Places of Refuge in Jamaica: Identifying Prospective Site Suitability through an Analysis of Environmental, Socioeconomic, and Physical Criteria

By

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Abstract

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Marine transportation is a predominant industry worldwide and has been experiencing increases in growth in the past several decades. Technological advances have led to improvements in safety and efficiency, which have strengthened the overall shipping sector. That being said, the ocean realm is laden with risks and hazards that constitute threats to the safety and security of human life, vessels, coastal states and their industries, as well as the environment. In the event of an incident at sea, coastal states have generally practiced the custom of allowing vessels to take refuge in their internal or surrounding waters. That being said, many nations are now refusing access to these "Places of Refuge" based on concerns for the environmental integrity of their coastlines and potential socioeconomic damage to their coastal state. The IMO has created Guidelines on Places of Refuge, however countries are neither required to adopt them, nor are they legally binding. The current study evaluated the Caribbean island of Jamaica for its potential in future contingency planning for Places of Refuge. Jamaica has currently not legally recognized Places of Refuge, and this study aimed to explore potential locations around the island for possible future designation. Through an analysis of environmental, socioeconomic, and physical/response criteria outlined in the IMO Guidelines, 14 potential sites were evaluated and assessed. It was determined that each site had strength and weakness areas, leading to the conclusion that all sites have criteria-specific suitability. The current study provides a framework for government authorities responding to potential future incidents by outlining the merits/drawbacks of prospective sites. While a continuation of this study is needed to incorporate further consultation and assessment, the study provides Jamaica with a baseline for increasing their marine contingency planning initiatives and setting a precedent for response preparedness in the Caribbean.

Keywords: marine transportation; distress; Places of Refuge; IMO; criteria; guidelines; contingency planning; site assessment; Jamaica.

List of Abbreviations

DWT – Dead Weight Tonnes

GESAMP - Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection

IMO – International Maritime Organization

JDF – Jamaican Defence Force

JERP – Jamaica Ecoregional Planning Project

JPAT – Jamaica Protected Areas Trust

MARPOL – The International Convention for the Prevention of Pollution from Ships

NEPA – National Environment and Planning Agency

NGO – Non-Governmental Organization

ODPEM – Office of Disaster Preparedness and Emergency Management

OPRC – Oil Pollution Response and Cooperation Plan

RAC/REMPEITC – Regional Activity Centre/Regional Marine Pollution Emergency Information and Training Centre

SFCA – Special Fishery Conservation Area

SOLAS – The International Convention for the Safety of Life at Sea

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CHAPTER 1: INTRODUCTION

1.1. Global Perspective of Marine Transportation

The oceans play a fundamental role in enabling life on earth. They offer sources of sustenance and livelihoods, in addition to providing transport to facilitate a robust and diverse global economy. Ocean-based transportation remains the predominant method of shipment for cargo traveling worldwide. It is estimated that over 90% of the world's global trade is transported by sea, making marine transport an integral component of the worldwide economy (IMO, 2012). The history of marine transportation can be documented as early as 5000 BC, with crucial improvements due to the globalization of industries only occurring in the past two centuries (Stopford, 2010). Technological progress has been made over the years in terms of hull materials and design, construction, energy sources, shipping systems, navigational systems, as well as through inland transport methods (Stopford, 2010). These considerable advancements have resulted in the expansion of the global marine transportation industry as it is seen today.

> Ships have never been so technically advanced, never been so sophisticated, never been more immense, never carried so much cargo, never been safer and never been so environmentally-friendly as they are today (IMO, 2012 p 8).

While beneficial to the economy, and a vital mode of transportation by many industries, shipping is not without drawbacks. Safety is a key issue in marine transportation, including various classifications relating to safety of human life, the environment, and the economy. Numerous conventions and treaties have been signed and instated internationally, including the International Convention for the Safety of Life at Sea (SOLAS), the International Convention for the Prevention of Pollution from Ships

(MARPOL), the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), and the International Convention on Maritime Search and Rescue (SAR).

1.2. The Management Problem

Despite advances in technology and safety, the nature of shipping is inherently risky; inclement weather, human error, and unavoidable circumstances have the possibility of occurring, leading to potential situations of distress. In the event that such situations arise, one mitigating strategy that applies in some circumstances is for the ship to navigate to an area that can provide shelter, as well as the capacity to better respond to the incident. The term 'Place of Refuge' has been defined by the IMO as follows:

> A place where a ship in need of assistance can take action to enable it to stabilize its condition and reduce the hazards to navigation, and to protect human life and the environment (IMO, 2004 p 6).

The aim of the Places of Refuge guidelines is to better inform all parties with a vested interest in such a situation, whether that be government authorities, private industries, the shipmaster, as well as the shipping company involved (IMO, 2004). The objectives of the guidelines also includes the creation of a framework to better assist responders in managing/controlling the situation to facilitate cooperation and coordination in response actions (IMO, 2004). Nevertheless, the IMO Guidelines on Places of Refuge are not mandatory, and do not require adoption by countries worldwide. There is a definite benefit to accepting these guidelines in that, should a future disaster occur, countries would likely be more prepared to respond. However, countries are not

likely to willingly accept a ship in distress into their coastal waters without contention. International laws have existed for centuries that outline rights of refuge, however, more recently, coastal states have begun to prohibit refuge on the basis of protecting their waters and the environmental/economic integrity of their coastlines (Chircop, 2002). The issue with not allowing refuge is that in doing so, countries are risking exposing their coastlines to even greater hazards (IMO, 2004). Very high profile examples of failed attempts at refuge have resulted in environmental and socioeconomic damage from oil spills that would likely not have occurred or expanded had refuge been granted and had the hazard been contained in a sheltered area (IMO, 2004).

The focus of this study is the Caribbean island nation of Jamaica. Jamaica does not currently have a Places of Refuge contingency plan in place; therefore in the event of a maritime emergency involving a ship in distress, it is uncertain as to how the country would respond to such an event. One key management issue to consider when discussing Places of Refuge is the lack of formal international requirements. The IMO Guidelines, whether a country chooses to follow them or not, do not represent a legally binding agreement, and cannot be enforced:

> When permission to access a place of refuge is requested, there is no obligation for the coastal State to grant it, but the coastal State should weigh all the factors and risks in a balanced manner and give shelter whenever reasonably possible (IMO, 2004 p 9).

It is evident that management gaps exist when considering shipping emergencies and Places of Refuge, and it is in every country's best interest to properly address this issue. Failing to adequately do so may result in future maritime disasters that could have been prevented or mitigated.

1.3. Global Shipping Fleet and Vessel Types

Shipbuilding reached the highest levels of production in 2012 on record, leading to increases in worldwide gross tonnage (UNCTAD, 2013). The worldwide shipping fleet in 2013 for vessels over 1000 DWT was 47,122 (UNCTAD, 2013). The breakdown of the world shipping fleet by vessel type in 2013 is as follows: oil tankers (30.1%), bulk carriers (42%), general cargo shops (4.9%), container ships (12.7%), and other types (10.2%)(UNCTAD, 2013). Shipping can be classified many ways, from cargo type to vessel type, as well as by maximum capacity (size)(See Figure 1 on oil tanker types). The various classifications of ships by size are outlined in Table 1.

Table 1. Merchant cargo vessel classification by capacity in deadweight tonnes (DWT). Adapted from Maritime Connector (2014).

