern section), including the narrow land barrier separating the Caribbean Sea and Kingston Harbour, the riprap armour, and the artificial sand dunes constructed along some sections of the beach.

Statistical analyses of wave conditions were conducted, including the incident wave angle brackets, the average significant wave height, and the average peak wave period within each bracket, as well as the storm conditions represented by the average of the top 2% and 1% of the highest waves within each bracket. The wave conditions within the study area are dominated by the easterly trade winds and the surrounding landmass causing waves seaward of the greater Kingston Harbour to be extremely unidirectional. The tide-driven flows at the entrance to the harbour and within the harbour were found to be quite low, with the depth-averaged velocity mostly less than 10 cm/s. The low magnitude of the velocity was attributed to various factors such as the small tidal range, the diurnal nature of the tides, and the width and depth of the entrance to the harbour. The fastest depth-averaged tidal flow occurred over

the relatively shallow water to the east of the wide entrance channel. However, the circulation pattern withing Kingston Harbor is significantly influenced by local wind conditions. Strong wind can generate much stronger currents than tides. Based on both the model results and statistical analyses, wave conditions in Port Royal area appear notably different from offshore wave conditions.

4.2.4 Noise, Air, and Water Quality

The primary objectives of the noise, air, and water quality assessments were to determine environmental health conditions within the study area, including the offshore cays; to assess the impact of current activities (e.g., agricultural, fisheries, residential, and tourist) on the aquatic environment (i.e., both marine and lagoon areas) prior to redevelopment activities related to the project; and to make recommendations for the monitoring and management of water resources based on the proposed activities.

The major parameters used for the analysis were heavy metals, pH, salinity, alkalinity, and conductivity. These parameters are generally used to indicate eutrophic waters which have likely been impacted by anthropogenic activities. Regarding pH, all the lagoon and sewage samples had pH values within the expected range and of the twenty-six (26) marine water samples analyzed, six (6) samples (or 23%) had pH levels slightly lower than the stipulated standard for marine water. The highest pH values were observed offshore a closed gypsum plant, likely attributable to surface or subsurface runoff of gypsum which is rich in mineral content and can cause high pH levels. The salinity of the marine samples was typical of seawater salinity (i.e., greater than 35 ppt.), while waters collected from the inland ponds/lagoons were mostly hypersaline, with salinities exceeding 40 ppt. The hyper salinity observed was likely because of restricted tidal mixing due to the pond being landlocked. The alkalinity values for the hypersaline samples were significantly higher at all locations except WQ5 (an in-land lagoon), where the salinity values were comparable with the marine samples. The higher concentration of ions in the hypersaline ponds and sewage samples is likely the primary reason for the high alkalinity observed. With respect to conductivity, although there is no value stipulated in the NRCA Standards for conductivity in marine waters, it was noteworthy that the conductivity values for the hypersaline lagoons were noticeably higher than offshore samples collected from the sea. The water samples taken within Kingston Harbour and the surrounding cays were all less than 10NTU, indicating good water clarity. However, higher turbidity levels were observed in the hypersaline ponds at some sites as well as in the sample taken offshore the gypsum plant, indicating the impact of surface runoff on water quality in that area.

The chapter also discusses the microbiological parameters assessed in the study, including testing for faecal coliforms and faecal enterococci. These tests can help indicate likely faecal contamination from humans and/or animals that pose significant health risks to humans who may bathe/swim in the water. The assessment found that all the marine water samples were within the recreational water standard for faecal enterococci, except for the control sample taken offshore the Port Royal beach. Six (6) of the twenty-six marine water samples obtained faecal coliform values above both the NRCA Ambient Water Quality for Marine water and the Recreational Water Standard, indicating either: i) inadequate sewage treatment infrastructure to support the visitor population in the area, or ii) direct sewage discharge into the harbour.

4.2.5 Infrastructure and Waste Management

This chapter describes the current waste management and infrastructural challenges within the Port Royal project area. Waste management is essential for public health and environmental protection, as well as for addressing the estimated lack of future resources. The infrastructural components investigated from a civil/sanitary engineering perspective were water supply, wastewater management, and solid waste management.

The entire project area is serviced by the National Water Commission, and a new 12-inch high-density polyethylene pipeline is planned for implementation from the airport round-about to Port Royal. The sewage treatment plant that serves the Harbour View community is located on the edge of the project area boundary and is considered a hybrid treatment plant. The plant currently produces an odour, which is likely attributable to the discharge of sewage from the pump stations. The wastewater at the Caribbean Maritime University is treated through septic tanks and then disposed of through tile fields, while a section of the facility is connected to an evapotranspiration bed. At the Yacht Club, there is an on-site system comprised of septic tanks and sub-surface infiltration. Solid waste management, including collection, is carried out by the National Solid Waste Management Authority at least once a week.

The current infrastructure is significantly deteriorated and at present does not address the escalating nature of waste production. There is also concern that the continuous discharge of untreated sewage into the sea may lead to contamination of marine areas with heavy metals, increasing health risks, especially since fishing is an important socioeconomic activity for the Port Royal community.

4.3 Ecology

The ecological environment of the study area has a focus on flora and fauna in delineated zones. The study area includes unique coastal forests, mangrove wetlands, as well as offshore areas and their related fisheries, all of which are closely linked to the area's sensitivity to development. Kingston Harbour has high ecological, social, and economic significance to the surrounding Port Royal area, serving as a habitat for a variety of species and a natural protective barrier from the sea. The ecological assessment starts by describing the different habitats and key floral species observed in each zone, such as the secondary scrub and roadside weeds in Zone A1, coastal strand species in Zone A2, and larger shrubs and cacti in Zone A3; all of which are influenced by human activity and disturbance. Inside Port Royal the area is dominated by mangroves and coastal scrub which are both important habitats for a variety of wildlife. There is also great variation in habitats due to differences in human activity and disturbance that has modified or otherwise impacted the type and quality of the habitat. The dominant vegetation in Port Royal are mangroves, particularly red mangroves (*Rhizophora mangle*), which have adapted to the harsh environmental conditions in the area.

Offshore Port Royal, and still within the study area, are the Port Royal Cays, a group of seven coral islets and shoals, bordered by Kingston Harbour to the north, a 3 km long Barrier reef to the south, and the Hellshire coastline to the west. These cays cover an area of approximately 12 km² and include fringing and patch reefs, mangroves, and seagrass beds. Three of the eight sandy cays have no vegetation and are known to have been completely washed away during adverse weather. Most of the other cays are dominated by mangrove trees and other coastal associates, which are periodically inhabited and/or used for roosting by seabirds. The marine ecology of the Port Royal Cays consists of large patchy and fringing reefs extending from near surface to approximately 20m deep within protected unexposed water behind

a southern barrier reef. The bulk of the fine sediment is made up of *Halimeda sp*. and foraminifera fragments. Turbidity is high due to i) current-transport of eroded soils, ii) resuspended sediment, and iii) flocculent organic particles. The cays serve multiple functions including acting as a barrier providing coastal protection; as vital recreational sites for both locals and tourists; and play a major role as a nearshore fishing site for the artisanal fishing industry. The area was declared the Palisadoes-Port Royal Protected Area in 1988 and was subsequently designated as a RAMSAR Wetland of international importance in 2005. Gun Cay is located close to the entrance of Kingston Harbour and contains mostly mangrove trees and Seaside Mahoe (*Thespesia populnea*). Drunkenman's Cay is a shingle structure located on the western side of the P-PRPA, south of the Kingston Harbour mouth. It is situated between Rackham's Cay and South Cay. Mangrove trees, including White Mangrove (*Laguncularia racemosa*) and Button Mangrove (*Conocarpus erectus*) grow mainly along the southern section of the cay. Red mangrove trees on the southern end of the cay were found to be a regular roost for seabirds, with scat from birds observed on the leaves. Drunkenman's cay, like many other cays in the area, has been eroding away, with recent evidence of erosion causing vegetation to die-off. The forereef zone towards the east and southern sections of the cay is characterized by numerous gorgonian and sponges, with cyanobacteria and scleractinian coral cover of an average 23%. The shallow *Orbicella annularis* zone (5-7m) of Drunkenman's Cay was dominated by aggressive invertebrates, live and partially dead *Orbicella sp.* colonies, and macroalgae, while the deep upper forereef slope (8-14m) was characterized by sedimented turf algae mats and soft corals (tubular gorgonians, sea whips, and sea fans). The backreef at Drunkenman's cay is mainly composed of Turtle Grass (*Thalassia testudinum*) and Manatee Grass (*Syringodium filliforme*). There were changes in seagrass density and species dominance with increased depth from the cay. Piles of *Sargassum fluitans* (Gulfweed) were observed along both the northeastern and northwestern sections of the cay. Lime Cay is the largest and most popular of the cays for recreational boating but has few birds roosting due to the frequent human presence. The Southern Barrier is a 3km long stretch of reef crest that borders the Port Royal Cays to the south. It is approximately 30m wide and contributes to the sheltered conditions experienced inside, which facilitates the growth of the various cays and shoals within the P-PRPA. The shallow back reef zone north of the reef crest is made up of sandy substrate in which algae, seagrass, and a few coral species were found growing. The notable feature along this stretch is the spur and groove reef formation that is present along the entire outer Barrier region. The spurs extend in a south-easterly direction, and between the spurs are sandy grooves. The feature is the result of exposure to strong wave action and subsurface current. Coral cover along the Southern Barrier was an average of 22% with low diversity and was characterized by mainly *P. astreoides* and *A. agaricites*, both non-reef-building coral species. Coral recruits observed were also mostly these species as well as *S. siderea*. The spurs along the southern barrier had a notable percentage cover of algal functional groups such as Crustose Coralline Algae (CCA), and Filamentous Turf Algae (TA). The growth of CCA was facilitated by the hard coral pavement substrate on the spurs, and the limited sand interaction reduced the ability for the creation of turf algae sediment mats on spurs, thus allowing for the filaments of the turf algae to remain sediment-free. Macroalgae was relatively low along the Barrier, accounting for less than 15% of total benthic cover, and the low nutrient level and the abundance of grazing *Diadema* urchins likely contributed to the controlled growth.

With regard to avifauna, the area is home to a variety of bird species including waterbirds like seabirds and shorebirds, as well as land birds, particularly those adaptable to human disturbance. Some bird species in the study area are endemic to Jamaica, including the Jamaican Mango Hummingbird and the

Red-billed Streamertail. The data generated from the ecological assessment also highlights the importance of the Refuge Cay as an important nesting colony for Magnificent Frigate Birds as well as Brown Pelicans. The P-PRA area has invasive/non-native species, including feral cats and dogs, domestic pigs, and goats, all of which pose significant threats to native wildlife. Similarly, the Small Indian Mongoose, which was introduced to control snakes, has proven to be a major predator of local species and is responsible for the extinction of several endemic species in the project area and the rest of the island. Two examples of endangered endemic species native to the Port Royal area are the Hawksbill turtle and American Crocodile, both of which reportedly utilize sandy areas as critical nesting grounds. The fish population is very diverse across the Barrier, with 37 fish species identified, the most common of which including the Yellowtail Damselfish, the Bluehead, and the Striped Parrotfish. Other frequently observed marine fauna within the project area include the Spotted Moray Eel, the herbivorous Caribbean Spiny Lobster, and the Long-Spine Black Urchin. The prevalence of both flora and fauna along the Southern Barrier is also provided in the chapter. The ecological assessment further highlighted some potential threats that the development plans could likely pose to wildlife in the area, for example pollution, noise, and disturbance from human activities. The chapter also reiterates the need for proper waste management practices to address the problem of plastic waste, which is affecting the mangrove forests and the marine environment. The chapter concludes by highlighting the importance of balancing economic development with environmental conservation to ensure the long-term sustainability of the area.

4.4 Socioeconomic Environment

This chapter describes and discusses the socioeconomic environment in Port Royal with a focus on its population and household demographics. The town's sphere of influence includes national heritage sites, cays, mangroves, and reef systems, as well as the Norman Manley International Airport. The area has a history of being an important port town in Jamaica but has faced challenges in recent times including natural disasters and economic decline. The chapter discusses various factors that affect the community's overall economic and social well-being, including household structure, consumption patterns, education, employment, garbage disposal, land use, and other housing demographics. The chapter further provides information on various aspects related to the living conditions of households in Port Royal, including housing, energy, water, information, communication, and technology (ICT). The data collected includes details on the sources of lighting used by households, access to electricity and energy sources for cooking, access to ICT devices and the internet, and sources of water for households. The data is presented based on different geographic areas and statistically groupings with a focus on the Port Royal project area. Additionally, the chapter provides information on changes in the data over time, including an increase in access to piped water and electricity over the years.

The population is mostly youthful, with 25% of residents below 15 years old, and 7% of the population being 65 years and older. Recent socioeconomic assessments conducted indicated that the community experienced a decline in the number of residents and households, as per the Statistical Institute of Jamaica's 2011 census, although the Social Development Commission's Community Profile of 2009 indicated a higher population. Approximately 70% of the residents may be classified as economically active, and the age-sex distribution shows more females than males living in the community. The prevalence of poverty in the Kingston Metropolitan Area (KMA), which includes Port Royal, decreased from 17.7% in 2017 to 4.7% in 2019, according to the Voluntary National Review (VNR) 2022 for Jamaica.

Poverty was more likely to affect females than males, although the frequency of poverty declined across all age categories. Additionally, the incidence of food poverty in Port Royal was lower than in other geographic areas, while the total poverty was lower than that of the rest of Kingston but higher than one section of the adjacent Harbour View community. The socioeconomic assessment also highlights the change in household structures in Port Royal over the years, with most households being considered small, typically comprising 1-3 people. However, single-person households similarly account for a significant percentage of the households in the area. Consumption patterns in Port Royal also vary by household characteristics, with wealthier households having smaller household sizes than poorer households. Education levels in Port Royal are generally low, with secondary education being the highest level of educational achievement for most residents. Male residents are less likely to pursue higher education, with many preferring vocational courses. Employment patterns in Port Royal also show gender disparities, with male residents being more likely to be employed than female residents; however, many residents (both male and female) are generally not interested in formal employment as they are supported by their families and remittances from abroad. Fishing-related activities are the primary source of income for most residents, followed by business and tourism. Housing in Port Royal is a mix of rented and owned homes, with some residents squatting. Some housing units are improvised, made from recycled materials, and occupied by one household. According to the STATIN 2011 census data, households in Port Royal dispose of their garbage using different methods, including public collection, burning, burying, and dumping. Based on the surveys conducted, Port Royal residents expect to benefit from the proposed redevelopment in several ways, with employment/higher income being the primary expected benefit. Other minor ways in which they could benefit include community awareness/development, the environment, tourism, housing development, and more business opportunities. Respondents are concerned about environmental issues, with deforestation being the primary concern. They suggest alternative uses for land in the community, with housing being the main use stated. Residents also express their willingness to support the redevelopment that is taking place or being considered for their community; however, they currently feel excluded from the plans and frequently reference the development and implementation of the cruise ship port and pier, which did not benefit the average Port Royal resident. Data provided by the PAJ for the Port Royal Cruise Ship Port showed that the vast majority of passengers who disembarked and left the port went outside of the Port Royal area, mirroring the sentiments and concerns expressed by most Port Royal residents during focus group discussions. Most residents in the community survey indicated that the infrastructure that exists in the community meets their needs but needs improvement. It was expressed however, that there is a need for a public recreational space for the community, a skill/training centre for the youth, a health care facility that is consistently open, functioning ATM machines and consistent water supply for the residents. About 70% of the respondents in the survey conducted indicated that flooding will not be a serious problem for the development area, while 8% believe that it would be a serious problem. Residents however unanimously agree that the town is vulnerable to liquefaction, climatological, and seismic hazards.

4.5 Archaeological Environment

The Port Royal area has a rich history dating back to the early habitation by Taíno, Spaniards, Jews, Africans, and English. The cataclysmic event of 1692 that resulted in 2/3 of the town being deposited in the sea also adds to the historical significance of the area. The presence of intact historical urban centres and monuments, buildings, and street patterns further highlights the strong political, governance, trade, and cultural activities that have taken place in the area.

Various Heritage/Historical Sites are located throughout Port Royal and demonstrates the extent of the archaeological environment in the area. It is recommended that all existing Heritage/Historic Features be flagged, and an appropriate narrative/storyboard be mounted there or nearby. This will allow visitors to learn about the history and significance of the area, which will be of economic benefit to the present inhabitants and to the entire island. Archaeological tourism opportunities/ possibilities are also proposed.