Ship Size	**Capacity (DWT) (unless specified)**	**Characteristics**
Handysize	~ 15,000 – 35,000	• Ideal for small ports
Handymax/Supramax	< 60,000	• Ideal for small ports
Panamax	~ 5000 TEU	• Largest ship capable of passing through the Panama Canal
New-Panamax	~ 13,000 TEU	• Largest ship capable of passing through the Panama Canal upon completion of the new locks
Aframax	~ 80,000 – 120,000	• Medium sized oil tankers
Malaccamax	~ 165,000	• Largest ship capable of passing through the Strait of Malacca • Typically bulkers and supertankers
Seawaymax	N/A	• Largest ships that can transit between the Great Lakes and Atlantic Ocean through the St. Lawrence Seaway
Suezmax	~ 120,000 – 200,000	• Largest ships capable of passing through the Suez Canal

Qatar-Max	~ 266,000 m^3	• Largest ships capable of docking at the Qatar terminal
Capesize	~ 150,000 – 400,000	• Cannot pass though Panama canal; must transit via Cape Horn • Only permissible at large ports and terminals
Chinamax	~ 380,000 – 400,000	• Very large bulk carriers • Often transit to and from China on various trade routes
Very Large Crude Carriers (VLCC)	~ 180,000 – 320,000	• Large vessel, but has the ability to enter ports with depth constraints
Ultra Large Crude Carriers (ULCC)	> 320,000	• Largest shipping vessels in the world

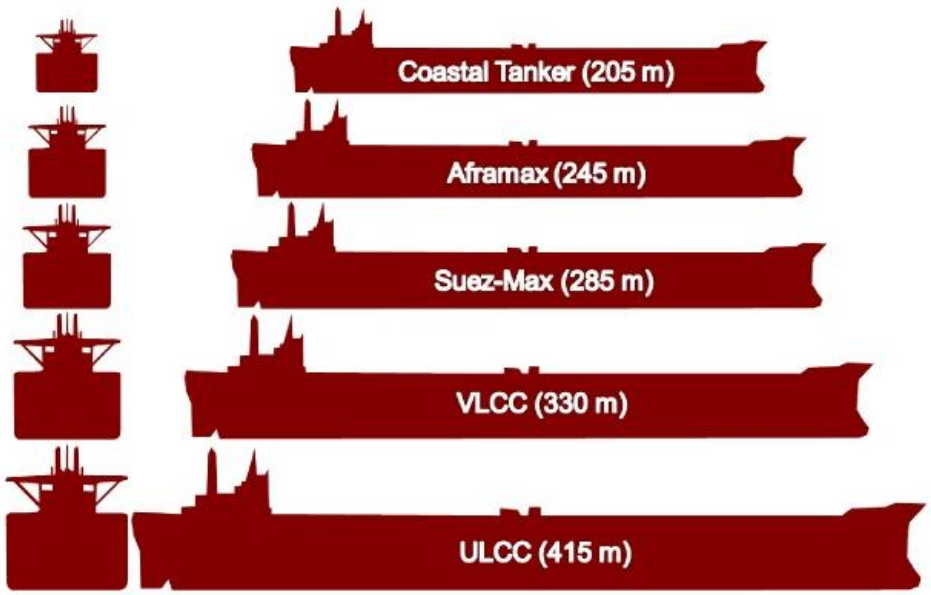

Figure 1. An example of various tanker sizes (m) of vessels in operation worldwide. Figure obtained from Maritime Connector (2014).

1.4. The Expanding Marine Transport Industry

Shipping has increased with the rise of industrialization and globalization. It continues to grow, but remains vulnerable to market and economic impacts (UNCTAD, 2013). In 2013, it was estimated that seaborne trade reached over 9 billion tons in the previous year, resulting in a 4.3% increase (UNCTAD, 2013). Consequently, as maritime transport increases, so do the risks of vessel incidents, and the need for Places of Refuge.

Table 1 and Figure 1 clearly outline differences in ship size and capacity, both of which are key factors in determining accessibility to ports. If the depths of the terminals and berthing areas do not meet the proper draught requirements for vessels, they will not be capable of entering port when seeking refuge. In addition, length requirements (i.e. pier size, etc.) are crucial in planning vessel routes. With such a vast array of sizes, cargo capacities, and draught limitations, there are canals and regions through which some vessels simply cannot transit. As the industry expands, countries have to accommodate larger vessels, and in doing so, may alter the volume of vessels in certain regions (e.g. the Panama Canal expansion project).

As a result, route modifications or increases in shipping will lead to the increase in need for proper shelter, and in conjunction, the need for areas to account for the wide variety of ships/physical requirements. Therefore, if the worldwide shipping fleet continues to expand, it must be balanced out by increasing the availability of suitable refuge areas. This includes improving on contingency plans and emergency guidelines to appropriately address all potential ship-types and ship-related problems.

1.5. Caribbean Context

The location of this project is focused around the island of Jamaica; therefore maritime traffic in the Caribbean region is relevant to this study. Many shipping routes navigate throughout the Caribbean, making it a highly trafficked marine region. The Caribbean also has an impact on shipping at a global level through a key feature: The Panama Canal. The Panama Canal is an integral trade route that connects the Pacific and Atlantic Oceans. In 2007, the Panama Canal Expansion project began, with its expected completion in 2015. The project will construct two additional Pacific and Atlantic side locks, which will have the capacity to accommodate Post-Panamax vessels (ACP, 2010). Dredging and widening of the canals to improve navigation and to decrease draught limitations will also be conducted, in addition to the creation of a Pacific Access Channel (ACP, 2010). With the completion of the expansion project, shipping traffic would increase in the Caribbean due to the new allowance of larger vessels that cannot currently pass through.

1.5.1. Caribbean Maritime Traffic

Shipping traffic has been modelled for the Caribbean and can be viewed through The Caribbean Maritime Traffic Database. The IMO mandated the Regional Activity Centre (RAC)/Regional Marine Pollution Emergency Information and Training Centre for the Wider Caribbean (REMPEITC) to design and create this GIS database for maritime traffic within the region. Figure 2 depicts maritime traffic within the wider Caribbean, between 2007 and 2008.

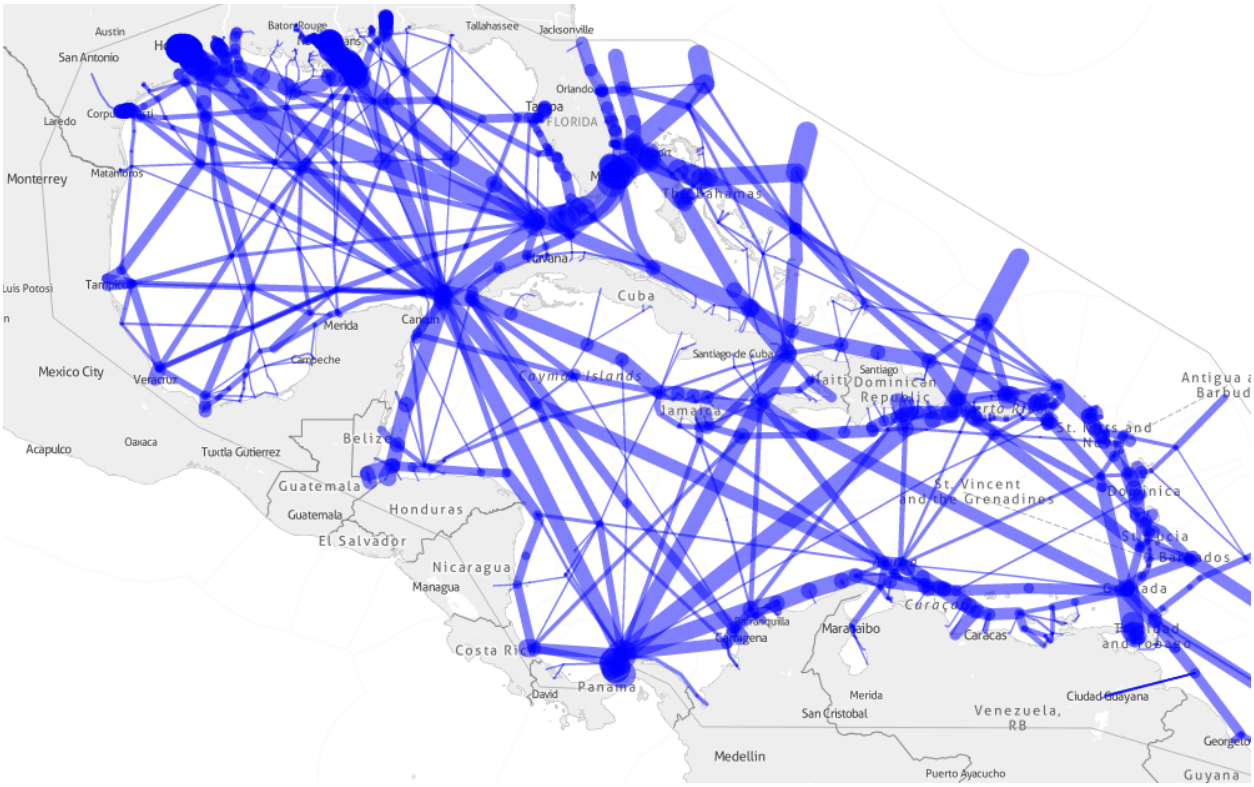

Figure 2. Maritime traffic within the Caribbean region (2007-2008). Data are shown by general routes, and include all types of merchant vessels. Source: RAC/REMPEITC (2014b).

The figures show major shipping routes in close proximity to Jamaica, travelling to key ports of call/shipping hubs (e.g. Panama City, Cancun, Houston, Miami).

Cruise tourism within the wider Caribbean region can be seen in Figure 3. Key densities include vessels traversing through the eastern, western, and southern Caribbean, with fewer routes passing through the Panama Canal and major industrial ports.

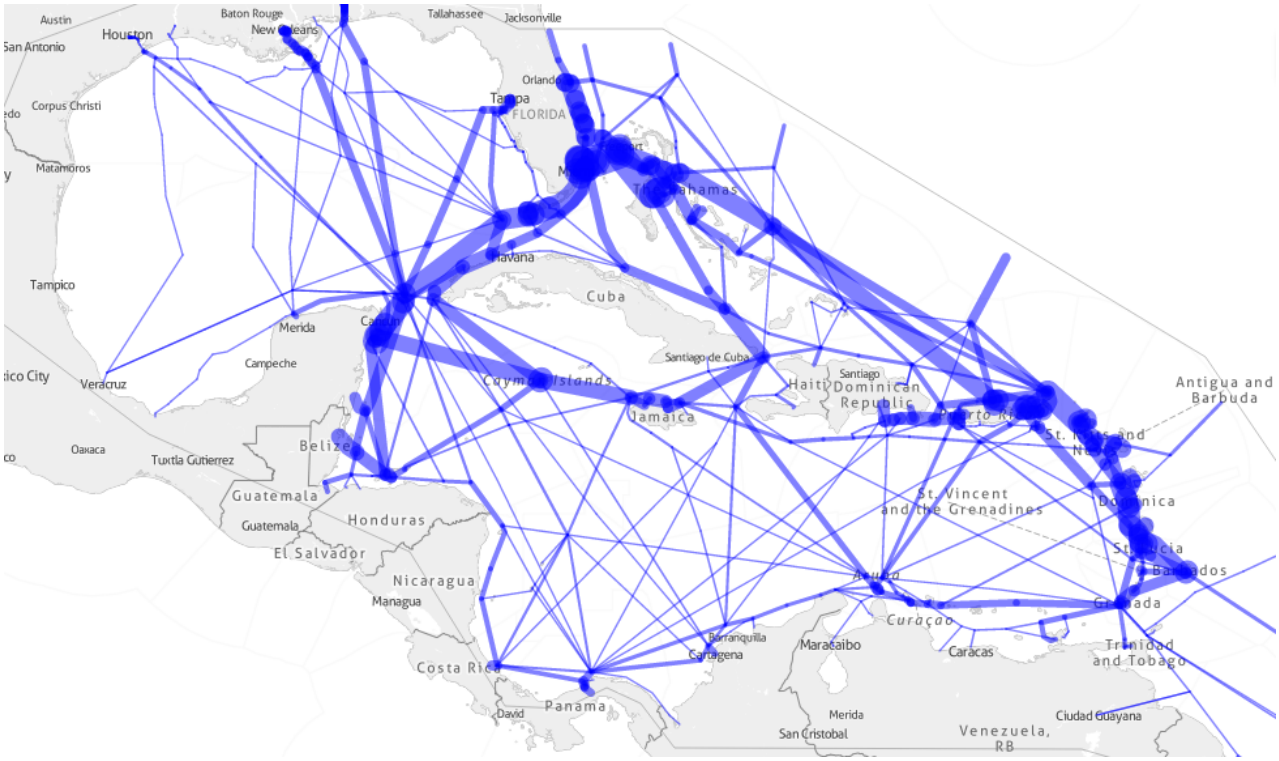

Figure 3. Maritime traffic within the Caribbean region (2007-2008). Data are shown by general routes and include only passenger vessels. Source: RAC/REMPEITC (2014b).

1.5.2. Logistics Hub

Jamaica is currently in the process of developing plans for its "logistics hub" initiative to promote and grow the economy.

> "With its location at the centre of North-South and East-West shipping lanes, Jamaica is the choice of global logistics companies to be the Hub of the Hemisphere, serving a market of 800 million, and becoming the gateway to Europe and Africa. With the establishment of the Logistics Hub, Jamaica will become an important part of the global value chain" (Jamaica Logistics Hub, 2014a).

The initiative includes developments to the ports, air cargo facilities, and road/rail infrastructure (Jamaica Logistics Hub, 2014b). The port expansion component consists of dredging of the Kingston Harbour to 15 m in order to accommodate 12,500 TEU

container ships once the Panama Canal Expansion Project has completed (Jamaica Logistics Hub, 2014b). Additionally, a bulk shipment port will be constructed approximately 20 km away from Kingston that will allow efficient shipments of petroleum and crude oil (Jamaica Logistics Hub, 2014b). Future projects in the area include supplementary terminals to accommodate minerals and grain, as well as a dry dock to permit maintenance and restoration services to ships (Jamaica Logistics Hub, 2014b).

With the Logistics Hub initiative in development, increased traffic around the island would further highlight the need for a Places of Refuge contingency plan.

1.6. Objectives and Research Question

The IMO Guidelines on Places of Refuge have identified procedures and frameworks for the provision of a Place of Refuge (IMO, 2004, Appendix 2).

> It is recommended that coastal States endeavour to establish procedures consistent with these Guidelines by which to receive and act on requests for assistance with a view to authorizing, where appropriate, the use of a suitable place of refuge. (IMO, 2004 p 7).

This project examined potential sites along the coast of Jamaica (existing ports and secluded bays) to determine their feasibility as Places of Refuge. Factors such as environmental impacts, biodiversity, socioeconomic impacts, and physical/natural limitations were considered in the analysis. The following research questions were asked:

1) What sites are best suited for identification as potential Places of Refuge?

2) What are the merits, drawbacks, and potential impacts of each of the chosen sites, and how should decision-makers proceed?