4.6 Urban Planning and Development

This section examines the relationship between physical and spatial planning, household and investment choices, and the natural assets of the community. The aim is to develop a sustainable approach to the development of Port Royal, Jamaica, considering the indigenous, ecological, physical, and social assets of the area. The chapter examines the Port Royal Development Master Plan (PRDMP) and its synergy with urban development and planning methodologies, anticipating household choices and their impact on the ecological assets of the community. Additionally, the chapter examines the correlation between economic investment-based choices and household choices, and the effects of this correlation on the natural/ecological assets of the community. The section also outlines and discusses the various local area plans and initiatives for Port Royal, and the challenges in measuring, assessing, and evaluating development goals and objectives that are not underpinned by clear conceptual frameworks.

The Port Royal area is ecologically sensitive and is constantly exposed to anthropogenic stressors, which threaten its ecological assets and functions. The town is dominated by three land use types, including mangrove forests, urban settlements, and sand, with approximately 80% of the land area being mangrove forest. The development order for Kingston and St. Andrew advises against large populations and building densities in the area. The chapter therefore highlights the need for spatial planning to assess the functional arrangement of all physical assets, using land use and land zoning methodologies, standards, and regulations to form systems that result in high-quality service delivery. The chapter also highlights the need for a diverse and regionally important economy in the area, which can be developed through the expansion of an aquatic-based gastronomical industry. The physical infrastructure of the area is also discussed, along with the need for a physical inventory and assessment map to show the location and physical condition of all physical (social, economic, and ecological) assets. The transportation and movement infrastructure are also discussed as both are extremely critical for the functioning of a single-access community like Port Royal. Both public and private transportation options are available for the residents and visitors to the area, including bicycles, motorbikes, walking, route taxis, and private minibuses. The Jamaica Urban Transit Company Ltd. (JUTC) provides public transportation between Port Royal and the KMA, and there is potential for the development of a multi-modal transportation hub that features both land and sea transportation options. The safety and security of the community are also of utmost importance, and Port Royal has a police station and a fire brigade station, although there was no fire truck available at the time of the report. The location of the police station at the prime waterfront of the community has been challenged by the PRDCL as it compromises the heritage veneer of the community in that location, and relocation to a more centralized area is recommended.

The management of Port Royal's heritage assets is also important, and a proposed Management Plan for each building/attraction may not necessarily be the best approach. The heritage assets are interconnected and can be seen in the land use and land zoning history of the city, and their management should be guided by their social and spatial association in their historic context. The NEPA has committed to ensuring

that its planning and zoning plan for Port Royal includes the need to preserve and safeguard the road reservations from intrusive development, and the quality of the area's road and transportation infrastructure allows residents access to various services within the KMA.

5 Potential Impacts and Development Guidelines

This section identifies and highlights the potential impacts associated with the various proposed project investments for the Port Royal Project area. Recommendations/mitigative measures/guidelines are also provided to minimize the identified impacts with respect to the proposed Port Royal Redevelopment Concept Plan.

5.1 Main Issues Identified

Multiple potential issues were identified for the proposed development within the Port Royal environmental setting. These issues primarily relate to:

- Archaeological Environment
- Physical Environment (e.g., hydrology and drainage, geology and soils, faults, and seismicity)
- Physicochemical Conditions (e.g., Water Quality, Air Quality, Noise) Natural Hazard Risks (e.g., earthquakes, hurricanes, storm surges)
- Ecological Impacts (Marine and Terrestrial)
- Socioeconomic Issues/Considerations
- Urban Planning and Development

These issues are discussed further below in relation to the proposed investment projects for the Port Royal area (see Figure 5-1 below). In some instances, reference will also be made to the physical zones previously defined in Section 4.2.8 above.

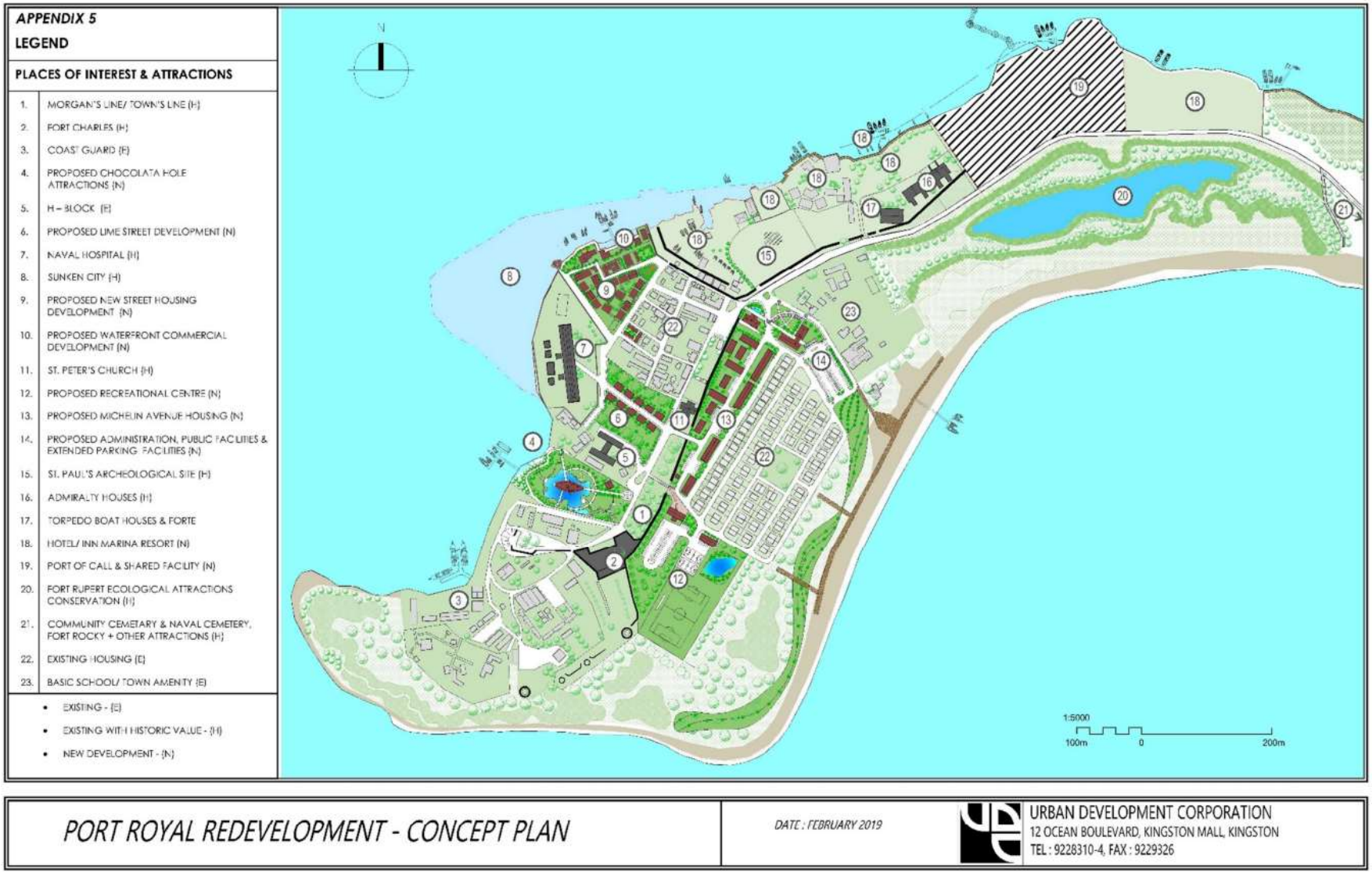


Figure 5-1: Port Royal Redevelopment Concept Plan

5.1.1 Historical Trail, and Historical Sites (Including Fort Charles, Fort Walker, Old Naval Hospital, Lime Street)

Proposed Development: These include surviving structures both above ground and those to be found below the ground and sea. There is a proposal to develop a Historic Trail for the cruise ship passengers and locals to include historic sites, archaeological dig sites, museums, and interactive exhibits. The build-out of the historic sites into stand-alone attractions will also be considered. Figure 5-2 (below) illustrates the proposed Historic Trail.

Figure 5-2: Location of the Proposed Historic Trail

Issue: Heritage Sites

The Port Royal area comprises a high density of heritage sites and assets, therefore there is a high risk of destruction of important heritage sites and assets whether inadvertently or intentionally. An increase in visitor traffic can result in damage of heritage assets through touching and/or handling displays, illegal collection of souvenirs from site, graffiti, vandalism, fire (from smoking), damage from camera flash (light) and the weight of people, for example, the weight of people in the Giddy House.

Development Guidelines:

1. The development of tour packages linking a series of related attractions – 'Heritage Trail' is supported, in keeping with the Tourism Action Plan (TAP) to ensure the best exposure and a more fulsome experience.
2. The expansion of linkages to other sites in the corporate area (i.e., Kingston/St. Catherine) is also recommended, for example:
    a. Protected Area Links and Excursions: Port Royal and Palisadoes; Portland Bight Protected Area; Blue and John Crow Mountains World Heritage Site; Military Links – Port Royal, Up Park Camp and New Castle.
    b. Religious Links: Churches including St Peter's, St Paul archaeological site, Kingston Parish Church, Coke Methodist, and the Jewish Synagogue.
    c. Music and Entertainment Link: To include The Bob Marley Museum, Trench Town tour, Peter Tosh Museum, and ending at Fort Rocky.
3. Identification of important and/or infamous persons and events in Port Royal's history from which to create a festival or special occasions (for e.g., JNHT's Annual Earthquake Awareness, June 6th each year) as a tool to invite the world to participate in Port Royal. Further linkages can be made to other locally already established events so that the richness of the Jamaican culture can be truly experienced.
4. Creation of a Calendar of Events to provide visitors with options around which to plan. A Calendar of Events can also be a valuable marketing tool for greater international exposure and recognition.
5. Similarly, the generation of a daily itinerary of activities developed based on the historical and environmental value of the town. This would be beneficial for both encouraging return visitors as well as increasing the demand for lay overs/connections.
6. Daily scheduled enactments and simulations as part of the historic attraction and/or town activities fostering inclusion between residents and tourists/visitors.
7. The creation of gift/souvenir shops for each attraction with handcrafted pieces relating to each site created by the local cottage industry.
8. Employment of local residents – Hiring Port Royalists incorporates local stakeholders in the success of the development.
9. Transportation/Movement – Part of the Port Royal experience should include how visitors travel between locations in the town. Unregulated areas of parking and traffic congestion will not be in keeping with the Port Royal experience and can also cause negative environmental impacts. Multi-modal links are instead proposed, as this offers the potential for accessibility via both land and sea (e.g., ferry). Potential multi-modal links for Port Royal include:
    a. Park and ride shuttle
    b. Park and ride ferry
    c. Limited on-site parking
    d. Electric trams or carts
    e. Bicycle tours
    f. Walking tours
10. Close collaboration between project contractors and the JNHT is necessary, and, where possible, the training of contractors is recommended, for example, in rudimentary artefact identification and recovery.
11. The following points are additional key measures recommended for implementation:

- Restoration of historical structures must be guided by the JNHT and the UNESCO guidelines to ensure that rehabilitated heritage assets maintain the standard for the area to achieve the internationally recognised UNESCO Heritage Site status.
- Appropriate visitor limitations as informed by a Carrying Capacity Assessment
- Proper warning and restriction signs are needed at strategic locations near key heritage assets.
- The implementation of 'Heritage Monitors' and licensed tour guides as a part of a wider monitoring system/network is recommended.
- Implementation of a designated footpath to facilitate the proposed walking tour is supported.

Issue: Artefacts with important heritage/historical considerations

Potential invaluable artefacts remain unrecovered, therefore there is risk not only associated with the potential destruction of these artefacts, but also theft of potentially newly discovered artefacts/valuables during project activities.

Development Guidelines:

JNHT must have representatives on site, especially during the construction phases of the project. Some sites may also require additional security measures (for e.g., 24-hr security and/or CCTV) in the event of a major discovery.

Issue: Long-term Impact on Heritage Sites and Assets

The economic benefits gained from conserving and managing heritage sites can ultimately lead to the deterioration of these areas if they are not well managed. For example, increased in-water activities from boat tours, snorkeling and/or diving can have deleterious effects on sensitive marine ecosystems. Similarly, pollution from cruise ships and chemicals (for e.g., from cosmetic products like lotions and sunscreen) can affect the water quality and eventually disrupt the reproduction and growth cycles of marine organisms.

Development Guidelines:

The Carrying Capacity Assessment (CCA) for Port Royal and the offshore cays will help determine the maximum sustainable use and level of activities that can be supported without causing significant harm to the heritage sites and surrounding ecosystems. This information can then help guide the development of a management plan for Port Royal based on the findings of the CCA. This plan should outline strategies and measures to ensure the sustainable management and conservation of the heritage sites while maximizing economic benefits. The development of pollution control measures may also be required, particularly in relation to cruise ships and the use of chemicals by visitors. Likewise, the establishment of guidelines for waste management, including the proper disposal of sewage, garbage, and hazardous substances is strongly recommended. The use of non-toxic/ environmentally friendly cosmetics should be encouraged and promoted.

5.1.2 Fort Rocky Entertainment Zone

Proposed Development: Entertainment events at Fort Rocky Entertainment Complex and Historical Tour. The focus here is on the 20th Century British Naval presence as well as an entertainment venue. It is proposed that the venue will include an administrative building, event/exhibit spaces, bar, (audio) master control tower, viewing deck, public rest rooms and souvenir/ gift shop.

Issue: Limited parking

Fort Rocky's current location (i.e., along Port Royal's only point of entry/exit) and surrounding environment (i.e., coastal/wetland vegetation in sandy substrate) do not provide for any sort of extensive parking options for patrons/visitors to the venue.

Issue: Impact on Fauna

Endemic faunal species that inhabit and utilize the area (for e.g., bats, crocodiles, and sea turtles) could be impacted by noise and light pollution generated by entertainment events.

Development Guidelines:

The implementation of a shuttle system to Fort Rocky is strongly supported in light of the limited parking options. Further consultations are required to determine the viability as well as the potential environmental impact of removing a very limited area of the surrounding (mostly coastal scrub) vegetation to facilitate a parking area. Although no removal or any kind of disturbance of the area is preferred, an appropriate parking area is considered necessary to prevent unregulated parking, for example, along the road and/or in ecologically sensitive areas. Where possible, the use of turtle-safe lighting should also be considered near known and potential nesting areas. More targeted faunal assessments may be necessary to establish baseline conditions for some nocturnal species- for example the existing bat population near Fort Rocky. This may be necessary as during our assessments some expected chiropteran species (for e.g., fish-eating bats such as *Noctilio leporinus*) were not observed but have been reported previously in the area. More extensive (temporal) monitoring of the area is also recommended with a focus on these chiropteran populations.

5.1.3 Waterfront Experience

Proposed Development: The Historic Royal Naval Hospital, including the waterfront from the Old Naval Dockyard to Morgan's Harbour Hotel. The proposed activities on the waterfront are provided in Table 5-1 below, specifically items 4, 6, and 10.

Table 5-1: Proposed Waterfront Experience

Historic Royal Naval Hospital to Old Naval Dockyard	Old Naval Dockyard to Morgan's Harbour Hotel
1. The established Ferry Pier 2. The Fisherman's Beach 3. The existing Gloria's Restaurant	6. Seaside gourmet restaurants of fine local and international cuisine

4. Boardwalk 5. Other commercial activities in support of the town	7. Limited parking and transportation options for traversing through the town 8. Visitors centre and rest stop incorporating ticketing, exchange facilities, offices, toiletry, and a Jamaica Tourist Board kiosk. 9. Interpretive centre with simulations dedicated to Port Royal's Naval History (incorporating the Jamaica Defence Force Coast Guard), and Kingston Harbour 10. New ferry terminal and marina with customs and possibly the relocated Police Station 11. St. Paul's Archaeological Park and Craft Bazaar

Other activities envisioned for the coastline include incorporating existing businesses such as the Royal Jamaica Yacht Club to facilitate activities like pleasure boating, yachting and recreational fishing; Morgan's Harbour Hotel Marina to facilitate diving and snorkeling as well as harbour activities such as kayaking/canoeing, jet skiing and other motorized and non-motorized sports.

Issue: Anthropogenic-induced pollution

Poor water quality resulting from anthropogenic influences including (but not limited to) catch and by-catch discard, sewage effluent discharge and solid waste pollution from storm water run-off, are already issues that exist in the study area.

Development Guidelines:

Regular Monitoring of Oils and Grease: The implementation of a regular monitoring program to assess the presence of oils and grease in nearshore and coastal waters is recommended, particularly in the vicinity of restaurants and other known and potential pollution sources. This monitoring regime can help with the early identification of any sources of contamination and can further help enable appropriate mitigation measures to be taken.

Regulations and Guidelines for Diving and Snorkeling: Recognizing the existing diving and snorkeling activities in Port Royal (e.g., Yardie Environmental Conservationists), the development of regulations and guidelines is recommended to ensure safe practices and minimize possible impacts on the marine environment. These regulations should address issues such as diver behavior, protection of sensitive habitats, and proper waste management (inclusive of catch and bycatch discards).

Management of Boating and Yachting Activities: Given the active boating and yachting culture associated with Port Royal, including the presence of the Royal Jamaica Yacht Club, the development of management strategies is necessary to minimize negative impacts on the marine environment. This may include

guidelines for responsible boating practices, waste management on vessels, and protection of marine habitats.

Consideration of Motorized vs. Non-Motorized Sports: The viability of motorized and non-motorized sports activities should be determined based on factors such as (but not limited to) water quality and boating traffic. Regular water quality assessments would therefore be necessary, particularly in areas like Kingston Harbour, to determine if body/skin contact is recommended. Where water quality is a concern, the restriction or limitation of motorized sports is recommended to prevent further pollution and disturbance to sensitive marine environments.

Environmental Impacts of Motorized Sports: The environmental impacts associated with the operation of motorized sports in Kingston Harbour may need assessment to include noise disturbance for marine animals and destruction of sensitive marine habitats. Non-motorized alternatives that have minimal ecological footprints should alternatively be promoted.

Aesthetics: The establishment of the waterfront experience would serve as a good face-lift for the Port Royal Town. Apart from the heritage structures that exist, that section of the town center is in need of a facelift and as such this boardwalk and physical interventions planned for this area will serve to positively enhance the area.

Issue: Natural Disasters (Earthquakes, Tsunamis, Hurricanes and Storm Surges)

Port Royal, due to its geographic location and historical events, remains highly vulnerable to various natural disasters. The risks associated with these events are further heightened by the impacts of climate change impacts, including sea level rise, global warming, ocean warming, and acidification.

Development Guidelines:

The following guidelines listed below are recommended to enhance Port Royal's resilience and preparedness with respect to natural disasters. These measures aim to minimize the potential impacts of earthquakes, tsunamis, hurricanes, and storm surges, protecting both the community and its valuable assets from the devastating effects of such events:

i) **Enforcement of General Natural Hazards Adaptation and Mitigation Measures:** The implementation and enforcement of measures to adapt and mitigate the risks posed by natural hazards are strongly recommended in Port Royal. This includes the development and enforcement of improved building codes that incorporate resilience against earthquakes, hurricanes, and storm surges. These codes should ensure that structures are designed and constructed to withstand the forces exerted by these events.

ii) **Development of Hurricane Preparedness Plans:** The creation of comprehensive evacuation plans and procedures, specifically tailored to potential hurricane impacts, is advised. These plans should outline evacuation routes, designated shelters, communication protocols, and emergency response strategies. Additionally, the adoption and utilization of modern hurricane forecasting tools can significantly

enhance preparedness efforts by providing timely and accurate information to residents and authorities.

iii) **Climate Change Adaptation Measures:** Implementation of measures to mitigate and adapt to the impacts of climate change in Port Royal is recommended. This includes initiatives to reduce greenhouse gas emissions and promote sustainable practices. By addressing the root causes of climate change, such as transitioning to renewable energy sources and implementing energy-efficient measures, the area can contribute to global efforts in reducing the intensity and frequency of extreme weather events.

iv) **Earthquake-Resistant Building Codes:** There is a need to establish and enforce in Port Royal building codes that prioritize earthquake resistance. This involves incorporating structural designs and materials that can withstand seismic forces. Additionally, promoting public awareness and education about earthquake safety measures can help enhance preparedness and response capabilities in the event of an earthquake**.**

v) **Tsunami Warning and Education System:** The development of a comprehensive tsunami warning system that includes early detection and timely dissemination of alerts to residents and visitors in Port Royal is also critical. Alongside the warning system, educational campaigns should be implemented to raise awareness about tsunamis, their potential impacts, and proper evacuation procedures. This will ensure that individuals have the knowledge and understanding to respond effectively in the event of a tsunami.

Issue: Water Quality

Water pollution in Port Royal is expected to worsen during and after the proposed development, especially if the existing infrastructure is not updated. The water quality data indicated that areas with high levels of anthropogenic activity (for e.g., the Cruise Ship Pier and the Fishing Village) had notably higher contamination by fats, oils and grease, microorganisms, as well as higher levels of turbidity and total suspended solids. Increasing human activities, especially in these areas, is expected to further amplify the contamination of surrounding waters and thus, further deteriorate water quality. Likewise, additional restaurants and other sources of pollution in the area will increase the likelihood of further contamination of the waterfront, particularly with fats, oils and grease, organic loading, and nutrients. Such pollution could also attract native predators, such as crocodiles, and further impact any plans for in-water recreational activities in these areas. The hypersaline lagoons observed in Port Royal appear to be important ecological habitats for many species, therefore any disturbance of these areas is not recommended as could cause irreversible damage to these unique ecosystems.

Development Guidelines:

The following guidelines are recommended to minimize potential negative impacts of the planned activities on the water quality within the project area:

i. Proper management of sewage, trade and surface runoff into the sea is needed, and the possibility of reusing treated effluents to reduce coastal enrichment should be considered.
ii. Proper management of catch and bycatch discards, particularly within Fishing Village

iii. Proper monitoring and enforcement are needed to ensure that regulatory requirements are not breached should they be employed (e.g., the use of oil/water separators or grease traps; regular drain cleaning and maintenance).

iv. The impact of an increase in water pollution with respect to the existing historical infrastructure and ecology should be carefully evaluated and the necessary planning done to mitigate any adverse impacts.

5.1.4 Conservation areas – Port Royal Mangroves, Refuge Cay, and most of the Port Royal Cays

Proposed Development: The Palisadoes-Port Royal Protected Area Zoning Plan speaks to conservation of the majority of the Port Royal mangroves (inclusive of Refuge Cay), as well as the coastal scrub vegetation dune ecosystem located east of the town. Included in this zoning is the archaeological site of Fort Rupert, which is included in a proposed eco-park. The proposed eco-park would also include the entire wetland area extending from Port Royal to the airport and encompassing Refuge Cay and all boat refuges. General upgrades to the area in keeping with a national park environment will include elements of security and safety and proactive management, due to the extensiveness of the area. The responsible facilitation of active and passive recreational activities and eco-attractions will further strengthen Port Royal as a prized destination.

Issue: Insufficient details of proposed designs

Design details for some components of the project are not yet available. Detailed designs may entail removal and/or modification of the natural environment including habitats such as wetlands, sea grasses, coral reefs, and woodland areas. If wetland areas are removed/damaged during project activities, this could result in a loss of critical habitat and ecological services. The removal of mangrove forests and seagrasses may also result in the release of years of stored/sequestered carbon into the atmosphere (as CO_2).

Development Guidelines:

i. The development of a conservation area or (Palisadoes) Marine Park is strongly supported.

ii. The University of the West Indies' Port Royal Marine Laboratory (PRML) – located amidst the sites for Lime Street, Chocolata Hole and the Historic Royal Naval Hospital – currently provides guided tours through the Port Royal mangroves and in Kingston Harbour. There is also a Biodiversity Centre that hosts interactive exhibits to facilitate continued interest and learning. The creation of a Palisadoes Marine Park, to operate in conjunction with the PRML, can help bring solutions to any identified ecological problems.

iii. To comply with the 'no net loss' policy adapted by NEPA, an ecological assessment may be required in areas proposed for removal or modification including terrestrial, coastal, and/or marine environments. This may include the area planned for boardwalks within the wetlands. This requires that detailed design features be made available. Where site-based activities are unable to mitigate biodiversity and/or habitat loss, then compensation mechanisms will need to be considered. These may include off-site

environmental compensation to improve environmental function or representation of the habitat or species elsewhere.

iv. Ecotourism activities can be enhanced if floral populations are adequately preserved; this will also lead to faunal populations being maintained. Recommended (sustainable) attractions for the area include establishing bird feeding and watering stations at strategic points to showcase birdlife in the area. Necessary buffers and prohibitive fencing are also recommended to protect ecological assets; likewise, appropriate signage with information on the various ecological assets in the area (including restricted/prohibited sites and/or activities that are detrimental to the area's ecology) is strongly recommended.

v. The treatment of the overall development in a wholistic manner is supported. For example, addressing solid waste, drainage, and sewage issues collectively, can lead to a cumulative benefit of preserving sensitive habits in the project area so that the community can benefit from a myriad of ecosystem functions along with the ecotourism benefit.

vi. As with the development of the historic attractions, a body for oversight, approvals and monitoring is necessary to safeguard these initiatives. Consideration should therefore be given to the implementation of management offices for the proposed Marine Park to provide oversight of the natural environment of the protected area implementing both the Zoning and Management Plan of NEPA.

5.1.5 Recreational Cays

Proposed Development: The Concept Plan proposes organized excursions to the cays, and around Kingston Harbour. The possibilities for diving and snorkeling, recreational fishing, pleasure boating, yachting and harbour activities such as kayaking/canoeing, jet skiing, as well as both motorized and non-motorized sports are included in the Concept Plan for the general Port Royal project area. Any development of the cays, for swimming and other recreational activities, will however require guidance from the ongoing Carrying Capacity Assessment.

5.1.5.1 Lime Cay

Issue: **Pollution Control and Waste Management**

The accumulation of garbage, particularly plastic and food waste, is a significant problem on all the cays, particularly Lime Cay. This is primarily due to the small size and limited waste management infrastructure on the cays, thus making them prone to littering and improper waste disposal. Plastic waste poses a particular threat to marine life as it can entangle marine animals or be mistaken for food, leading to ingestion and subsequent health issues. An increase in food waste on Lime Cay could also ultimately negatively impact water quality by contributing to growth and the proliferation of harmful algal blooms.

Development Guidelines:

To address this issue, it is crucial to implement proper waste management systems, particularly on Lime Cay, the largest and most-utilized cay. This includes establishing regular garbage collection services for the already existing waste bins, providing additional waste bins or containers (if necessary), and

promoting recycling, waste segregation and composting programs. Public awareness campaigns and education initiatives can also help raise awareness about the importance of responsible waste disposal and encourage individuals to reduce their usage of single-use plastics, and properly dispose of their waste.

Issue: **Destruction of Sensitive Habitats (including benthos from anchoring)**

Lime Cay supports diverse and fragile habitats, including coral reefs, seagrass beds, and sandy beaches. Anchoring activities in these areas can cause significant damage to the benthic communities and disturb the substrate, eventually leading to erosion and loss of habitat. Additionally, boat anchors can directly damage coral reefs and seagrass beds, which are vital breeding and feeding grounds for many marine species.

Development Guidelines:

The development and enforcement of regulations to prevent the destruction of sensitive habitats are strongly recommended, including those that support benthic communities and coastal environments. This could involve the implementation of measures to minimize anchor damage, such as designated mooring areas and the installation of mooring buoys or environmentally friendly anchoring systems. It is also recommended that boaters and visitors be educated about the importance of responsible anchoring practices and the fragility of these sensitive ecosystems/habitats.

Lastly, regular monitoring and assessments of both marine and terrestrial areas Cay are recommended on Lime to identify any potential threats or impacts, as well as coordinate the necessary conservation actions.

Issue: **Disturbance of Sensitive Marine Organisms (e.g., sea turtles, waterfowl)**

Vegetated cays like Lime Cay, as well as their sandy beaches, often serve as important nesting and foraging sites for sensitive marine organisms, including waterfowl and sea turtles. Human activities, such as excessive noise, invasive beachfront development, and disturbance caused by recreational activities, can disrupt their natural behavior, nesting success, as well as feeding patterns.

Development Guidelines:

To mitigate disturbance to sensitive marine organisms, it is crucial to establish buffer zones or restricted areas where nesting and feeding activities occur. Designated wildlife protection areas can provide a safe space for these organisms to breed and forage without human interference. Public education programs and signage can further help inform visitors about the presence of sensitive species, as well as encourage them to respect these areas, maintain distance, and avoid causing disturbance. Sea turtle and crocodile nesting sites must be identified, visitors and residents sensitized to such areas, and adequate lighting designs in these areas should minimize negative impacts on adults and hatchlings.

The following additional measures are recommended to minimize potential negative impacts to sensitive marine habitats and organisms, particularly waterfowl/avifauna in the project area:

i. Avoid regular visitation to known bird habitats (e.g., less frequent visits and/or specific times for visits).
ii. Regulate vessels to approach bird habitat areas indirectly.
iii. Develop hyde for camouflage.
iv. Develop birdlife identification and other mitigation/interpretative training for residents.
v. Use of optics (binoculars) at a distance for birdwatching.
vi. Local participation with Port Royal residents (e.g., birdwatching clubs).

Issue: **Rodents and Invasive Species**

Lime Cay has, in the past, been affected by human associated rodents, in particular rats. An increase in visitor traffic could cause the proliferation of other human associated rodents such as mongoose, cockroaches, dogs, and feral cats. These rodents/non-native species can pose a significant problem on the cay especially when there are inadequate waste management practices and/or food sources readily available. Rodents can damage infrastructure, contaminate food supplies, and pose a threat to the survival of endemic fauna such as nesting birds and other small wildlife (e.g., reptiles).

Development Guidelines:

To control rodent populations, it is essential to implement effective rodent control measures. This may include regular monitoring and maintenance of waste disposal areas to prevent access to food sources; and/or the implementation of proper food storage practices to minimize attractants for rodents. If necessary, traps or environmentally safe rodenticides can be used in a targeted and controlled manner to reduce rodent populations while minimizing negative impacts on the ecosystem. Domestic animals and pets should also be prohibited on the cays.

Issue: Endemic/Endangered/Protected Species

Protected species such as the American crocodile (*Crocodylus acutus*) and Hawksbill turtle (*Eretmochelys imbricata*) have long utilized beach areas in Port Royal (including Lime Cay and other offshore cays) as nesting areas. An increase in visitor traffic (and associated impacts) could have deleterious effects on these already threatened populations, as well as increase the frequency of human-attack incidents. Other native fauna may likewise be impacted by increased noise and light pollution for example, and/or the alteration of the existing natural habitat.

Development Guidelines:

Regular monitoring and surveying are recommended to assess the population status of all (Port Royal) native species, in particular endemic/ endangered/protected fauna and flora before, during, and after project activities. Turtle and bird safe lighting are recommended to avoid visibility from sea and predation.

5.1.5.2 Maiden Cay

Issue: Destruction of Sensitive Habitats (including benthos from anchoring)

As with Lime Cay, engaging in anchoring activities around Maiden Cay has the potential to cause comparable harm to the benthic communities and, ultimately, the sandy shoreline of the cay. For instance, the direct harm inflicted on coral reefs and seagrass beds (for e.g., from anchor damage) can have a direct negative effect on crucial breeding and feeding areas for a variety of marine species. Additionally, the disruption of the seabed can indirectly contribute to erosion and the depletion of the sand over time. This can eventually impact sea turtle nesting for example, which has been documented on Maiden Cay in the past (Eckert and Eckert 2019).

Development Guidelines:

It is essential to establish designated mooring areas or install environmentally friendly anchoring systems/measures that minimize damage to the seabed. These measures can include using mooring buoys or implementing anchor-free zones to protect sensitive habitats. Educating boaters and visitors about the importance of responsible anchoring practices and the fragility of these habitats can also help reduce the impact on sensitive ecosystems. Regular, systematic monitoring of Maiden Cay is also recommended, in particular the surrounding water quality.

5.1.6 Port Royal Recreational Beach

Proposed Development: It is proposed that the Port Royal beach be maintained as a recreational area and enhanced to accommodate swimming and other recreational activities.

Issue: Planned Recreational Activities

There are some activities being proposed that may need to be reconsidered. For example, motorized and non-motorized sports such as kayaking/canoeing and jet skiing. These activities are not necessarily safe given the commercial use of the harbour for transshipment; as well as current laws that prohibit the use of motorized sports in Jamaica. Furthermore, there have been reports of turtle nesting sites, particularly along the eastern section of the Port Royal beach, which could potentially be deleteriously impacted by any increased recreational activities. Similarly, swimming, diving, and snorkeling may also not be viable activities within most of Kingston Harbour. It may be possible for zones to be established where such activities may be allowed in the project area, however, due to safety reasons including poor water quality conditions and visibility as well as the possible presence of nesting crocodiles, it may be best to limit recreational activities and numbers around designated Cays. This will be explored further in the Carrying Capacity Assessment.

Development Guidelines:

While most nearshore areas may not be ideal for swimming or water sports, these areas appear suitable for lyming, picnicking, and other social gatherings. This could be further supported by the provision of adequate waste receptacles and a proper maintenance programme for the cleanup of solid waste and old debris. The area could also possibly accommodate a limited number of temporary structures (for e.g., small commercial stalls, shops, or bars) as well as park benches and tables. Discussions will need to be had

with the Port Authority to determine if there may be specific zones within the project area with limited numbers where non-motorized activities may possibly be allowed. This will be explored and further examined and reported on in the Carrying Capacity Assessment.