The objective of this study was to provide government authorities in Jamaica with information to better inform them on issues concerning Places of Refuge. With the assessment of suitability for potential locations, it could assist with contingency planning and a possible site-designation process in the event of a future maritime incident.

CHAPTER 2: HISTORICAL CONTEXT

2.1. Customary Rights of Ships in Distress

Shipping has been and currently is a predominant mode of transportation; and historically, ships navigating the world's oceans have usually been permitted refuge in coastal areas to prevent damage from storms or other inclement weather (Chircop, 2002).

> Granting refuge to ships in distress has been an ancient custom, which has been practiced over the centuries. Nowadays, some States choose to recognize its existence and observe the custom while other States opt to refuse or ignore it (Constantinou, n.d. p 2).

As was indicated in the paper by Chircop (2002), concerns from coastal states were not only limited to the marine environment, but also in the form of potential conflict that could occur once on land. For example, if a ship were to seek refuge in a port, there exists a potential for issues relating to immigration, customs, as well as criminal or human health issues (Chircop, 2002). In other words, granting refuge may lead to additional concerning issues that do not even have much relevance or relation to the ocean environment. That being said, "granting refuge is distinct from the right to receive assistance. It is not necessarily a right to enter port" (Constantinou, n.d. p 2). In the 19th century, ships exercised the right to freely conduct maintenance and repairs on ships, if needed, and were not subjected to current customs practices (Constantinou, n.d.). At present, many conventions and treaties have been signed, which has resulted in confusion surrounding accepted practices and perceptions relating to Places of Refuge (Constantinou, n.d.). In general, there are two positions that are seen when examining the issue: ship owners, salvors, and shipmasters are focused on preserving the integrity of a ship, and coastal states would like to preserve their coastlines and environmental integrity

(Morrison, 2012). Ship owners and salvors are more likely to encourage a vessel being taken into a Place of Refuge, while coastal states would be more hesitant on the grounds of potential environmental damage (Morrison, 2012).

The potential for a high volume oil spill would surely alarm any coastal state, however, ships are improving in technologies and engineering capabilities. Despite advances, coastal states are still reluctant to allow refuge: "But since the 1970s coastal states have begun to refuse refuge to ships in distress, particularly to those carrying oil or other dangerous cargoes" (Morrison, 2011a p 82). Therefore, it is clear that longstanding customs have dictated a certain way of responding to vessels in distress, and now in present times, emerging concerns relating to environmental integrity and the overall security of a coastal state overshadow best practices.

2.2. Refusing Versus Granting Refuge

When faced with a decision in a time-sensitive scenario, the following question may be asked: Will the consequences be that much worse if refuge is not granted? A simple answer to that question is often yes (Devanney, 2000). There have been previous situations in which allowing refuge still resulted in environmental damage from oil spills, however, the overarching trend is that when ships are allowed refuge by a coastal state, the impacts are lessened (Devanney, 2000). Table 2 illustrates this concept well, in that the majority of incidents where refuge was refused resulted in spills of over 50,000 m^2. Conversely, in Table 3 the majority of spills that occurred when refuge was granted were under either 0 or under 10,000 m^3.

Table 2. Coastal States that Refused Refuge. Obtained from Devanney (2000).

No.	Date	Country Requested for Refuge	Ship in Need of Assistance	No. Dead in Incident	Volume of Oil Spilled in m^3
1	May 12, 1976	Spain	Urquiola	1	111,700
2	Dec. 15, 1976	U.S	Argo Merchant	0	29,000
3	Dec. 31, 1978	Spain	Andros Patria	30	58,800
4	Dec. 31, 1978	Portugal	Andros Patria	30	58,800
5	Dec. 31, 1978	U.K	Andros Patria	30	58,800
6	Dec. 31, 1978	France	Andros Patria	30	58,800
7	Jan. 7, 1983	Oman	Assimi	0	60,200
8	Dec. 19, 1989	Spain	Khark 5	0	82,300
9	Dec. 19, 1989	Portugal	Khark 5	0	82,300
10	Apr. 8 1991	Mauritius	Starfish	0	0
11	Feb. 15, 1996	U.K	Sea Empress	0	84,400
12	Jun. 14, 2000	South Africa	Treasure	0	1,400
13	Oct. 31, 2000	U.S	Bear G	0	0
14	Dec. 6, 2000	Canada	Eastern Power	0	0
15	Dec. 31, 2000	Morocco	Castor	0	0
16	Dec. 31, 2000	Algeria	Castor	0	0
17	Dec. 31, 2000	France	Castor	0	0
18	Dec. 31, 2000	Gibraltar	Castor	0	0
19	Dec. 31, 2000	Greece	Castor	0	0
20	Dec. 31, 2000	Italy	Castor	0	0
21	Dec. 31, 2000	Malta	Castor	0	0
22	Dec. 31, 2000	Spain	Castor	0	0
23	Dec. 31, 2000	Tunisia	Castor	0	0
24	May 2, 2002	Japan	Front Tobago	0	0
25	May 2, 2002	Taiwan	Front Tobago	0	0
26	Nov. 13, 2002	Spain	Prestige	0	82,000
27	Nov. 13, 2002	Portugal	Prestige	0	82,000

Table 3. Coastal States that Granted Refuge. Obtained from Devanney (2000).

No.	Date	Country Requested for Refuge	Ship in Need of Assistance	No. Dead in Incident	Volume of Oil Spilled in m^3
1	Apr. 29, 1968	South Africa	Esso Essen	0	4,400
2	Aug. 21, 1972	South Africa	Oswego Guardian	44	11,700
3	Oct. 10, 1974	South Africa	Obo Queen	0	600
4	May 13, 1975	Australia	Princess Ann Marie	0	16,000
5	Sept. 28, 1975	Netherlands	Pacific Colocotronis	0	1,760

6	Jun. 1, 1977	South Africa	Norse Queen	0	0
7	Dec. 16, 1977	South Africa	Venpet	2	4,000
8	Dec. 16, 1977	South Africa	Venoil	2	31,000
9	May 26, 1978	South Africa	World Horizon	0	830
10	Oct. 12, 1978	Ireland	Christos Bitas	0	4,290
11	Dec. 15, 1979	Spain	Turgut Reis	0	300
12	Apr. 9, 1981	South Africa	Energy Endurance	0	2,100
13	Dec. 14, 1981	Portugal	Almizar	0	0
14	Dec. 26, 1982	Bahamas	Charalambos	0	1,160
15	Feb. 2, 1984	Spain	Enrico Dandolo	0	0
16	Nov. 18, 1986	Ireland	Kowloon Bridge	0	2,000
17	Feb. 17, 1987	Canada	Dodsland	0	0
18	Oct. 19, 1988	South Africa	Kition	0	0
19	Feb. 5, 1990	Ireland	Tribulus	0	50
20	Aug. 3, 1991	South Africa	Mimosa	0	0
21	Aug. 29, 1991	South Africa	Atlas Pride	0	0
22	Aug. 15, 1992	Norway	Trave Ore	0	0
23	Feb. 25, 1992	Uruguay	Kamari	0	0
24	Apr. 18, 1994	South Africa	Arima	0	0
25	Jun. 2, 1994	South Africa	Tochal	0	223
26	Jan. 11, 1995	U.K	Mimosa	0	0
27	Mar. 1, 1996	South Africa	Kraka	0	0
28	Jun. 29, 2002	South Africa	Obo Venture	0	0
29	Feb. 14, 2004	Australia	Eurydice	0	0
30	Feb. 4, 2005	Cyprus	Genmar Kestrel	0	1,557
31	Oct. 20, 2006	Cyprus	Front Vanguard	0	6,000

From these tables, it appears that the incidents in which refuge was refused do not have a nation specific trend. A diverse range of countries have refused refuge for many different reasons (see Devanney, 2000). On the other hand, South Africa has had multiple scenarios in which it has granted refuge (15 in total from the list)(Devanney, 2000). It is presumptuous to conclude that South Africa is "ahead of the game" in terms of its views on Places of Refuge without additional information and influencing factors, but it has clearly allowed refuge for ships more than its other coastal nation counterparts on this list (Devanney, 2000). The author also noted that the list is incomplete, and that

many additional incidents were avoided but those data were not recorded since they received little attention (Devanney, 2000).