Issue: Transportation to/from beach and cays

One potential issue associated with the increased usage of, and transportation between beach areas and the offshore cays, is the potential for an increase in transportation-related pollution. Transportation-related pollution refers to both solid waste pollution directly generated during transport (e.g., between land and cays), as well as air and noise pollution from vessels. Another (indirect) associated impact during transportation includes structural (physical) damage to benthic habitats and ecologically sensitive environments.

Development Guidelines:

General measures recommended with respect to the coastal environment include the following:

- Anchor buoys for vessels in key recreational areas (e.g., Lime Cay, Maiden Cay, Port Royal Beach, etc.) to avoid potential damage to the benthic habitats.
- Signages to educate visitors on delicate and unique ecosystems as well as to guide visitors away from these sensitive habitats.
- Development of proper management guidelines and practices to be implemented. For example, beach safety flags (green, yellow, or red) and marine life (e.g., jellyfish) safety flags (green or purple) could be utilized.
- Adequate and regular garbage collection would be needed, especially with increased traffic on the beach.
- Beaching of seaweed tends to be episodic, therefore management plans can be developed to coordinate clean-up efforts when such beaching occurs.
- Development and implementation of nature-based ecotourism along the Caribbean-facing sandy beach at Port Royal, as well as several exposed offshore cays. This complements the history and culture-based plan.
- Maximization of public and mass transportation or walking, to the beach.
- Lifeguards are recommended to ensure swimmer safety.

5.1.7 Gun Boat Recreational Beach and Marina Area (A3)

Proposed Development: The Concept Plan explored the proposal for swimming at the Gunboat Beach, diving and snorkeling, recreational fishing, and the sustainability of harbour activities such as kayaking/canoeing, jet skiing, both motorized and non-motorized sports.

Issue: Recreational Fishing

Recreational fishing, while currently a popular activity in some areas along the Palisadoes strip including Gunboat Beach, can have negative impacts on fish populations and the overall ecosystem within the

protected area. Overfishing and/or improper fishing practices, such as using illegal gear or catching undersized fish, can also disrupt ecosystem balance, and eventually lead to the decline of target fish species and other marine organisms.

Development Guidelines:

Recreational fishing is not recommended at Gunboat Beach due to its situation within the Palisadoes-Port Royal Protected Area (P-PRPA). However, if recreational fishing were to be permitted, the following measures are proposed:

d. Establish fishing regulations – Implement and enforce fishing regulations within the protected area, including catch limits, size restrictions, closed seasons, and designated fishing zones. These regulations should be communicated to the public through signage, education campaigns, and collaboration with local fishing communities.
e. Promote sustainable fishing practices – Educate recreational fishermen about sustainable fishing techniques, including proper handling and release of non-target species, use of barbless hooks, and avoidance of sensitive habitats. Additionally, the use of sustainable gear and techniques, such as catch-and-release practices or selective fishing methods should be encouraged.
f. Monitor and enforce compliance – Regularly monitor fishing activities within the protected area to ensure compliance with regulations. Collaborate with local authorities, fishing organizations, and community members to report any violations and take appropriate enforcement actions.

Issue: Poor Water Quality

Poor water quality conditions can impede any plans for swimming/diving and can likewise have detrimental effects on the health of marine ecosystems, including coral reefs, seagrass beds, and fish populations. Sources of water pollution can include untreated sewage discharge, run-off from agriculture and/or more urbanized areas and improper waste disposal.

Development Guidelines:

c. Enhance monitoring and water quality assessment: Regularly monitor water quality parameters such as nutrient levels, dissolved oxygen, pH, and pollutants. A robust water quality monitoring regime can help to identify sources of pollution and guide appropriate remedial actions.
d. Improve wastewater management: Implement proper sewage treatment systems to prevent untreated sewage discharge into surrounding coastal waters. Encourage boaters and visitors to use pump-out stations or onshore facilities for waste disposal.

Issue: High Boating Traffic

High boating traffic can result in physical damage to sensitive habitats, disturbance to marine organisms, and increased risks of accidents or collisions within the protected area.

Development Guidelines:

d. Establish boating regulations: Implement speed limits, no-wake zones, and designated boating channels within the protected area to minimize impacts on sensitive habitats and wildlife. Enforce compliance with these regulations through regular patrols and education campaigns.
e. Provide boater education and outreach: Educate boaters about the importance of responsible boating practices, including avoiding sensitive areas, reducing engine noise, and properly disposing of waste. Promote the use of environmentally friendly boating equipment and encourage boaters to respect marine life and habitats.
f. Improve boating infrastructure: Develop adequate mooring and docking facilities to minimize anchoring damage to seabed habitats. Install navigation aids and markers to guide boaters and prevent accidental damage to coral reefs or seagrass beds.

5.1.8 Port Royal Green Spaces

Proposed Development: Various open spaces are proposed for camping and other recreational activities for both visitors and residents; this includes the possible use of Fort Rupert which is marked on the Concept Plan. The entire Caribbean Sea frontage, extending back to the main road is designated public open space, containing two beach areas and parkland. The lagoon at the entry to Port Royal is to be landscaped as a picnic area, while extensive areas along the southern and eastern sections of the Palisadoes are also designated as open space due to the unsuitability of this area for permanent structures. These areas are proposed for extensive landscaping to provide recreational spaces for the surrounding communities (i.e., Harbour View and Port Royal).

Issue: Loss of critical habitat and services

Port Royal's natural environment includes extensive mangrove wetland forests, seagrass beds, and coral reefs, all of which provide diverse critical services to the area including (but not limited to):

i. a habitat for a diversity of organisms (including endemic/threatened species)
ii. a nursery/refuge area for larva and juvenile spp.
iii. protection from storm surges (e.g., coral reefs and mangroves)
iv. important carbon sinks (e.g., mangrove and seagrass)
v. a food source for fauna (e.g., seagrass)

Any alteration of the naturally occurring environment (for e.g., the loss or removal of such habitats) could therefore impact the critical services/functions they provide.

Development Guidelines:

A mangrove restoration/compensation plan is recommended for development, as guided by the regulators (i.e., NEPA), to mitigate against any mangrove loss including inadvertent removal and destruction.

Developers and stakeholders should also be required to conduct thorough environmental impact assessments for any proposed projects or activities in Port Royal. These assessments should evaluate the potential environmental impacts and provide mitigation strategies to minimize negative effects on the

surrounding ecosystems. Strict adherence to these assessments will help ensure sustainable development practices and the protection of the area's natural resources.

5.1.9 Housing Solutions

Proposed Development: The main objective of the proposed Housing Strategy is to assess and provide improved housing solutions for the existing occupiers of the Port Royal Brotherhood Apartments with inclusive and suitable amenity space through collaborative implementation. The Housing Strategy proposed 198 families/households to be housed in 60 new buildings and 138 reconstructed units. Figure 5-3 illustrates the project area and the areas outlined in red are the locations being proposed for the housing solutions.

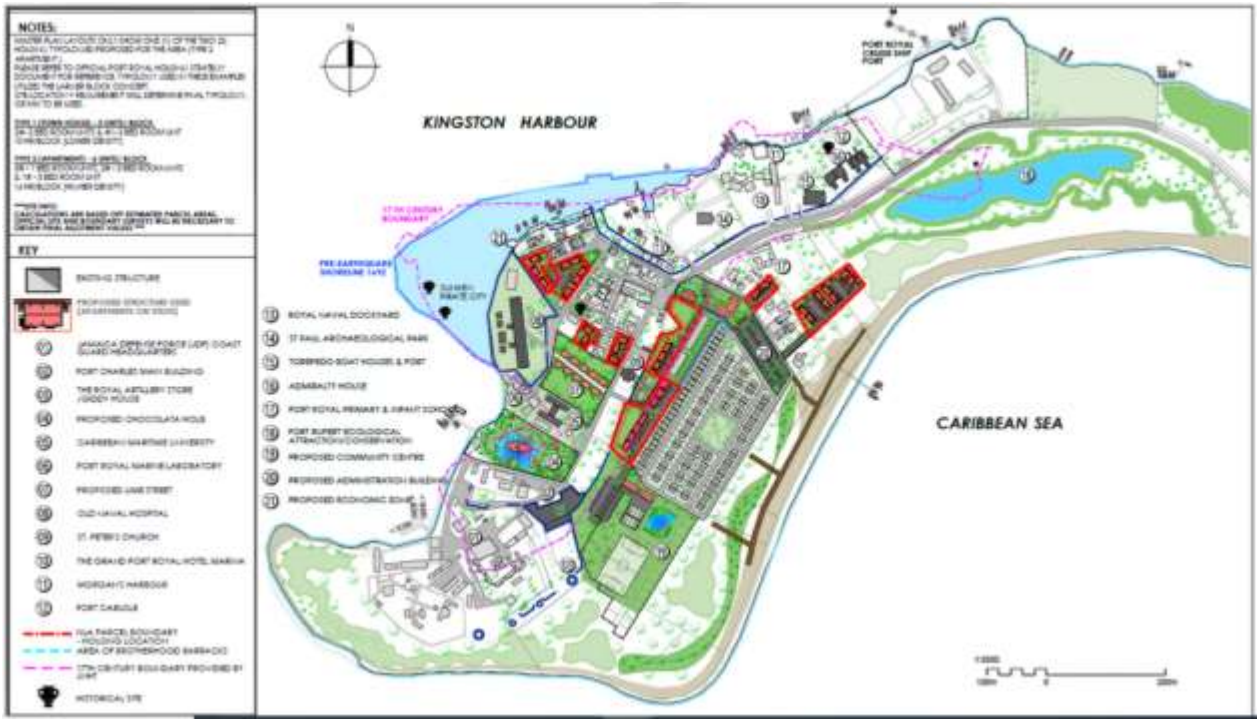


Figure 5-3: Housing Strategy for Port Royal

Issue: Geology and Soils

As mentioned in Section 4.2.1, the area is dominated by unconsolidated, sandy soil and noteworthy of mention is the considerably shallow (<5m) water table below the surface. This not only places restrictions on potential building designs for the proposed housing solutions, but poorly designed and maintained sanitation systems can potentially contaminate the groundwater resources in the area based on the soil permeability and water table depth.

According to the Geotechnical Investigation conducted (see Appendix VI), most of the sites investigated will undergo minimal risk for the settlement of foundations, where it is expected to be short term and that most of the settlement would occur during the construction phase of the project. However, at

borehole 9, in the vicinity of Broad Street and Queen Street (where there are plans to demolish the existing houses and rehabilitate the area), there is a high risk of excessive ground settlement. This excessive settlement poses a negative risk to the proposed construction of three (3) blocks, consisting of eighteen (18) apartments and nine (9) townhouses.

The site proposed for the development of housing solution 'D3' could also be at risk of storm water settlement in its current state and poses additional risks relating to the transfer of stormwater to the nearby Port Royal Primary School and adjacent commercial entities. This is primarily due to the topography, where there is a shallow depression on site and fill material present.

Development Guidelines:

It is recommended that there be full enforcement of both building height restrictions, as well as strictly ***no building*** in some areas**. The following additional measures should also be considered:**

i. Buildings should be appropriately designed to the typical ground acceleration forces anticipated.
ii. Unconsolidated soils can have differential settlement during earthquakes and any buildings zoned for these areas will require a detailed site-specific geotechnical assessment to ensure the foundations are appropriately designed. Recommendations from the geotechnical assessment for foundation design should be adhered to. Otherwise, these locations should be avoided or maintained as green/open areas.
iii. Groundwork, footings, foundations should all be designed in light of geotechnical assessment and applicable building codes for the anticipated earthquake intensity and return period. Similarly, buildings and structures should conform to best practice design and construction for earthquake impact. Building foundations must also consider additional factors including (but not limited to) the general geology of the area, the water table depth, and the conditions of sub-surface materials. Geotechnical investigations should further inform building siting as well as designs. Where the findings of the Geotechnical Investigations warrant additional studies, these should be strongly considered.
iv. Recommendations for grading on sites, in particular D3, should be followed to reduce risk to the proposed construction and surrounding properties.

Issue: Topography

The topography of the P-PRA is generally flat, as evidenced by frequent inundation in some areas, stagnant water, and multiple hypersaline ponds especially near low-lying, coastal areas. This, along with the predominantly sandy soil in the area will likely restrict some building designs and types in Port Royal.

Development Guidelines:

The following measures are recommended to ensure that the challenges posed by the flat topography and sandy soil in Port Royal are addressed effectively, resulting in resilient and sustainable housing solutions that harmonize with the natural environment:

i. Identify high-risk areas and establish appropriate setback distances to avoid construction in vulnerable zones (e.g., low-lying areas).
ii. Engage architects and engineers experienced in working with flat topography and sandy soil conditions and integrate the natural topography into the design and layout of the development.
iii. Implement appropriate drainage systems, including stormwater management techniques, to prevent water accumulation and ensure efficient runoff.
iv. Since proposed residential housing solution lots are no greater than 4 hectares, lot level and conveyance controls such as roof-top storage, parking lot storage and green-area storage, could be implemented to detain stormwater and reduce peak runoff rates.
v. Implement soil stabilization techniques, such as compaction, soil improvement, or reinforcement, to enhance the load-bearing capacity of the predominantly sandy soil.
vi. Design and construct foundations that are suitable for the specific soil conditions, considering factors such as settlement, bearing capacity, and lateral stability.
vii. Develop a comprehensive flood mitigation strategy that includes measures to minimize the impact of inundation events.
viii. Implement coastal protection measures, such as the construction of seawalls or levees, or bioremediation measures (e.g., utilizing mangroves), to safeguard low-lying coastal areas from storm surges and tidal flooding.
ix. Incorporate sustainable drainage systems (SuDS) to manage stormwater runoff, reducing the risk of stagnant water and improving coastal water quality.
x. Implement strategies for water conservation and reuse to minimize the strain on freshwater resources.
xi. Promote the use of permeable surfaces and rainwater harvesting techniques to enhance water infiltration and reduce the burden on drainage systems.
xii. Educate residents, developers, and stakeholders about the challenges and opportunities associated with the flat topography and sandy soil.

Issue: Faults and Seismicity

Port Royal has experienced an active seismic history, including two major/catastrophic earthquakes in 1692 and 1907. Seismicity mapping in the area has indicated that there is a concentration of seismic activities in Jamaica's eastern parishes of St. Thomas, Portland, and Kingston and St. Andrew. It is unknown whether or not construction activities may induce further seismic vulnerabilities but based on the aforementioned seismicity mapping (see Section 4.2.1.3), as well as from historical evidence, there is high risk and likelihood of continued seismic activities after redevelopment.

Development Guidelines:

Building designs should mandatorily include considerations/adaptations for high magnitude earthquakes as well as their potential primary and secondary hazards (i.e., aftershocks, tsunamis). Emergency response plans should also be developed and implemented to guide the management of hazard responses during and after construction activities.

Issue: Air Quality and Noise

Areas with increased vehicular traffic or near main thoroughfares were observed to have higher levels of noise pollution and airborne particulate matter. These forms of pollution can impact the quality of life and health of people in the area.

The phased development approach being proposed for the project means that construction may be ongoing in populated zones. It is also expected that there will be an increase in vehicular traffic, as well as commercial and domestic activities (e.g., trucking of construction material and heavy-duty equipment, burning of garbage, etc.). These activities will inevitably lead to an increase in both air and noise pollution.

Development Guidelines:

The following guidelines are recommended to mitigate potential negative impacts on the air and noise quality in Port Royal as a result of the planned construction activities:

- Continuous and adequate monitoring is recommended to ensure appropriate mitigative measures are being employed (e.g., dust screening, wetting of areas, etc.).
- Designated times for construction activities should be implemented in order to minimize the impact of noise pollution on residents in the area.
- Traffic management protocols should likewise be implemented to minimize the impact of both air and noise pollution in the area.
- Stockpiles of construction supplies/materials should be covered to prevent airborne particulates, and properly burned where applicable.
- Sediment screens may also be placed around areas where stockpiles of (covered) construction material are stored.

Issue: Occupational Health and Safety

Improper/Inadequate occupational health and safety measures during the construction and operation phases of the development could be detrimental to workers, employees, visitors, and the public in general. The magnitude of the proposed development presents a statistically higher likelihood of accidents and incidents where safety is at risk and therefore warrants that these rules and principles be applied to all aspects of the development.

Development Guidelines:

Safety training must be provided to all construction workers and should be a requirement for all the individual work sites throughout the duration of the project. Most major industrial entities and large contractors in the country apply high safety standards and as such, models for implementation in the Jamaican context are readily available. This is an essential requirement for the construction phase of the project and should be required for all entities that will access the project sites.