2.3. Previous Incidents – Refuge Refused

The following section outlines specific examples and past incidents that set a precedent for future guidelines and discussions on allowing refuge for ships in distress. Examples of both refuge refusal and allowance will be discussed, to better understand the complexity of the issue.

2.3.1. The Erika

The Erika was a ship that sank off the Bay of Biscay on December 12, 1999 (Cedre, 2009a). She was a flagged ship from Malta, carrying approximately 31,000 tonnes of heavy fuel oil from France to Italy (Cedre, 2009a). The day prior to the sinking, the Erika had been subjected to extremely rough sea conditions, warranting an alert call from the Ship Master (Cedre, 2009a). One report on the incident does not state that the Erika was refused entry, but rather that the coastal state had an "exceedingly high level of trust" in the captain's judgment call to revoke the distress signal (White et al., 2003 p 3). There have been disputes as to whether or not refuge was actually sought, which has led to confusion surrounding the incident (see Murray, 2002; Morrison, 2011b). However, it has been concluded that if this refuge request was in fact made, access would have been denied anyways (Morrison, 2011b). All things considered, the Erika ended up sinking, and spilling between 19,000 and 20,000 tonnes of heavy fuel oil (Cedre, 2009a). Spill slicks affected the coastline, with one contaminated stretch being almost 15 km in length during initial observations (Cedre, 2009a). In total, the spill

affected hundreds of kilometres of shoreline and beaches, in addition to disrupting various marine industries (Morrison, 2011b). A notable detail is that the Erika was a single hulled ship, built in advance of more rigid MARPOL guidelines, which would have likely enabled the spill (Morrison, 2011b).

2.3.2. The Castor

The Castor was a ship that encountered difficulties in a region close to Morocco on December 31st, 2000 (Cedre, 2009b). She was a flagged ship from Cyprus, carrying approximately 29,500 tonnes of unleaded gasoline (Cedre, 2009b). The cause of the incident was due to inclement weather conditions, which resulted in a large 24 m crack forming on the vessel (Cedre, 2009b). The crew was safely evacuated, but the ship was left in the hands of a salvage crew (Cedre, 2009b). The vessel was towed throughout the Mediterranean for over 40 days, since refuge requests were refused from all ports in 9 countries (Table 2) (Cedre, 2009b). The Castor was finally taken in off the Tunisian coast and a cargo transfer was permitted (Cedre, 2009b). Despite the 40-day ordeal, there was no damage to coastal states, and no cargo was spilled (Devanney, 2000; Cedre, 2009b). However, this incident clearly demonstrated the lack of international cooperation and consensus on how to properly respond to a ship in need of refuge.

2.3.3. The Prestige

The Prestige was a ship that encountered issues in the region of Cape Finisterre on November 13th, 2002 (Cedre, 2014). She was a flagged ship from the Bahamas that was subjected to difficulties in inclement weather, resulting in failure of a ballast tank, and an approximate 30-degree starboard list (Cedre, 2014; Devanney, 2000). The majority of

the crew was evacuated, with exception to the captain, first mate, and chief mechanic (Cedre, 2014). According to reports "The ship asked for refuge, and this was not only denied by Spain and Portugal, but the ship was forced further offshore" (Devanney, 2000 p 3). This led to the vessel being towed for over six days offshore, and ultimately sinking on the 19th of November 2002 (Cedre, 2014). The sinking of the Prestige resulted in the spillage of approximately 64,000 tonnes of heavy fuel oil, decimating 2,900 km of coastline, killing hundreds of thousands of birds, and oiling 1,140 beaches (Cedre, 2014).

Criticisms of the lack of response have stated that the spill likely would not have occurred if refuge had been granted:

> Given that the ship survived six days, she almost certainly would have survived the short tow to sheltered waters. Forcing such a ship offshore, practically guaranteed a 72,000-ton spill; and one whose impact would be spread over a wide area (Devanney, 2000 p 3).

The response from the scientific community in regards to the spill was also criticized, stating that the lack of organization and structure further exacerbated the impacts (Friere et al., 2006). Following the incident, legal proceedings relating to environmental damage were issued, however, the cases against the captain, first mate, chief engineer, and former head of the Spanish merchant navy were adjourned until November 13 2013 (Cedre, 2014). The captain was found to be the only one guilty of the charges against him due to "serious disobedience of authority" (Cedre, 2014 para 11). While there were many causal factors to the sinking of the Prestige, human error was a definite contributor. If the captain had heeded the requests for towage, the severity of the incident may have been reduced. Also, given that there was confusion and a lack of response from coastal states, Places of Refuge guidelines would have undoubtedly

provided additional assistance and framework for decisions. Moreover, the captain may have been more agreeable had he been provided with a step-by-step outline of the process to follow.

In conclusion, the past three examples demonstrate the lack of understanding surrounding the benefits of allowing refuge, and the lack of international consensus with respect to the issue. The IMO Guidelines were established in the years following these incidents, however, it remains to be a controversial subject.

2.4. Previous Incidents - Refuge Granted

Devanney (2000) has outlined refuge provision examples clearly in the following paper: "The Consequences of Providing and Refusing Refuge". The following table summarizes various events that have been discussed in the paper, and incidents in which major impacts have been avoided. The list only represents a select few cases out of many successful refuge approvals.

Table 4. Vessel names and descriptions of incidents in which refuge was granted. Adapted from Devanney (2000).

Vessel Name	Description of Event
Pacific Colocotronis	- September 28 1975 - Carrying 72,000 tonnes of crude oil - Began leaking cargo while travelling off of the Dutch coast - Damage was determined to be severe - The port of Ijmuiden (Netherlands) granted refuge within its harbour - Approximately 1,800 m^3 of oil was spilled, as opposed to 72,000 tonnes (Devanney, 2000)
World Horizon	- May 26, 1978 - Fully loaded Very Large Crude Carrier (220,000 tonnage) - Bad weather off the coast of South Africa resulted in cargo leakage - Was granted refuge in St. Helena Bay (South Africa) - Approximately 830 m^3 of oil was spilled, as opposed to 220,000 tonnes (Devanney, 2000)

Christos Bitas	- October 12 1978 - Carrying 35,000 tonnes of crude oil, off the coast of Ireland - Human error in navigation resulted in the ship grounding - Ship re floated itself and navigated towards Belfast (Northern Ireland) - Royal Navy towed the ship to safety, where lightering of the cargo could take place - Once all the cargo had been removed, the ship was sunk 300 miles off Ireland. - Approximately 4,000 tonnes of oil were spilled, as opposed to 35,000 (Devanney, 2000)
Mimosa	- August 3 1991 - Fully loaded Ultra Large Crude Carrier (357,000 tonnes) - Encountered inclement weather off of the southern tip of Africa - Steering gear malfunctioned, which resulted in further mechanical breakdowns - A large hole in one of the ballast tanks was discovered - The ship was towed into Algoa Bay (South Africa) and resulted in no spilled cargo (Devanney, 2000)

CHAPTER 3: JAMAICA

3.1. Preface

The current study focuses on the country of Jamaica, a Caribbean island nation situated directly west of Haiti and south of Cuba in the Caribbean Sea. Jamaica is an island heavily reliant on tourism, due to its lush tropical environment, sandy beaches, and vibrant culture. This section covers general background information on the country, its geographic context, socioeconomic context, status on environmental protection, and coastal resource pressures. The information provided serves to illustrate the various influences relating to Places of Refuge and how numerous factors must be considered in decision-making with respect to the issue.