Post construction, all entities must implement OHS protocols and should all have specific programs developed that provide training for the entire workforce. This is important for the safety of visitors and residents during the operational phases when the various tours become readily available for leisure and educational purposes. An Occupational Health and Safety Management Plan should be developed to outline the necessary management actions for both the proposed construction activities as well as the operational phases of the implemented activities. This management plan must be mandated. Appropriate signage should also be in place to identify the various risks and hazards on the site. Provisions of the required personal protective equipment must be made for all workers employed by the developer. Sub-contractors must also ensure that their staff are appropriately outfitted.

5.1.10 Physical Infrastructure

5.1.10.1 Sewage and wastewater system

Proposed Development: The concept in summary is a network of gravity sewers, which convey to two lift stations (See Figure 6-3) and subsequently pump to a new treatment station which is proposed to be located on the property that will accommodate the port development. Two lift stations will be utilized, one in the north section (beside the post office) and the second one to replace the malfunctioning HAJ plant. The concept conveys the sewage east from the harbour's coastline to lift station 1. The maximum pipeline excavation is expected to be about 1.5m (5ft). The HAJ development is already sewered and would invariably capture those sewered flows into lift station 2 at the back of the general proposed recreational area. The concept also makes provision for agencies such as the Coast Guard, CMU, the Police Station, the Primary School, and restaurants to connect to the system. The connection of restaurants and homes will need to be retrofitted on an individual basis to provide grease traps to prevent its inclusion into the system.

Figure 5-4: Proposed Sewerage Treatment and Disposal Plan for Port Royal

Issue: Sewage and Wastewater Management

The existing sewage treatment plant at Harbour View is currently at maximal capacity, therefore, any new development in this area (i.e., Zone **A1**) must either provide its own treatment facility or expand the capacity of the NWC plant; the latter is recommended to avoid having multiple facilities.

Zone **A2** (located along the Palisadoes Strip, between the Harbour View Roundabout and the Airport Roundabout) is regularly utilized by people for exercise and other recreational activities (e.g., cycling, catch-release fishing, etc.), particularly on the weekends. The parking area opposite the entrance to Gunboat Beach is similarly used for recreational purposes, as well as a waiting area for people awaiting flights but do not necessarily wish to utilize the paid parking system at the airport. There may be a need for public sanitary conveniences in these areas (Zone **A2**).

Zone **A3** includes facilities such as the Royal Jamaica Yacht Club, the Caribbean Maritime University, and the now defunct Buccaneer/Gunboat Beach facility. Each facility has its own sewage disposal system including subterranean disposal systems in absorption pits. There are two recommended options for improvement of the disposal of sewage effluent in this zone (Zone **A3);** these are outlined further in Section 10 below (Consideration of Alternatives).

The airport complex, which represents Zone **A4**, already has its own sewage treatment facility, but could facilitate future expansion to receive additional loads from the adjacent area (Zone **A3**)**.**

Fort Rocky, located in Zone **A5,** is approximately 2 km from the Cruise Ship Pier at Port Royal and it would therefore be impractical to pump sewage over such a long distance.

Development Guidelines:

Rather than the typical direct discharge of effluent into the harbour as now occurs at the airport plant, the effluent from the facilities should be discharged through the adjacent wetlands and/or used for irrigation along a practical length of the strip. This would significantly decrease and potentially eliminate any discharge directly into the already eutrophic Kingston Harbour. Discharge into the sea or south side of the strip is not recommended as seen from the example of the hurricane destruction of the outfall at the Harbour View plant.

In Zone **A3**, two alternate options for improving the disposal of sewage effluent both recommend consolidating the waste streams and directing them to the same location for treatment. These options are presented in Section 5.1.10.1.1 of this document (Alternate Sewage Treatment Design Options).

Fort Rocky (Zone **A5**) should have its own treatment system and the effluent could be distributed along the Palisadoes or discharged in a controlled manner through the adjacent wetlands, or used to create a wet area for plants that may need higher levels of water than the very dry/arid nature that the P-PRA provides. Most of the effluent would otherwise be subject to evapotranspiration.

If similar recreational or parking areas are developed (i.e., as present at Zone **A2**), then public sanitary conveniences should also be considered in these areas.

For waste disposal on the cays, the implementation of dry toilets is recommended. Dry toilets are both fairly inexpensive and relatively efficient for locations like Port Royal with low water supply. These are commonly used in hunting lodges and in deep rural recreational locations and can be prepped and vented to eliminate the main physical detractions from the use of latrines. Wet disposal of sewage should be prohibited on all cays as this may cause degradation of the water quality in close proximity; and further, the long-term consideration of emptying such systems when full may not be feasible. Disposing of composted solid waste is a much more practical option.

Lastly, the planning authorities, (i.e., NEPA/KSAMC) should conduct an analysis of the projected development in the P-PRA with an aim of extrapolating the sewage management needs in Port Royal in the medium and long term. Subsequent approvals and implementation would then be guided by this analysis.

5.1.10.1.1 Alternate Sewage Treatment Design Options

Royal Jamaica Yacht Club, the Caribbean Maritime University, and the now defunct Buccaneer/Gunboat Beach facility all have their own sewage disposal system including subterranean disposal systems in absorption pits. The following are recommended designs for two options to be considered in light of the planned developments:

1. Each facility would upgrade its collection network and convey the flows to a pumping station and then pump to the existing treatment plant that serves the airport. That plant would require upgrading to receive the increased flows, but there would be a single plant serving the wider area. Conveying the flows to the existing facility will require pumping, and the line must go across a

section of the wetland. The shortest over/underwater route would require a pipeline underground through the driveway in the Yacht Club and a pumping station at the western end of the Yacht Club Marina which would then have to cross an approximately 50-meter section of water. This pipeline could be laid on the floor of the lagoon, which would allow for passage of vessels above the pipe or carried across on an elevated pipe bridge; this would allow boats to pass beneath the pipe bridge. Once across this section, the pipeline could be laid underground alongside the existing facility. To convey the flows from Gunboat Beach to the existing plant will require a series of pumping stations at each of the existing facilities. The treatment technology could be simply an expansion of the activated sludge facility that currently exists, or designers may use optional treatment technologies for the additional flows. Sewage ponds would be unlikely because of the space required and the future demands on space, as the airport and its associated services expand.

2. Each facility would upgrade its collection network and convey the flows to a sewage treatment facility serving this area only. This would be a new plant. The Marina, the Caribbean Maritime University and the two beach areas would be connected to this single plant. The plant should therefore have the capacity to receive sewage from future developments as well as currently existing buildings, which are expected to expand (e.g., the Caribbean Maritime University). If sludge is generated, this can be dried and trucked away to a solid waste disposal site.

5.1.10.2 Water supply

Proposed Development: The population in Port Royal, as of the 2011 census, was 1,251 persons with an expected increase of up to 6,000 persons per day with the expansion of the hotel and installation of the port. The capacity of the existing NWC facility needs to be assessed to determine its capability to service the increased demand. Although this increase is not permanent, a temporary spike should nonetheless be considered to ensure the supply is adequate.

This would also be an ideal time to assess the supply main from Harbour View, which was last upgraded during the renovation of the Palisadoes corridor from Harbour View to the Norman Manley International Airport Roundabout. The main lines from NMIA to Port Royal were not upgraded during that renovation.

Issue: Water Supply

Port Royal is not connected to the island's central water supply system/network, but instead is essentially located at the end of a single node/line that serves the entire town. Water supply to Port Royal is currently delivered on a scheduled basis, this is further compounded by the absence of an alternate water supply option to Port Royal, therefore resulting in frequent disruptions for the entire area if or when there are water supply issues along any section of the main line.

Development Guidelines:

A new 12-inch high-density polyethylene (HDPE) pipeline is planned for implementation from the Airport Roundabout to Port Royal and was expected to be in service by 2023. This should help to alleviate some of the water supply issues currently being experienced in Port Royal (for e.g., the delivery of potable water on a scheduled basis). The NWC may also wish to consider and prioritize rainwater harvesting and

additional water storage regulations for new developments in Port Royal, for example, mandatory adaptations for rainwater harvesting and storage.

A detailed drainage design and plan needs to be prepared for the Port Royal area given the various developments being proposed in the Concept Plan. This should be submitted to the Municipal Corporation for approval to facilitate implementation in tandem with the proposed development activities. It would not be wise to further the construction and upgrade plans without ensuring that the road and drainage infrastructure are improved. The design should take into consideration climate change projections for the area, the inclusion of options for storm water management features as well as careful positioning of drainage outfalls away from sensitive ecological and social locations.

5.1.10.3 Road works and storm water drainage system

Proposed Development: A general upgrade of the road surface and drainage system from the Airport Roundabout to Port Royal town is included in the proposed redevelopment. An analysis of movement options is currently being conducted in the area and based on these results; the roadways will be upgraded. Road works are to include the application of public standards to streetscape in the town to make it pedestrian-friendly. In the town, there is a network of open drains with a system of non-return flaps that prevents sea water from flooding the town during storms or high tide. Wastewater flows from open channels in the housing yards to channels under the sidewalks.

Issue: Hydrology and Drainage

The Palisadoes-Port Royal Area (P-PRA) is generally low-lying and therefore highly susceptible to flooding. To compound this the P-PRA lacks natural surface hydrological features and has a severely deteriorated stormwater runoff drainage system, which currently serves the entire town**.**

Development Guidelines:

It is recommended that all new buildings constructed in Port Royal incorporate climate adaptation strategies (e.g., building on stilts to prevent flooding; hurricane- and earthquake-resistant construction; etc.). The proposed redevelopment of Port Royal should also address restoring or improving the existing (deteriorated) drainage infrastructure in the town.

5.1.10.4 Solid waste collection and management

Proposed Development: This must include daily domestic refuse collection and appropriate environmental awareness programs to be put in place such as recycling, proper disposal, and the strategic placement of waste receptacles.

Issue: Solid Waste

Solid waste pollution is already an issue in Port Royal, and this is expected to be exacerbated during project activities. The main considerations relate to the collection of construction and related material, as well as domestic litter and waste from restaurants and shops.

Development Guidelines:

These issues may be addressed with the placement of additional litter bins throughout the town in conjunction with regular collection. Adequate commercial disposal containers (waste skips) and a transfer station, for example on the outskirts of the town with waste compactors, should also be considered. This would not require regular trips by compactor trucks, which are frequently in inadequate supply, but instead, a transfer station with an appropriate number of storage bins and 'roll on, roll off' compactors could significantly help address the needs of the town. An intensive programme of plastic bottle separation and collection should be implemented as this would greatly help to improve the management of solid waste.

The current proposal for solid waste in the Concept Plan includes improvements in collection, placement of receptacles and recycling. However, with a project of this magnitude, outside of these well needed improvements, there is an opportunity for using integrated waste management approaches such as composting, waste separation and recycling, and this needs to be considered at the design stage so that the necessary infrastructure or space requirements can be put in place. This waste management approach can also be integrated into any improvements of the drainage design for the town of Port Royal, to include grills over open drains to prevent the clogging of drains, which is currently an issue.

Solid waste collection is not only required at various points throughout the town but also to ensure there are receptacles located along the Palisadoes Strip, between the Harbour View Roundabout and the Airport Roundabout, which is regularly utilized by people for exercise and other recreational activities.

5.1.10.5 Electricity supply

Proposed Development: The 4KV from the airport, which causes fluctuations of voltage in Port Royal, is to be upgraded. The Coast Guard Base has a Stand-by Generator. Streetlights in the town will boast period designs (17th, 18th Century); where feasible, the layout will be underground.

Issue: Underground Lines for Electricity Supply

Overall, the plan for electricity upgrades is a positive one for Port Royal. In laying underground lines, there are potential issues that can be associated with impeding pedestrian road users and vehicular traffic, potential concerns with health and safety of workers and road users as well as potential concerns with air quality and noise nuisance.

Development Guidelines:

The upgrades anticipated for the area will require excavation to lay lines underground. It is important that proper traffic management, stakeholder engagement, air quality measures, as well as general health and safety protocols are implemented. Such measures are typical in construction operations and are employed to ensure the safety of workers, community members and visitors as well as nearby business operators and residents.

5.1.10.6 Telecommunications

Proposed Development: Cabling and upgrade of landline and cell phone facilities will be implemented as is required in the town, after provider assessments.

Issue:

There have not been any reports of telecommunication issues within the area. Residents have options for internet access within their homes as long as they can afford it.

No issues were identified with the telecommunications plans for the area, but considerations are provided below to enhance access to locals and visitors.

Development Guidelines:

Considerations could be made for the library service to be enhanced to house an internet café for persons who may not be able to afford laptops and internet service on a consistent basis. This would be particularly useful for students. Alternatively, as the area develops, commercial businesses could offer wi-fi services to customers, which would be useful for visitors in the area especially as cruise ship passengers are expected to increase.

5.1.11 Social Infrastructure

Developing the community of Port Royal as a tourist destination encourages new infrastructure investment resulting in an improved overall standard of living as both residents and non-residents capitalize on higher income generated from tourist-related activities. However, the negative aspects of tourism may overshadow the positives as one considers the economic costs. The limited resources of Port Royal including (but not limited to) food, land, transportation, energy, and water supply may be placed under immense pressure from a growing tourism industry. The rising demand for these amenities could then result in other issues such as inflation, which is potentially detrimental to a community like Port Royal.

Proposed Development: The proposed developments in Port Royal, particularly relating to the social infrastructure, include an improvement of the following buildings and/or services**:**

- Community Centre
- Public Library
- Customs
- Post Office
- Schools
- Transportation (including bus, taxi, and ferry system)

Issues: Safety and Security

Port Royal is currently considered one of the safest communities in the KMA. Residents expressed concern that this could change with an influx of 'outsiders' (i.e., non-residents). Another concern was the likelihood of increased small level crimes.

Development Guidelines:

An increased police presence may be necessary to assure the public that the community is just as safe as it was prior to the development. The Police Station will also require an improved infrastructure along with the increased manpower, to enable officers to fulfil their mandate to serve, protect, and reassure both residents and visitors.

Issue: Location of Emergency Services

There is a Police Station and a Fire Brigade Station (with no operational fire truck at the time of report) located along Port Royal's southwestern coastline. This location, at the prime waterfront of the community, has long been challenged by the PRDCL as it compromises the heritage veneer of the community in that location.

Development Guidelines:

Although redesigned and still relatively new, these services are recommended for relocation to occupy a more centralized area.

Issue: Vehicular Traffic/Congestion

It is likely that road use will increase significantly creating potentially negative cumulative impacts associated with safety, noise, air quality, and traffic management. There are unknowns related to expected visitor traffic once the additional housing accommodations, the waterfront experience, and the boardwalk are constructed; likewise after the historical sites are upgraded to increase tours, and the ferry is re-established as another means of transportation.

Development Guidelines:

Traffic impacts will require detailed assessments for both the construction and operations phases of the project. These assessments will need to be conducted and a Traffic Management Plan prepared to guide and inform the transportation and upgrade plans for the town. Controlled parking can also be considered in the Traffic Management Plan. Traffic volumes and patterns may also need reassessment once the entire project is completed.

Issue: Parking

Parking in Port Royal may become increasingly more challenging as the development occurs and the town itself receives more visitors. This may create a negative impact on the daily lives of existing residents when they need parking for their own domestic events (for e.g., birthdays, weddings, and other gatherings). The use of the roadways by children may also become less safe with a high volume of visitor traffic.

Development Guidelines:

Remote parking should be introduced and enforced to reduce or eliminate vehicular traffic in the town, with only exceptions for Port Royal residents, employees, deliveries, and emergency vehicles. The existing commercial spaces can be used as overflow parking areas for residents, but all other visitors to Port Royal should utilize the proposed shuttle service. Such a shuttle system could be carried out by shuttle buses, wheeled trams, or a small rail system which would become part of the attraction of the town. Sidewalk and side street parking should be prohibited.

Issue: Availability of Local Labourers

Redeveloping a community such as Port Royal will require both the construction of new buildings, as well as renovation or refurbishment of existing infrastructure (e.g., housing, pipelines, sewage, etc.). This will therefore require both skilled and unskilled labour, and it would be prudent – and perhaps more efficient – to employ and involve local (Port Royal) labourers for the project. The surveys conducted in the community however highlighted the reluctance of most residents to become involved in non-fishing related employment. This viewpoint was observed and expressed across multiple age ranges and both sexes. Additionally, multiple business owners reiterated that they rely on 'drift coconuts' (i.e., outsiders) for their labour supply as residents are either unwilling to work or have poor work ethics. Another related issue pertaining to local labour is the potential for contention between residents and outsiders over job preference and availability.