3.2. Geographic Context

Jamaica is the third largest island within the Caribbean, with a total area of just over 10,000 km^2 and a coastline spanning 1,022 km (CIA, 2014; UWI, 2013).

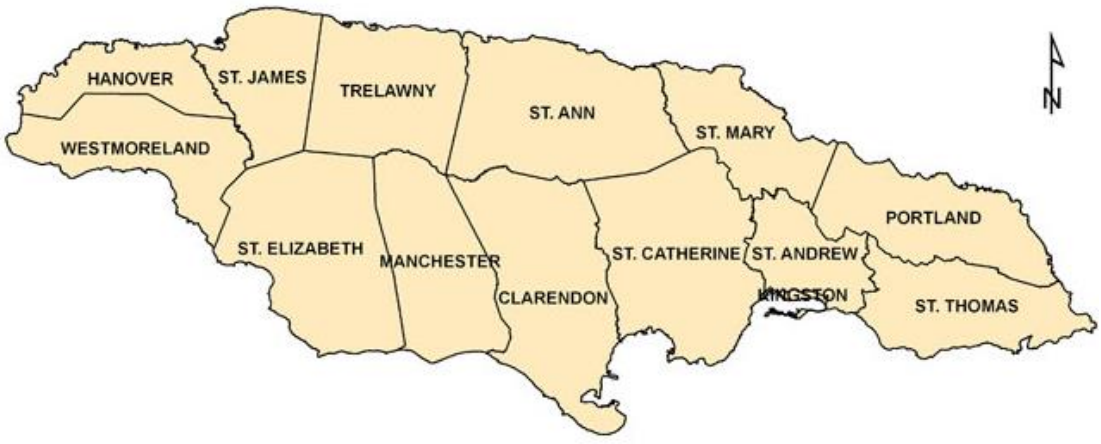

Figure 4. Parishes in Jamaica. Retrieved from Electoral Commission of Jamaica (2014).

The climate is tropical, with hot and humid weather throughout the year, in addition to wet and dry seasons. The topography of Jamaica is relatively mountainous, with the highest peak (Blue Mountain) reaching an elevation of 2,256 m (CIA, 2014). The marine environment varies in different regions of the island, with the south side possessing a broader continental shelf and shallower seas (UWI, 2013). Conversely, the northern part of the island is characterized by fringing reefs and deeper water, with the continental shelf slope being more pronounced (UWI, 2013). Jamaica experiences little seasonal variability in temperature, however, winds can vary to a great degree, peaking in intensity between the months of January-April and July (UWI, 2013). Tides in Jamaica are quite small and do not impact the sea surface height to a great degree (UWI, 2013).

3.3. Socioeconomic Context

The Jamaican economy is focused mainly on tourism, but also has valuable industries such as bauxite and sugar production (Sullivan, 2006).

Fisheries play a role in the economy; however, the Jamaican fishing fleet comprises fundamentally artisanal fishermen (NEPA, 2011). Commercial operations began to expand in the 1980s when companies initiated lobster and conch fisheries on the Pedro and Morant Banks (NEPA, 2011). Fishermen in Jamaica are dependent upon income from fishing, and have developed destructive and harmful fishing practices including dynamite and poison fishing, as well as illegal poaching (NEPA, 2011). The majority of fishing activity takes place on the southern coast of Jamaica, where the continental shelf is less steep, and can support ground fish fisheries and bottom dwelling

organisms (Zenny, 2006). Therefore, damage to the southern coast and coastal zone would be extremely detrimental to the fishing industry.

Jamaica's energy consumption rate is high in comparison to other developing countries, and requires importation of fuels in order to accommodate residential and commercial energy needs (NEPA, 2011). This is draining on the economy of Jamaica, since they are left at the mercy of external inflation and price increases (NEPA, 2011). Currently, petroleum and petroleum products supply the country with approximately 91% of its needs, with the remaining 9% being provided by renewable energy (NEPA, 2011). Therefore, there is a potential for renewable energy within Jamaica, and it could place less of a financial burden on the country as a result of decreased imports of petroleum.

The mining industry is also quite substantial in Jamaica, with the main production being of the minerals bauxite, alumina, and gypsum (NEPA, 2011). Various quarries are located throughout the country, mainly in rural areas, and then subsequently sent in transit to the coast, where they are loaded onto ships to be exported (NEPA, 2011; UWI, 2013). Port Rhodes (located in Discovery Bay), and Ocho Rios both export bauxite from their marine terminals and piers (see Figure 5)(UWI, 2013). Port Esquivel, Rocky Point, and Port Kaiser are all fairly large exporters of alumina on the southern coast of Jamaica (UWI, 2013). Socioeconomic impacts from the mining industry may deter the designation or use of some commercially active ports as Places of Refuge. Jamaica's mining industry is hugely dependent on its ability to export product, therefore the integrity of the ports and surrounding areas is crucial for the economy.

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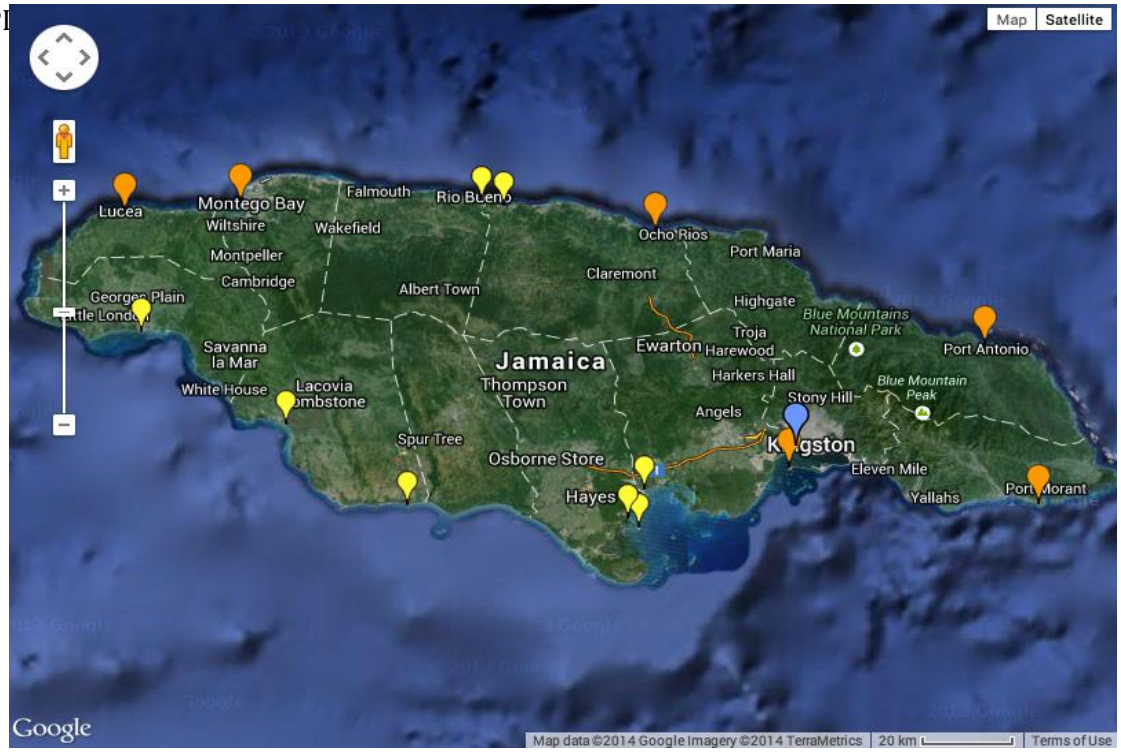

Figure 5. Ports of call within Jamaica. Very small ports are indicated in yellow, small ports are indicated as orange, and medium sized ports as blue. Figure retrieved from World Port Source (2014).

The tourism industry is large and a key factor in sustaining and promoting Jamaica's economy. Cruise ship piers and resorts have been constructed in areas all around the island, focusing on the north and west coasts (NEPA, 2011). In 2010, tourism earnings amounted to over $2 billion, comprising 20% of the total gross domestic product for the country, and a quarter of all jobs (NEPA, 2011). Therefore, it is an integral sector for the country.

3.4. Environmental Context

Jamaica is a country rich in natural beauty and high levels of biodiversity. It has the highest number of endemic birds and plants in the Caribbean, and is fifth worldwide (NEPA, 2011). Jamaica is exposed to many threats and impacts to its environmental integrity, including: habitat loss, over-exploitation, invasive alien species, weak law enforcement, inadequate awareness of the value of natural resources, urban population growth, poor spatial planning and land use, and climate change (NEPA, 2011).

Many of these issues are consequences of economic growth and expansion in order to benefit the economy, however, some issues are somewhat preventable (e.g. awareness of the value of natural resources, and weak law enforcement). A quote from Hayle (2003 p 79) accurately depicts this problem: "In the case of Jamaica, environmental issues are manifestations of the social issues that plague the country." People need to understand the value of the natural resources in Jamaica, because without comprehension, little action will take place in order to preserve the natural world. This may also be a problem in relation to Places of Refuge, where people do not appreciate the threats and impacts of marine pollution. If that is the case, then allowing refuge on the basis of providing environmental protection for the coastline is not likely.

3.4.1. Marine Reserves

Jamaica has instigated environmental conservation efforts by establishing protected areas in its marine, estuarine, freshwater, and terrestrial regions (JPAT, 2013). The Jamaica Protected Areas Trust (JPAT) is the overarching organization responsible for the engagement, monitoring, implementation, and support of the protected areas

around the country (JPAT, 2013). The structural authority for protected areas includes input from the Nature Conservancy, other non-governmental organizations (NGOs), and government departments (Fisheries, Forestry, Jamaica National Heritage Trust, Natural Resources Conservation Authority, and the National Environment and Planning Agency)(JPAT, 2013; NEPA, 2011). Types of protected areas in Jamaica include parks, national parks, forest reserves, forest management areas, and fish sanctuaries (Figure 6)(JPAT, 2013).

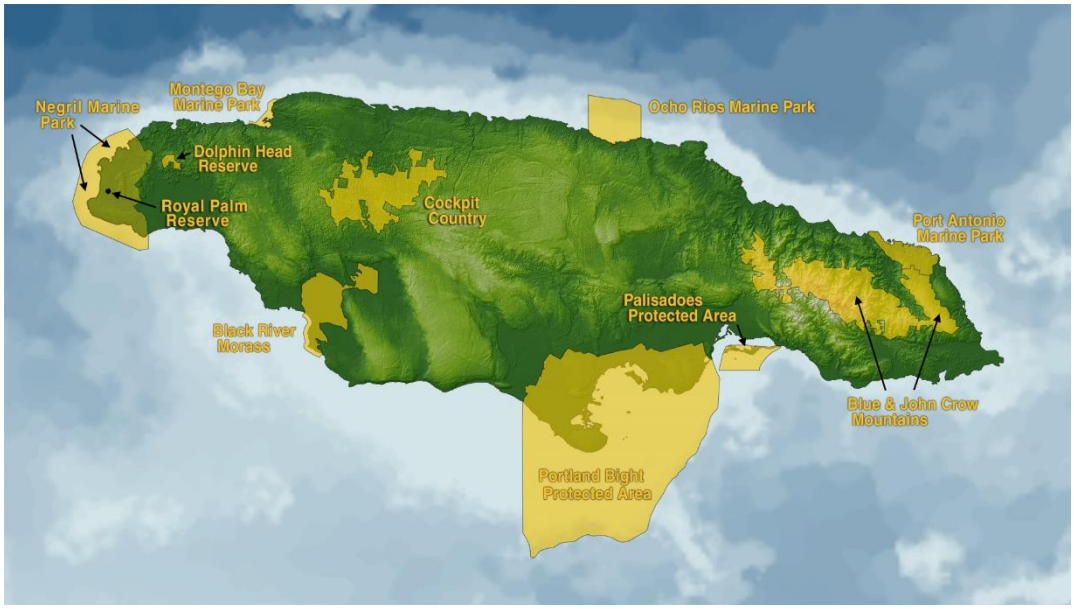

Figure 6. Protected Area locations around Jamaica. Obtained from JPAT (2013).

Jamaica currently has 11 marine and terrestrial protected areas (see Table 5).

Table 5. Protected Areas within and around Jamaica. Adapted from JPAT (2013).

Protected Area Name	Type (Marine or Terrestrial)
Negril Marine Park	Marine
Black River Morass	Marine
Royal Palm Reserve	Terrestrial
Dolphin Head Reserve	Terrestrial
Ocho Rios Marine Park	Marine
Cockpit Country Reserve	Terrestrial
Port Antonio Marine Park	Marine

Montego Bay Marine Park	Marine
Palisadoes –Port Royal Protected Area	Marine
Portland Bight Protected Area	Marine
Blue & John Crow Mountains National Park	Terrestrial

3.4.2. Special Fishery Conservation Areas

The Ministry of Fisheries and Agriculture has declared 11 legally protected special fishery conservation areas (SFCA) around Jamaica (MOAF, 2014). Table 6 provides a summary of name and location (parish).

Table 6. Special Fishery Conservation Areas & Locations (Parish). Obtained from MOAF (2014).

Special Fishery Conservation Area	Parish
Bogue Island Lagoon	St. James
Bowden	St. Thomas
Three Bays	St. Catherine
Salt Harbour	Clarendon
Galleon Harbour	St. Elizabeth
Montego Bay Marine Park	St. James
Bluefields Bay	Westmoreland
Oracabessa Bay	St. Mary
Discovery Bay	St. Ann
Orange Bay	St. Mary
Sandals Boscobel	St. Mary

Any unauthorized fishing activities within SFCAs is strictly prohibited and punishable by law, as these regions are protected under the Fishing Industry Act of 1975 (MOAF, 2014). Benefits of declaring SFCAs include increases in fish populations and biomass, as well as benefits from the 'spill over' effect on surrounding unprotected areas (MOAF, 2014). Therefore, these protected fishing areas are crucial in maintaining biodiversity for fish populations around the island, as well as for sustaining the fishing

industry in the future. Any impacts to these regions would likely have extremely negative results.