Development Guidelines:

i. Preference should be given to Port Royal residents, where possible, for both skilled and unskilled labour needs pertaining to the project.
ii. The use of mostly local labour could also help alleviate already existing parking issues in the town as fewer outsiders (e.g., non-resident labourers) would require parking spaces inside the town.
iii. During project activities, consideration should be given to transporting outside workers into Port Royal, for example, using designated buses. Likewise, construction of temporary structures should be considered to house labourers and also help reduce the cost of transporting workers to and from location, over the long term.

Issue: Impact on Local Businesses and Community Amenities

The redevelopment of Port Royal is not only expected to increase daily traffic into the community (e.g., from visitors as well as labourers), but such an influx of people will ultimately need to be fed and provided for. This is expected to increase demands on the mostly small and medium-sized businesses in the community, as well as the already limited amenities/infrastructure (for e.g., public bathrooms). There was a similar situation in the past following the opening of CMU's Port Royal campus, which resulted in a scarcity of (cooked) food and water inside the town, especially during select hours (e.g., midday to 2 p.m.).

Development Guidelines:

i. The establishment of a liaison officer to communicate labourer/worker needs with various business owners is recommended. Involving community residents in decision-making could help to reduce the negative impact that may result from not having access to key recreational areas. It is important to encourage participation as residents can assist with alternate options.
ii. Another measure for consideration is to ensure that not all development activities that will impact access to recreational spaces and activities occur at the same time. This is important so that residents may have the opportunity to engage in leisure and/or physical activities.
iii. The development of a niche goods/services market is recommended to cater to specific needs within the town (for both residents and workers) during the various phases of project activities.

Issue: Awareness of the Proposed Plans

The surveys conducted in the community indicated that 92% of respondents were not aware of the Port Royal development plan. Of those who reported awareness, 25% were able to state three things they knew about the plan. Residents further indicated that no housing development plan was provided, and that they learnt about the development plan either from another resident or the Community Development Committee. If residents are not made aware and kept updated of the plans for the community, this could negatively impact the activities associated with the development.

Development Guidelines:

The planners should liaise with the community groups such as the Benevolent Society, the schools, and churches to keep residents regularly informed until the plans have been implemented. It may also become necessary to: i) set up Notice Boards around the community, ii) establish social media groups, if they don't already exist, as well as iii) place paper notices in mailboxes or under doors. Information dissemination should be consistent before, during, and after project activities.

5.2 Summary Potential Impacts and Development Guidelines

5.2.1 Summary Potential Impacts and Development Guidelines during Pre-Construction and Construction Activities

Table 5-2 below summarizes the main and existing areas of concern (disaggregated by proposed investment project); potential impacts during the preconstruction, construction, and operational phases of the various and combined project activities; as well as recommended mitigative actions/development guidelines for consideration.

Table 5-2: Potential Impacts and Development Guidelines during Pre-Construction and Construction

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
Waterfront Experience								
Sewage contaminating nearby water quality	High	No adequate sewage treatment exists in Port Royal and as such the potential for improper disposal during the construction phase of activities is high. Increase in discharge of untreated sewage may have impacts on ecological environment (turbidity, algal growth, pathogenic organisms, etc.) and can negatively affect any potential eco-tourism activities planned for the area.	Negative	Reversible	High	Short-term	The installation of portable dry toilets should be implemented during construction to prevent potential environmental pollution and negative public health risks during construction works.	US$4,000 purchase portable restroom (rental options are also available)

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		Improper management of untreated sewage is a major public health issue as it poses significant health risks to persons using the water for recreational and/or economic purposes.						
Inadequate Water Supply	Moderate	Availability of water to support increased demands (e.g., construction activities) PR is not connected to the island's central water supply system/network, but instead is serviced by singular node/line that serves the entire town. Water supply to PR is delivered on a scheduled basis. Water supply issues further compounded by absence of alternate	Negative	Reversible	Moderate	Long-term	Arrangement will need to be made through NWC or trucking companies for the supply of water during construction activities. Temporary water storage tanks would need to be in place to secure water for construction purposes.	US$200 for delivery of water US$500 for a 1000gal. storage tank.

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		water supply routing option(s) Frequent disruptions for the entire town if/when there are any water supply issues along (single) main.						
Water pollution from other activities	Moderate	With the proposed construction, it is expected that there will be an increase in water pollution. Increasing human activity and capacity in the Port Royal area amplifies the potential for contamination of the surrounding waters, worsening the water quality. Areas with high levels of anthropogenic activity from construction activities can potentially further increase existing contamination by fats, oils and grease,	Negative	Reversible	Moderate	Medium-term	Stormwater drainage construction sites should be properly managed to prevent sedimentation of coastal waters and sensitive ecosystems such as nearby wetlands. A Waste Management Plan (WMP) should be developed for construction to prevent and minimize associated negative impacts from improperly managed sewage and solid waste from construction sites.	US$3,000 for preparation of WMP

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		microorganisms, and higher levels of turbidity and total suspended solids. The hypersaline lagoons observed appear to be important ecological habitats for many species. Disturbing or discharging into these areas increases the risk of irreversible damage to the specialized ecosystem from improper drainage management and sedimentation from construction sites.					Sediment screens should be utilized where necessary (e.g., high traffic areas, areas storing stockpiles of construction material).	US$130 for screen size: 6 ft X 50 ft
Poor air quality and noise nuisance	Moderate	Areas with increased vehicular traffic or near main thoroughfares were observed to have higher levels of noise pollution and particulate matter in the air. These impact the quality of life and	Negative	Reversible	Moderate	Short-term	This will necessitate continuous and adequate monitoring to ensure appropriate mitigative measures are being employed (e.g., dust screening, wetting of areas, etc.)	US$4,000 monthly monitoring

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		health of PR residents and visitors. The phased development approach being proposed in this project means that construction will be ongoing in populated zones. It is also expected that there will be increased vehicular traffic, commercial activities, and domestic activities (e.g., burning of garbage, etc.). These activities will inevitably lead to an increase in both air and noise pollution.					Construction activities should be scheduled to coincide with off-peak hours to minimize the impact of noise pollution on residents in the area. Traffic management protocols must be planned and employed to minimize the impact of both air and noise pollution in the area. Stockpiles of construction supplies/materials should be covered to prevent airborne particulates and properly burned where applicable.	
Housing Solutions								
Increased post development run-off	Moderate to High	If not curtailed within the site by drainage design solutions, there may be issues related to	Negative	Reversible	Moderate – High	Short-term	Design and install drainage solutions.	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		flooding, such as damage to infrastructure as well as increased sedimentation in surface water sources					Maintain vegetated buffers. Incorporate drainage features with landscaping	
Seismic Activity resulting in damage to structures	Moderate to High	Damage to infrastructure and property from earthquakes	Negative	Irreversible	Moderate – High	Short-term	Buildings and structures should conform to best practice design and construction. Emergency response plan (ERP) to be developed to guide the management of hazard responses during construction activities. Updating of earthquake and other emergency response drills	US$5,000 prepare ERP
Land pollution from improper disposal of solid waste	Moderate	Inconsistent solid waste management services Access to potable water (current situation includes lock-offs,	Negative	Reversible	Moderate	Short-term	Appropriate receptables to be provided on contructionconstruction sites for proper solid waste disposal.	US$100 per receptacle

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		corrosive piping, and contamination from heavy metals) May cause additional solid waste pileups, especially during construction periods. Expected to worsen during construction period					ContractorContractors should engage a collection company to cover shortfall of the public NSWMA collection system. There should be consideration for a transfer station on the outskirts of the town with waste compactors.	
Flooding of site D3 and surrounding properties during storm surge events	Moderate	Damage to infrastructure and property	Negative	Reversible	Moderate	Short-term	Adhere to recommendations provided in the Geotechnical Investigation Report	
Loss or damage to Artefacts with Potential Historical/Heritage Considerations	Moderate	Potential invaluable artefacts remain unrecovered. Destruction of artefacts during pre-construction land clearing and excavation	Negative	Irreversible	Moderate	Short-term	JNHT should be given an opportunity to review the areas for planned clearing and excavation. Based on their review, they will determine the areas to conduct archaeological exploration exercises	US$30,000

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		Theft of newly discovered artefacts/ valuables during pre-construction land clearing and excavation					to see if there are any finds. Following this exercise, these sites can then be handed over to the respective developers to proceed with their activities. This is to prevent damage and loss of assets during excavation that may not be prevented during watching briefs. Some sites may require additional security measures (e.g., 24-hr security and/or CCTV) in the event of a major discovery.	US$5,000 monthly duingdurin g period of excavation activities US$3,000 to establish cameras in certain locations.
Occupational Health and Safety	Moderate	Occupational Health and Safety during the construction phase of the development is very important to both	Negative	Reversible	High	Short-term	Safety training is to be provided to all construction workers and must be a requirement of all the	US$2,000

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		workers, employees, visitorsvisitors, and the public in general. The magnitude of this development presents a statistically higher likeliness of accidents and incidents where safety is at risk and therefore warrants that these rules and principles be applied to construction activities. Unwanted accidents, residents in the area, visitors as well as to construction workers are crucial.					individual work sites through the life of the development. Most major industrial entities and large contractors in the country apply high safety standards and as such, models for implementation in the Jamaican context are available. This must be an essential requirement for the construction phase of the project and be required of all entities that will access the project sites. An Occupational Health and Safety Management Plan needs to be developed outlining the necessary management actions for the various construction activities to be undergone.	US$3,000

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
							Appropriate signage must be out in places which identify the various risks and hazards on the site. Provisions of the required personal protective equipment must be made for all workers employed by the developer. Sub-contractors must also ensure that their staff are properly outfitted.	US$3,000 US$10,000 [1]
Dislocation of residents	Moderate	Fear of social exclusion from any new development- validated by cruise ship pier whereby tourists are shuttled out of PR community without any interaction with PR	Negative	Reversible	High	Short-term	Include residents in all stages of project activities. Designate a liaison for PR community and developers.	US$3,000 (to host community meeting) US$2,000 monthly

[1] Cost is dependent on the number of workers to be employed on site during construction period.

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		residents who were promised shop spaces on the pier. Overcrowding and worsening housing crisis expected with the influx of new peoplepeople. Increased competition for new jobs with PR residents. There is an already general shortage of available housing stock in PR, with most houses being overcrowdedovercrowded. Fear of social exclusion from any new development Expansion of informal (squatter) settlements from influx of construction workers						

Risks	**Probability Of Impact**	**Potential Impacts**	**Direction Of Impact**	**Permanence**	**Magnitude Of Impact**	**Impact Duration**	**Proposed Development Guidelines**	**Estimated Cost (If Applicable)**
Congestion due to inadequate parking	Moderate	Lack of parking further compounded by narrow roads within PR, making street parking not a viable optionoption. Lack of parking expected to worsen during construction activitiesactivities. This may negatively impact the daily lives of PR residents when they need additional parking for their own domestic events (for e.g., birthdays, weddingsweddings, and other gatherings) Heavy-duty construction equipment may need to be parked/stored in PR during construction/project activities.	Negative	Reversible	Moderate	Short-term	Sidewalk and side street parking should be disallowed. Remote parking should be introduced to reduce/eliminate vehicular traffic in the town, with exceptions for PR residents, employees, deliveries, and emergency vehicles. The existing commercial spaces can be used as overflow parking for residents, all other visitors to PR should utilize shuttle service, which could be via shuttle buses, wheeled trams or a small rail system which would become part of the attraction of the town.	Stakeholder meetings N/A

Risks	**Probability Of Impact**	**Potential Impacts**	**Direction Of Impact**	**Permanence**	**Magnitude Of Impact**	**Impact Duration**	**Proposed Development Guidelines**	**Estimated Cost (If Applicable)**
Poor air quality and noise nuisance	High	Areas with increased vehicular traffic or near main thoroughfares were observed to have higher levels of noise pollution and particulate matter in the air. These impact the quality of life and health of PR residents and visitors. The phased development approach being proposed in this project means that construction will be ongoing in populated zones. It is also expected that there will be increased vehicular traffic, commercial activitiesactivities, and domestic activities (e.g., burning of garbage, etc.). These activities will inevitably lead to an increase in both air and noise pollution.	Negative	Reversible	High	Short-term	This will necessitate continuous and adequate monitoring to ensure appropriate mitigative measures are being employed (e.g., dust screening, wetting of areas, etc.). Construction activities should be scheduled to coincide with off-peak hours to minimize the impact of noise pollution on residents in the area. Traffic management protocols must be planned and employed to minimize the impact of both air and noise pollution in the area. Stockpiles of construction supplies/materials should be covered to prevent airborne particulates and	US$4,500 Monthly monitoring

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
							properly burned, where applicable.	

5.2.2 Summary Potential Impacts and Development Guidelines during Operations

Table 5-3 elaborates on the potential impacts and development guidelines associated with the operations of the various project investments proposed for the Port Royal project area.

Table 5-3: Potential Impacts and Development Guidelines during Operations

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
Historical Trail and Historical Sites								
Damage to heritage assets	Moderate	Area comprises a high density of heritage sites and assets. Destruction of important heritage sites and assets (inadvertently or intentionally) An increase in visitor traffic can result in damage of heritage assets	Negative	Irreversible	Moderate	Long-term	Close collaboration between project operators and the JNHT will be required. Training of asset managers and workers, for example, for artefact recovery and sensitization	US$2,000

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		through touching and/or handling of displays, illegal collection of souvenirs from site, graffiti, vandalism, fire (from smoking), damage from photo flash (light) and the weight of people, for example, the weight of people in the Giddy House.					for restrictions on tampering with historical assets may be necessary. Proper warning and restrictions signs need to be erected in strategic locations near these key heritage assets. Presence of Monitors as a part of a monitoring system Restoration of historical structures must be guided by the JNHT and the UNESCO guidelines to ensure that rehabilitated heritage assets maintain the standard for the area to achieve the internationally recognized	US$2,000 US$2,000 monthly

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
							UNESCO Heritage Site status. Appropriate visitor limitations Proper warning and restrictions signs need to be erected in strategic locations near these key heritage assets. Use of licensed tour guides who are friendly and informed. Have licensed tour guides so visitors do not accidentally deface heritage assets. Designated path that is followed Availability of trash receptacles Disposal of trash	US$100 each receptacle

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
							Regular sanitization of relevant areas. A proposed Management Plan for each building/attraction, may not necessarily be the best approach to manage Port Royal's heritage assets. These assets are interconnected and can be seen in the land use and land zoning history of the city. The management of the heritage assets should be guided by their social and spatial association, albeit, in their historic context.	
Waterfront Experience								
Land pollution from	Moderate	Inconsistent solid waste management services	Negative	Reversible	Moderate	Short-term	Appropriate receptables to be provided on	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
improper disposal of solid waste							construction sites for proper solid waste disposal. Commercial entities can engage a collection company to cover shortfall of the public NSWMA collection system.	
Conservation Areas (Mangrove Areas, Refuge Cay, and Most of Port Royal Cays)								
Loss of Critical Habitat and Services	Moderate	PR has extensive, healthy wetland (mangrove) areas that provide critical services to the area including: - habitats for endemic/threatened species - nursery for larva and juvenile spp. - protection from storm surges - carbon sink Benthic communities (e.g., seagrass and coral reefs) may also be impacted by land-based activities that lead to suboptimal conditions in these	Negative	Irreversible	Moderate	Long-term	Development of mangrove restoration/ compensation plan Water quality and sediment monitoring during and after project activities	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		environments (e.g., enrichment/eutrophication) Some wetland areas may be removed/damaged during construction activities which may then result in the loss of critical ecological services and habitat. Removal of mangroves may also result in the release of (stored) carbon						
Endemic/ Endangered / Protected Species	Moderate	Protected species such as the American crocodile and Hawksbill turtle have long utilized some beaches and areas in PR as nesting areas. Wetland areas are particularly important for migratory and/or nesting birds. Loss of habitat and potential death of endangered species Reduction/depletion of critical avifauna	Negative	Irreversible	Moderate	Long-term	Regular monitoring and surveying to assess population status during the construction period. Training of construction workers on identifying sensitive and endangered species and bringing awareness to the restrictions	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
							on capturing and killing same.	
Recreational Cays								
Pollution from improper waste management	Moderate to high	Solid waste pollution, health risks	Negative	Cumulative, reversible	Moderate	Medium to long term	implement proper waste management systems, particularly on Lime Cay, the largest and most-utilized cay. Establish regular garbage collection services for existing waste bins, Provide additional waste bins or containers (if necessary) Promote recycling, waste segregation and composting programs. Implement public awareness campaigns and education initiatives targeting responsible waste disposal and	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
							discourage single-use plastics	
Destruction of sensitive habitats	Moderate to High	Loss of critical habitats, reduction in endangered/endemic/protected species	Negative	Reversible	Moderate	Short, medium, and long term	Development and enforcement of regulations preventing destruction of sensitive habitats is strongly recommended, including those that support benthic communities. Implementation of measures to minimize anchor damage, such as designated mooring areas and the installation of mooring buoys or environmentally friendly anchoring systems. Further recommended that boaters and visitors be educated about	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
							the importance of responsible anchoring practices and the fragility of these sensitive ecosystems/habitats.	
Disturbance of sensitive marine organisms	Moderate	Destruction of ecosystems such as mangrove, coral reefs, and seagrass beds	Negative	Cumulative, reversible	Moderate	Short and Long term	Establish buffer zones or restricted areas where nesting and feeding activities occur. Implement public education programs and signage to further help inform visitors about the presence of sensitive species, Sea turtle and Crocodile nesting sites must be identified, visitors and residents sensitized to such areas, and lighting designs in these areas should minimize negative impacts on adults and hatchlings.	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
Increased prevalence of Rodents and Invasive species	Low to Moderate	Visitor traffic could cause proliferation of human associated rodents such as mongoose, cockroaches, dogs, and feral cats. These rodents/ non-native species can pose a significant problem on the cay especially when there are inadequate waste management practices and/or food sources readily available. Rodents can damage infrastructure, contaminate food supplies, and pose a threat to the survival of endemic fauna such as nesting birds and other small wildlife (e.g., reptiles).	Negative	Reversible, cumulative	Low to moderate	Medium to Long Term	Implement effective rodent control measures. This may include regular monitoring and maintenance of waste disposal areas to prevent access to food sources; and/or the implementation of proper food storage practices to minimize attractants for rodents	
Inadequate parking and challenges with sea transportation to/from beach and cays		Transportation-related pollution including solid waste, fuel/oil spills. Other transportation-related issues including structural (physical) damage to benthic					Maximization of public and mass transportation – or walking, to the beach Anchor buoys for vessels are	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		habitats and other ecologically sensitive environments. Influx of seaweed, particularly Sargassum sp. on beaches and offshore cays Wave heights (WH) off Jamaica's south coast tend to be notably higher than WH on the island's northern shelf – this may pose some challenges regarding swimmer safety (for e.g., at the Foreshore Road beach) Lack of parking for visitors wishing to access cays. Overcrowding of cays Increased pollution of offshore areas due to increased visitor traffic Destruction of ecologically sensitive environments					recommended in key recreational areas (e.g., Lime Cay, Port Royal beach, etc.) to avoid potential damage to the benthic habitat. Signage is proposed to educate visitors on delicate and unique ecosystems as well as guide visitors away from these sensitive habitats. Proper management guidelines and practices should be developed and implemented, for e.g., beach safety flags (green, yellow, or red) and marine life (e.g., jellyfish) safety flags (green or	US$5,000

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		due to increased visitor traffic					purple) could be utilized. Adequate (regular) garbage collection recommended, especially on offshore cays. Beaching of seaweed tends to be episodic, therefore management plans should be developed to coordinate clean-up efforts when such beaching occurs. Nature-based ecotourism along the Caribbean-facing sandy beach at Port Royal, as well as several exposed offshore cays should be developed and implemented. This	US$10,000 develop managemen t plan.

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
							complements the history and culture-based plan. Lifeguards are recommended to ensure swimmer safety.	 US$600 monthly
Port Royal Green Spaces								
Flooding	Moderate	Existing salt ponds in wetland areas may also increase in size during heavy rainfall periods/flood events	Negative	Reversible	Moderate	Short-term	Have buffer zones around the hypersaline areas to prevent the potential of flooding in nearby developed areas	N/A
Housing Solutions								
Increased post developmen t run-off	Moderate to High	If not curtailed within the site by drainage design solutions, there may be issues related to flooding, such as damage to infrastructure as well as increased sedimentation in surface wate0r sources	Negative	Reversible	Moderate – High	Short-term	Design and install drainage solutions. Maintain vegetated buffers. Incorporate drainage features with landscaping	US$50,000 (design drainage) US$100,000 (implementa tion of drainage)
Seismic Activity	Moderate to High	Damage to infrastructure and property from earthquakes	Negative	Irreversible	Moderate – Significant	Short-term	Buildings and structures should conform to best	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
							practice design and construction. Emergency response plan to be developed to guide the management of hazard responses during construction activities. Updating of earthquake and other emergency response drills	US$6,000 (prepare ERP)
Excessive Ground Settlement in the vicinity of Broad and Queen Street	Moderate to High	Damage to infrastructure and property and potential injury	Negative	Reversible	Moderate to Significant	Long-term	Buildings and structures should conform to best practice design and construction	
Flooding of site D3 and surrounding properties during storm surge events	Moderate	Damage to infrastructure and property	Negative	Reversible	Moderate	Short-term	Adhere to recommendations provided in the Geotechnical Investigation Report	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
Land pollution from improper disposal of solid waste	Moderate	Inconsistent solid waste management services	Negative	Reversible	Moderate	Short-term	Appropriate receptables to be provided at all housing solutions sites for proper solid waste disposal.	US$100 each receptacle
Improved housing facilities for residents	High	The implementation of the housing solutions will provide improved housing facilities for the residents of PR. This is a positive improvement to the housing conditions in which the local people live.	Positive	Reversible	High	Long-term	N/A	N/A
Physical Infrastructure								
Absence of sewage treatment facilities in Port Royal	High	Drain maintenance is an area of concern. During sampling, it was observed that most drains in Port Royal were blocked. This was accompanied by a strong smell of raw sewage (indicating its likely presence in the drain). Additionally, the drains observed in some cases discharged directly into	Negative	Reversible	High	Long-term	Any available information (e.g., drawings of existing sewage infrastructure) is needed to assess what additional infrastructure would be needed to facilitate an increase in population in the area.	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		fishing areas. This was later confirmed by water quality results which indicated high faecal coliform and nutrients in these areas. Two main areas of concern: CMU/Airport area, PR Town- sewage needs to be centralized. Accumulation of untreated sewage is a major public health issue as it poses significant health risks to persons using the water for recreational and/or economic purposes. Increase in discharge of untreated sewage may have impacts on ecological environment (turbidity, algal growth, pathogenic organisms, etc.) and can negatively affect any potential eco-tourism activities planned for the area.					A complete overhaul and assessment of the sewage treatment infrastructure is needed, and any sewage plant installed must consider both the existing and future development use in the area. It should be ensured that any technology used for sewage treatment meet/exceed standards and requirements of regulations. The possibility of reusing treated effluent (e.g., for irrigation) should also be considered to help reduce the amount of discharge being released to the sea.	US$80,000 sewage treatment design US$3 million (installation and commissioning) Assumed plant size for population of 5,000 people. Pipeline approx. US$3 million

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
							Low energy systems recommended. Proper monitoring and enforcement are required to ensure regulatory requirements are adhered to (e.g., use of oil/water separators or grease traps; regular drain cleaning, etc.).	
Inadequate water supply for Port Royal	High	PR is not connected to the island's central water supply system/network, but instead is serviced by singular node/line that serves the entire town. Water supply to PR delivered on a scheduled basis. Water supply issues further compounded by absence of alternate water supply routing option(s)	Negative	Reversible	High	Long-term	The NWC may wish to consider and prioritize rainwater harvesting in PR. Additional water storage regulations are recommended for new developments, for e.g., mandatory adaptations for rainwater harvesting and storage.	US$500 for a 1000gal. storage tank.

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		Frequent disruptions for the entire town if/when there are any water supply issues along (single) main. Availability of water to support increased demands (e.g., increase in visitor activities, business activities, tours, residents of new housing solutions, etc.).						
Inadequate solid waste management	High	There appears to be deficiencies in the management and removal of solid waste in the Port Royal community. While some receptacles/skips were observed around the community, including recycle bins for plastic bottles, large quantities of various types of waste (e.g., paper, plastics, organic waste) were observed strewn around the community, or nearby	Negative	Reversible	High	Long-term	A robust solid waste management regime (including proper enforcement and monitoring) should be implemented in the community prior to commencement of the project. Areas must be designated for solid waste disposal/temporary storage which are not easily inhabited	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		overflowing garbage bins. With the expected increased visitor population in the area, as well as the additional restaurants/food establishments being proposed, failure to improve solid waste management will increase the likelihood of pests and other health hazards being introduced in the area. Additional solid waste is also expected to be created during construction activities, which will necessitate removal of this additional waste.					by pests and not near any receiving water bodies. Litter bins are recommended for placement throughout the town, inclusive of commercial disposal containers (waste skips) Regular garbage collection needs to be implemented. There should be consideration for a transfer station on the outskirts of the town with waste compactors.	US$100 each receptacle
Social Infrastructure								
Inadequate access to emergency services	High	There is no health facility in the Port Royal community. In the event of a health emergency, the nearest hospitals are the Kingston Public Hospital (24.9km away) and the	Negative	Irreversible	High	Long-term	Other emergency services (police, fire) would need to be expanded and/or improved to manage the increased load	TBD

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		University Hospital of the West Indies (30.1km away). This, coupled with the single road access to the area, is an extreme risk to both residents and tourists visiting the area. The closest fire station is located at the Norman Manley International Airport (outside of the community). Fire Flows (e.g., number of hydrants, emergency exit plan, etc.) This risk is expected to increase as more persons are introduced into the area, both during the construction activities, as well as after the completion of the redevelopment.					expected in the area. Adequate and easy access to health centres, hospitals and fire services must be incorporated into the development planning.	N/A
Crime and deviant behaviour	Moderate	High unemployment rate especially among the youth which can lead to significant youth disenfranchisement.	Negative	Reversible	Moderate	Long-term	Development and implantation of social development programs	TBD

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		The evidence of squatting/ informal settlement, especially in sensitive mangrove/wetland areas is a major cause for concern and should be addressed immediately. An invasion of strangers into the community – This would not only threaten the character of the community but may also create demand for illegal substances and/or an increase in criminal activity such as prostitution and the sexual abuse of children.						
Increased opportunities for businesses	High	With an increase in visitors to the area, the potential exists for new businesses to emerge, including souvenir stores, more restaurants, and commercial entities.	Positive	Reversible	High	Long-term	N/A	N/A
Limited accessibility to PR	High	There is only one road to access Port Royal.	Negative	Reversible	High	Long-term	Alternate routes (e.g., ferries, trams, airlifting for	US$50,000 (for a Transportati

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
		With the expected increased traffic to the area, this significantly increases the area's vulnerability to congestion					emergencies, etc.) should be explored.	on plan for PR)
Inadequate parking	Moderate	Lack of parking is further compounded by narrow roads within PR, making street parking not a viable option. With the anticipated increase in tourism activities, this may negatively impact the daily lives of PR residents when they need additional parking for their own domestic events (for e.g., birthdays, weddings, and other gatherings).	Negative	Reversible	Moderate	Long-term	Sidewalk and side street parking should be disallowed. Remote parking should be introduced to reduce/eliminate vehicular traffic in the town, with exceptions for PR residents, employees, deliveries, and emergency vehicles. The existing commercial spaces can be used as overflow parking for residents, all other visitors to PR should utilize shuttle service, which could be via shuttle buses,	

Risks	Probability Of Impact	Potential Impacts	Direction Of Impact	Permanence	Magnitude Of Impact	Impact Duration	Proposed Development Guidelines	Estimated Cost (If Applicable)
							wheeled trams or a small rail system which would become part of the attraction of the town.	

6 Cumulative Impacts

6.1 Sewage, Solid Waste and Stormwater Run-off

Considering the planned developments in Port Royal, there are significant concerns that must be addressed to avoid potential negative impacts on the area. Issues such as inadequate management of sewage, solid waste, and stormwater runoff can collectively harm public health, ecological balance, and water quality. These factors contribute to nutrient enrichment/eutrophication in marine environments and fostering the growth of algae that suffocates and destroys coral reefs. This loss of corals ultimately leads to the degradation of reefs, species loss, and erosion of beaches. Additionally, wetland ecosystems, particularly mangroves, can suffer from impaired growth and even death, resembling a "mangrove heart attack". To effectively address these environmental challenges, a holistic approach is necessary, considering the integration of sewage management, waste disposal, and stormwater drainage systems. It is crucial to avoid fragmented solutions tailored to specific development activities. Such an individualistic approach would not optimize resource utilization nor ensure the desired sustainability goals outlined in the community redevelopment plan.

6.2 Economic Benefit and Ecological Balance

The upcoming phase of the project, which involves assessing and determining the carrying capacity for the overall development, presents an excellent opportunity to adopt a wholistic approach. By doing so, positive cumulative benefits can be achieved for the community. This approach will strike a balance between the potential economic advantages of the various projects and the conservation of the ecological assets that provide multiple ecosystem functions for Port Royal. These functions encompass essential aspects such as fish spawning, flood control, biodiversity maintenance, food chains, aesthetics, and recreation, among others. By taking this approach, potential negative cumulative impacts on sensitive habitats can be avoided. Such impacts may include the loss of habitat and species, as well as an increase in habitat fragmentation and isolation.

6.3 Air Quality

As the general development of the area progresses, there is a possibility of experiencing negative cumulative impacts on air quality. This can arise from increased emissions originating from energy sources, vehicular traffic, and the generation of particulate matter during construction activities. Due to the relatively small land area and the need to phase construction projects, it is likely that Port Royal will face these issues over an extended period of several years, given the proximity to emission sources. Additionally, odors can become a nuisance if solid waste storage sites and sewage/wastewater plants are not adequately managed and operated. These potential cumulative impacts have the potential to affect the residents and businesses in Port Royal if appropriate mitigation measures are not implemented and effectively managed.

6.4 Income and Societal Benefits

The income impact of the overall development is expected to increase through employment, growth of entrepreneurship and businesses, and government revenue. Cumulatively, the overall development will likely yield positive benefits to increased economic gains and livelihood diversification, training of human capital, decreased poverty, as well as increased access to upgraded social infrastructure and services offered for Port Royal including road, transportation, drainage, sewage treatment, solid waste management, banking atm services, community centre, recreational spaces, health centre, fire station and police station.

The overall development in Port Royal is expected to have a significant impact on the income levels in the Jamaican economy. This impact will be realized through various channels, including employment opportunities, growth of entrepreneurship and businesses, and increased government revenues. As the development progresses, these effects are expected to multiply and thus contribute to positive economic gains and livelihood diversification. One of the key benefits of the development is the creation of employment opportunities, which will provide individuals with a means to earn income and support their families. The growth of businesses and entrepreneurship will further contribute to job creation and economic prosperity. The increased economic activity will also likely lead to training and skill development, improving the human capital of the local workforce. This, in turn, will enhance productivity and competitiveness in the labor market. The overall development will have a positive impact on poverty reduction as well. With the increase in employment opportunities and economic growth, individuals and households will have the opportunity to uplift their living standards and escape poverty.

The improvement in the housing facilities for residents is also a positive enhancement to the living conditions of the residents. These can also serve as an aesthetical improvement to the area.

Furthermore, the development will improve access to upgraded social infrastructure and services in Port Royal. This includes improvements in road and transportation networks, drainage systems, sewage treatment facilities, solid waste management, banking and ATM services, community centers, recreational spaces, health centers, fire stations, and police stations. These enhancements will contribute to the overall well-being and quality of life for residents in Port Royal. Overall, the cumulative impact of the development in Port Royal is expected to yield positive benefits in terms of increased economic gains, livelihood diversification, human capital development, poverty reduction, and improved access to upgraded social infrastructure and services.

7 Environmental Quality Objectives

Environmental Quality Objectives have been identified for the proposed development to highlight the following aspects:

7.1 Integration of Archaeological and Cultural Heritage Features

The entire Port Royal area is rich in archaeological and cultural/heritage features, including potentially invaluable artefacts that remain undiscovered. The consultant team strongly supports the incorporation of these features (where practical) into the redevelopment of the historic area, as outlined in the UDC's 2020 Master Concept Plan. This will help to improve the general historical awareness and appreciation in Port Royal.

7.2 Conservation of Endangered/Protected/Endemic Species

Conservation of the mangrove wetland forest areas in Port Royal is highly recommended, considering Jamaica's commitment as a signatory to the Ramsar Convention on Wetlands of International Importance. The government has a responsibility to preserve and protect wetlands, particularly those that serve as habitats for waterfowl, such as Refuge Cay. Mangrove wetland resources in Port Royal are safeguarded under the mangrove and coastal wetlands protection policy and regulation. This provides a legal framework for the conservation and sustainable management of these valuable ecosystems. Additionally, the Port Royal area is believed to be home to potential threatened endemic species, including the American Crocodile and Hawksbill turtle. These species are known to inhabit, traverse, and nest in and around the area. To ensure their protection, it is crucial to implement measures that minimize disturbance to their habitats and nesting sites.

To enhance the experience of visitors and promote ecotourism, the construction of a boardwalk in the mangroves is recommended. Similar initiatives have been successfully implemented at other locations, such as the Caribbean Coastal Area Management Foundation (CCAM) and Discovery Bay Marine Laboratory (DBML). The boardwalk would provide a designated path for visitors, allowing them to explore the mangroves while minimizing impact and disturbance. This would create opportunities for activities like bird watching, particularly in the mangroves near Refuge Cay. By conserving the mangrove wetland forest areas, Jamaica can fulfill its obligations under international conventions, protect critical habitats for waterfowl, and preserve the natural heritage of the Port Royal area.

7.3 Aesthetic Appeal

As seen at the entrance of the Cruise Ship Pier, the use of grassy verges and red bricks have been effectively incorporated into the design to both enhance the aesthetic appeal and reflect the historical background of the town. Increasing green spaces (including the planting of native trees) will help protect the habitat of endemic and other critical fauna, including species of birds, reptiles, and insects. The planned walkway throughout the town is also supported not only to increase the aesthetic appeal throughout Port Royal, but also to discourage vehicular traffic and encourage use of these tours.

7.4 Stormwater run-off and Watershed Management

Effective control of stormwater runoff into nearby coastal areas is crucial to prevent nutrient enrichment and the harmful consequences of eutrophication on sensitive marine ecosystems. Stormwater runoff often carries high concentrations of agricultural chemicals, sediment, sewage, and other organic and inorganic matter, posing significant threats to marine life and the surrounding environment. Implementing measures to mitigate stormwater runoff is essential and as mentioned earlier, one approach is to utilize grassy verges instead of paved sidewalks. This choice allows for the percolation of stormwater, enabling natural infiltration into the soil and thus minimizing runoff, ponding, and accelerated erosion. Grassy verges act as permeable surfaces that absorb and retain rainwater, facilitating its gradual absorption into the ground. This process allows for natural filtration and reduces the volume and velocity of stormwater entering nearby coastal areas. Consequently, the harmful pollutants carried by the runoff have a reduced impact on marine ecosystems. By incorporating grassy verges and other permeable surfaces into the design of the urban environment, the community can effectively manage stormwater runoff. This approach not only helps preserve the water quality of coastal areas but also contributes to the prevention of erosion and the overall health of marine ecosystems.

7.5 Pollution Prevention

Pollution of coastal environments near Port Royal is compounded by the severely deteriorated sewage system, in conjunction with poor solid waste management practices. Adequate solid waste management practices are to be incorporated in the redevelopment of Port Royal including (but not limited to) the installation of trash receptacles and the collection/removal of trash by a certified contractor for disposal at an approved site.

7.6 Integrated Water Resource Management

The use of potable water in conjunction with the treatment of wastewater and irrigation systems is proposed to encourage recycling and reuse where possible. Rainwater harvesting and storage is also strongly recommended where viable. Storage facilities are similarly recommended, especially for the planned apartment buildings. Additionally, new building designs and construction should incorporate water conservation devices that foster sustainable use of the scarce resource.

7.7 Energy Efficiency

The integration of energy efficient systems should be part of all aspects of proposed new developments as energy efficiency is critical for sustainable development. Energy efficient methods and systems including fluorescent bulbs, timers, and energy efficient appliances should be considered for project activities. Leadership in Energy and Environmental Designs (LEED) buildings should likewise be promoted where possible.

8 Positive Impacts

8.1 Physical Environment

i. Based on the results of the numerical wave modelling, the sandy beach (near Foreshore Road) is well protected by the barrier reef and offshore cays, with waves typically lower than 0.5 m. The beach is also quite wide (notably wider than most beaches on Jamaica's south- and north- coasts) and can be characterized as stable to accretionary, with no apparent trend of erosion under existing conditions based on the coastal dynamics study.

ii. The offshore cays, including Lime Cay and Maiden Cay, are in relatively proximity to the mainland and therefore can potentially provide recreational amenities such as swimming, snorkelling/SCUBA diving and ecotourism. The relatively large Lime Cay especially is potentially capable of accommodating a considerable number of visitors however these exact numbers will be determined during the concurrent carrying capacity assessment.

iii. No mitigation measures are needed to widen/stabilize the (Foreshore Road) beach at present, however, adequate maintenance and safeguarding may be needed in the near future (for e.g., lifeguards and ancillary staff). Such maintenance and supporting activities could also potentially provide much needed employment for Port Royal residents.

iv. Grassy verges, in conjunction with the conservation of mangrove wetland forests will help enhance surface percolation and shoreline protection respectively. Fulfilment of setback requirements for shoreline facilities should also help mitigate against risks from storm surge and

wave action. Sedimentation control devices can also help reduce/control the levels of siltation in nearshore coastal waters.

v. An integrated water management approach will facilitate consideration of water consumption, sewage disposal, recycling, and reuse as part of water use efficiency and pollution prevention in the project area.

8.2 Biological Environment

Improving/ upgrading the sewage network system will have beneficial impacts on the marine environment through the reduction of land-based pollution. The maintenance of mangrove wetland forest areas, including large diameter trees will continue to provide critical ecological services including as a habitat, food source and for carbon storage. These measures are highly beneficial for habitat protection, aesthetic appeal, and watershed management.

8.3 Built Environment

The proposed redevelopment of the Port Royal area is expected to significantly contribute to the tourism product in Jamaica by improving well-needed infrastructure as well as marketing recreational activities that highlight the area's unique history and culture. The predominant goal for Port Royal's redevelopment is predicated on "retention, sensitive restoration and careful repair". The Sustainable Master Plan seeks to achieve multiple objectives which include:

- Improving/upgrading critical infrastructure (e.g., sewage, stormwater drains, etc.).
- Developing a niche tourism market.
- Marketing leisure activities highlighting the community's unique heritage and culture.
- Attracting tourism investment that will enhance the existing community assets; and
- Developing products that will attract residents to stay in the small community and visitors to return.
- Housing solution serves to improve living conditions for residents.
- The project investments will also result in the aesthetical enhancement to the project environment.

The opportunity exists for entrepreneurs within the community to 'set up shop'. In other words, opportunities exist for micro and small businesses to become established so that both residents and outsiders may benefit. This will require assessing the needs of those who will be residing and or working in Port Royal when project activities commence.

Seventy-five percent (75.34%) of the residents are in favour of the proposed development plans for the community, according to the socio-economic survey that was conducted in 2022. This is a positive reflection of their acceptance of the Master Concept Plan.

9 Other Environmental Requirements

In addition to the legislative and regulatory framework that will need to be adhered to, the Consultants further recommend advanced preparation to ensure the developers are aware of the potential planning

and environmental requirements that may arise during the proposed phases of the project. This section provides:

i. a list of Government Agencies that should be contacted early.

ii. an indicative list of post permit requirements likely; and

iii. an indicative list of permits and licenses that may be required.

9.1 List of GOJ (and Other) Agencies Recommended for Early Dialogue

The GOJ agencies and companies recommended for initial contact by the project developers/ UDC includes regulatory agencies, implementing agencies, emergency services as well as non-governmental organizations (NGOs). Early dialogue with these agencies should significantly assist in mutual information sharing, early determination of agency requirements and foster good relations.

Table 9-1: List of GOJ Agencies and Others Recommended for Early Dialogue

Abbreviation	Agency	Portfolio
EHU	Environmental Health Unit	Public and environmental health aspects and regulations
JCF	Jamaica Constabulary Force	Security
JPSCo	Jamaica Public Service Company	Provision of Electricity
JNHT	Jamaica National Heritage Trust	Preservation of archaeological and cultural heritage. Establishment of Watching Brief during site preparation and construction. Excavation of artefacts/relics. Assistance in development of heritage aspects and interpretive signages.
NEPA	National Environment and Planning Agency	Environmental permitting, town planning, land development, monitoring requirements
NSWMA	National Solid Waste Management Agency	Approval of quantities for disposal and designation of disposal site. Collection regimes.
NWA	National Works Agency	Submission of drainage plan for approval
NWC	National Water Commission	Supply of potable water
NGO's	Non-governmental Organizations	These include environmental NGO's fishers, =and community groups. Provision of labour, public sentiment, and community acceptance.
ODPEM	Office of Disaster Preparedness and Emergency Management	National response in the event of a disaster. Liaisons and preparers of Hazard Management Plan if required

9.2 Indicative List of Post Permit Requirements

Based on the Consultant's experience the list provided below has been generated as an indicative list of the types of post permit requirements the developer may be required to obtain. It should be noted that any permit or license issued in respect of any component of the project must be adhered to, and any post permit requirements must be submitted to the responsibly agency within the stipulated time frame. Failure to do so will result in the developer being in breach of the permit conditions which could result in the implementation of a Stop Order on the development, or further legal action.

Table 9-2: Indicative List of Post Permit Requirements

Environmental Monitoring Programme
Fortnightly or monthly Environmental Monitoring Reports
Environmental and Social Management Plan
Stakeholder Engagement Plan
Mitigation Plan
Hazard Management Plan
Emergency Responses and Evacuation Plan
Wildlife Management Plan
Landscape Management Plan
Drainage Plan

9.3 Indicative List of Environmental Approvals, Permit and/or Licences

Several approvals, permits ands or licenses would be required with respect to the proposed Project, and regular communication with the agencies outlined below will assist in early determination of the requirement for these. The following table is an indicative list of some of the approvals, permits and/or licenses that may be required, and the corresponding responsible agency:

Table 9-3: Indicative List of Environmental Approvals, Permits and/or Licences.

Agency	**Approval, Permit and/or Licence**
Ministry of Security	Immigration and Customs Facilities
Ministry of Justice	Beach Licences (for foreshore modification, dredging and coastal works, recreational use)
NEPA	Licence to Construct Sewage Treatment Facility
NEPA	Licence to Discharge Treated (Sewage or Trade) Effluent

Agency	Approval, Permit and/or Licence
NEPA	Licence for Storage of Petroleum Products
NEPA	Mangrove Modification/ Reclamation Permit
Parish Council	Subdivision Approval

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Appendix I: Selected Plans and Documents prepared for Port Royal

Between 1964 and 2009 various Master Plans were developed for Port Royal, most notably:

1. 1964 (Sir Anthony Jenkinson, former Managing Director of Morgan's Harbour Limited)
2. 1965 &1967 (Sir Robert McAlpine & Ivor Noel Hume)
3. 1968 (UNESCO)
4. 1979 (Anthony Aarons, Government Archaeologist) and
5. 1981 (UNESCO, Faulkner & Lemaire)
6. 1984 (Oliver Cox, UDC, JNHT)
7. 1993 (Marvin Goodman)
8. 2000 (Marvin Goodman)
9. 2009 (Oliver Cox)

Several other research and assessments have been undertaken in the area. Some of these are presented below:

1. Sonar surveys of the Port Royal Harbour area by Bert Instruments
2. Radar surveys of the land in Port Royal were undertaken by PRDC.
3. An Archaeological Impact Assessment by JNHT
4. Port Royal Community Assessment by Dr Ian Boxill UWI
5. A detailed Retail Plan done by Thomas Consultants
6. An Interpretive Master Plan done by a team led by museologist Dr Leslie Patten from Canada who was supported by several local experts.
7. Sewage Treatment Plan and System done by Wallace Evans and Partners
8. An Environmental Impact Assessment of the Port Royal Protected Area by ESL Management Solutions Ltd
9. Phased redevelopment of the Port Royal housing stock by Peter Francis
10. Architectural plans for Port Royal redevelopment completed by Marvin Goodman and Associates in collaboration Jerde Partnership
11. Environmental Impact Assessment of Floating Dock Pier by TEMN

Appendix II: Legal and Regulatory Considerations

Legislations, Regulations and Policy

LEGISLATION/REGULATIONS/POLICY/ INTERNATIONAL TREATY	RELEVANCE TO PROJECT
LEGISLATION	
Natural Resources Conservation Authority Act, 1991	Responsible for environmental management; governs all pollution activities within Jamaica, the EIA regulatory framework (where this is applicable) is governed by the NRCA Act. NRCA's powers and responsibilities include among others: • Establishing and enforcing pollution control and waste management standards and regulations. • Monitoring and enforcing environmental laws and regulations, especially those included in the NRCA, Beach Control, Watershed Protection, and Wildlife Protection Acts. The NRCA Act binds the Crown and as such supersedes all other legislation relating to environmental issues. The Minister is empowered to request an Environmental Impact Statement (EIS) in relation to certain major projects.
Town & Country Planning Act	Regulates land-based developments. The Act establishes area-specific standards for land use, density, and zoning. ***Approval will need to be sought from the Kingston and St. Andrew Municipal Corporation for the Development.***
Building Act, 2018	It facilitates the adoption and efficient application of national building standards to be called the National Building Code of Jamaica for ensuring safety in the built environment, enhancing amenities, and promoting sustainable development; and for connected matters.
National Solid Waste Management Act, 2001	This Act provides for the regulation and management of solid waste. It establishes the National Solid Waste Management Authority (NSWMA) for matters connected therewith or incidental thereto. ***Solid waste management will be essential in the construction phase and will require the removal and proper disposal of vegetative matter, soil, and construction rubble. The NSWMA should be contacted regarding an approved disposal site.***
Wildlife Protection Act	specifically protects designated species of animals and regulates hunting in Jamaica. The Act also regulates the hunting of game birds and provides for the declaration of game sanctuaries and games reserves in which no hunting is allowed.
Water Resources Act (1996)	The Water Resources Act established the Water Resources Authority (WRA). This Authority is mandated to regulate,

LEGISLATION/REGULATIONS/POLICY/ INTERNATIONAL TREATY	RELEVANCE TO PROJECT
	allocate, conserve, and manage the water resources of the island.
Watersheds Protection Act (1963)	This Act provides for the protection of watersheds to include areas adjoining watersheds and the conservation of water resources for Jamaica.
Flood-Water Control Act (1958)	An act to make provision for the construction, improvement, repair, and maintenance of works for the control of flood water, and for other matters connected therewith.
Disaster Risk Management Act (2015)	The Disaster Preparedness and Emergency Act established the Office of Disaster Preparedness and Emergency Management (ODPEM) which is responsible for carrying out the provisions of the Act.
Registration of Titles Act (1989)	This Act sets out the legal basis for land registration in Jamaica. Under this system, land registration is not compulsory, although once a property is entered in the registry system the title is continued through any transfer of ownership.
Public Health Act (1976)	This Act establishes the Central Health Committee with the local bodies being resident under the Parish Council of respective parishes. The Public Health (air, soil, and water pollution) Regulations 1976 aim at controlling, reducing, removing, or preventing air, soil, and water pollution in all possible forms. ***The excavation and construction work and use of heavy machinery and equipment may result in the temporary generation of fugitive dust. Proper care and standard best practices for the construction industry should be applied to minimize public health risks.***
The Access to Information Act (2002)	It gives citizens and other persons a general legal right of access to official government documents which would otherwise be inaccessible. This allows for informed knowledge of the functioning of government.
REGULATIONS/ STANDARDS AND GUIDELINES	
The Natural Resources Conservation (Wastewater and Sludge) Regulations 2013	This regulation is designed to prevent pollution of the environment (land, surface, and marine water) from manufacturers, developers, operators of various (trade and sewage) treatment facilities and other relevant sectors, etc.
The Natural Resources Conservation Authority (Air Quality) Regulations, 2002	The Act states that no person shall emit or cause to be emitted from any air pollutant source at a new facility, any visible air pollutants the opacity or pollutant amount of which exceeds the standards. Every owner of a facility with one or more air pollutant source or activity shall employ such control measures and operating procedures as are necessary to minimize fugitive emissions into the atmosphere, and such owner shall use available practical methods which are technologically feasible and economical, and

LEGISLATION/REGULATIONS/POLICY/ INTERNATIONAL TREATY	RELEVANCE TO PROJECT
	which reduce, prevent, or control fugitive emissions to facilitate the achievement of the maximum practical degree of air purity. ***The UDC must ensure that contractors employ emission control measures to minimize fugitive emissions during construction.***
Public Health (Nuisance) Regulations, 1995	In these Regulations "nuisance" includes any nuisance specified in the Schedule. It states that no person shall cause or permit nuisance on any premises owned or occupied by him.
Noise Standards	Jamaica has no national legislation for noise, but World Bank guidelines have been adopted by the National Environment and Planning Agency (NEPA) and are used for benchmarking purposes along with the draft National Noise Standards that is being prepared.
POLICIES	
National Hazard Mitigation Policy, 2005	This policy provides a framework for integrating hazard mitigation into all policies, programs and plans at national and community levels. It sets out the broad goals and guiding principles for hazard risk reduction and informs the development of national hazard mitigation plans.
The National Land Policy (1996)	The goals and objectives of this Policy are to ensure the sustainable, productive, and equitable development, use and management of the country's natural resources.