3.4.3. Pressures on Coastal Resources

Coral reefs, which provide many services both ecologically and economically, are in decline worldwide. Reefs in Jamaica have been particularly impacted by stresses relating to overfishing, dredging, sewage discharge, increased runoff, and coastal development (NEPA, 2011). Between the years of 2001 and 2005, the value of reef fisheries in Jamaica was $34.3 million per year (NEPA, 2011). Not only are coral reefs attracting tourists, but they also provide an immense economic value to local populations.

Jamaica's beaches are also in a dire state, due to erosion, coastal development, sea level rise, and the removal of coastal vegetation (e.g. sea grass beds) (NEPA, 2011). This is as a result of a high level of tourism/human use and development for resorts and recreational activities (NEPA, 2011). NEPA has a monitoring program for 36 beaches around Jamaica, and results indicate that the region of Negril has a severe erosion problem (NEPA, 2011). While there are no proposed sites for Places of Refuge within Negril, there is the possibility of beach contamination and environmental degradation should widespread effects occur from a shipping incident in another area.

Mangroves and sea grass beds have been severely depleted by human pressures in Jamaica (NEPA, 2011). The issue of public awareness with respect to the environment is critical here, in that for many years a stigma existed surrounding mangroves and coastal wetland areas, where people perceived them as a source of disease (NEPA, 2011).

CHAPTER 4: MARINE AND SHIP SOURCE POLLUTION

4.1. Marine Pollution in the Caribbean

The Caribbean has been facing a diverse range of marine pollution impacts within the past 10 to 15 years, mainly deterioration of water quality, coastal degradation, coral reef destruction, and coastal erosion (Siung-Chang, 1997). Oil spills in the Caribbean have the potential to harm high amounts of biodiversity and can have immense impacts on fishery products and other economically viable sources of income (e.g. tourism) (Nansingh and Jurawan, 1999). Particular pollution types of interest that have become key issues in the Caribbean include pollution from petroleum hydrocarbons, marine debris, industrial wastes, and sewage/wastes (Siung-Chang, 1997).

Jamaica has high levels of pollution, with beaches in the northern and western parts of the country being highly contaminated with tar (GESAMP, 1993). Causes of this pollution can be attributed to shipping, through tanker traffic and the accumulation of pollutants due to discharges from vessels (Siung-Chang, 1997). While marine pollution is a contentious issue, oil spill incidents have in fact decreased significantly from decades ago due to improvements in navigation and ship design (Jernelov, 2010). Tankers that transport oil and other substances are double hulled and sectioned, therefore the risk of spillage is lowered, and in the event of an actual spill, the entire shipment is not lost (Jernelov, 2010).

In 1973 the IMO adopted a convention entitled “The International Convention for the Prevention of Pollution from Ships”, or MARPOL (IMO, 2014). This convention was targeted at reducing pollution to the marine environment from ships (both

operational and accidental inputs)(IMO, 2014). Many countries have recognized and ratified MARPOL, Jamaica included.

4.2. Oil Spills and Impacts

When oil enters the marine environment, it spreads out across the water into a fine layer (Jernelov, 2010). Depending on the quantity and oil type, it may appear as a slick, or as droplets of oil within water (Jernelov, 2010). It begins to break down into dissolvable components, and the process is aided by ultra violet light from the sun, and bacteria that can consume specific biodegradable components (Jernelov, 2010). Elements of the oil will remain in the natural environment for a prolonged period of time, and begin to accumulate in susceptible locations (e.g. sandy beaches, sediment, etc.)(Jernelov, 2010). Depending on the type of oil (refined, crude, etc.), the long-term effects in the ecosystem differ, but nevertheless have profound impacts on wildlife (Jernelov, 2010). Smothering of birds, mammals and fish are just some of the many detrimental effects that oil can impose on the natural environment (Jernelov, 2010). Another consequence that has been seen is in the form of algae blooms and overgrowths (Jernelov, 2010). This is due to the absence of grazing organisms as a consequence of the spill, and has resulted in an overabundance of algae, which can be damaging for many ecosystems, including coral reefs (Jernelov, 2010).

While environmental concerns of oil spills are of great importance, a rising concern for the impact on human heath is being seen (GESAMP, 1993). Individuals who reside along coastlines and near areas where an oil spill could occur, as well as those responding to the incidents (e.g. clean-up workers, surveyors, etc.) represent vulnerable

populations (GESAMP, 1993). Impacts of concern to humans include dermatitis, emphysema, and other organ failures (Baringa, 1989). Therefore, caution needs to be exercised in situations that would result in direct human exposure to oil spills. This represents a challenge in responding to issues relating to Places of Refuge, where a rapid response is needed, and exposure may be inevitable.

Economic concerns from oil spills range from tainted seafood and fish stocks, to contamination of fishing gear and aquaculture facilities (GESAMP, 1993). Oil spills may kill off or seriously harm stocks, and result in economic losses to fisheries (GESAMP, 1993). Additionally, fouling of gear may be seen (particularly in netted types), which can lead to the destruction of the particular equipment and further contamination of catches already within the net/traps/trawls (GESAMP, 1993). Tourism losses, such as destruction of beaches, parks, and other marine sites due to oil contamination may result, as well as aesthetic losses from an incident (GESAMP, 1993). Lastly, oil may impact industrial plants and facilities that rely on seawater for cooling purposes, and may result in disruptions or closures (Nichols and Parker, 1989).

4.3. Oil Input from Ships

The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) has published a report on the "Estimates of Oil Entering the Marine Environment from Sea-Based Activities" (2007). The GESAMP report outlines in detail the type and approximate amount of oil pollution from various regions throughout the world, which will be discussed briefly. Between the years of 1988-1997, approximately 457,000 metric tonnes of oil entered the marine environment as a result of

ships (GESAMP, 2007). Of this number, approximately 36% was a result of shipping accidents (GESAMP, 2007). The main types of oil inputs from ships are though operational discharges (ship related), operational discharges (cargo related), accidental discharges of oil, dry docking of ships, and the recycling of ships (GESAMP, 2007). In the context of this study, accidental discharges of oil would apply to situations requiring refuge.

4.4. Previous Oil Spills in Jamaica

Jamaica's oil spill history is not as notable as some other regions around the world, but it does have a record of relatively significant oil spills. In 1981 the first major oil spill occurred on the southern coast of the island at Port Kaiser (ODPEM, 2008). The ship (Erodona) grounded while navigating within the port and resulted in a spill of 600 tonnes of fuel oil (ODPEM, 2008). This spill resulted in negative impacts on the coastlines, as well as economic losses to fishermen and other industries (ODPEM, 2008). Another spill occurred in 1999 at Bluefields (in proximity to a Savanna la Mar, see Chapter 5), which resulted in approximately 2 km of coastline being affected (ODPEM, 2008).

4.5. Spill Risk in Jamaica

Shipping traffic in the Caribbean and worldwide will only increase in years to come, owing to advances and demands in the shipping industry. The Panama Canal Expansion project, when completed, will allow the transit of larger ships, however, many major shipping routes already exist in the Caribbean and around Jamaica (RAC/REMPEITC, 2012). One of the main routes for tankers carrying crude petroleum

from the Middle East is right off the north and south coasts of Jamaica (RAC/REMPEITC, 2012). Ships travelling towards the United States from the Middle East pass directly south of Jamaica through the Antilles current, and then when returning, pass through on the north side of Jamaica (RAC/REMPEITC, 2012). Additionally, ships travelling to and from Trinidad and Venezuela also operate on this route (RAC/REMPEITC, 2012). Mexico is the largest exporter of crude petroleum in the Caribbean, and those ships often transit the northern route around Jamaica (RAC/REMPEITC, 2012). Eleven straits of least width have been identified in the wider Caribbean, and while none are directly adjacent to Jamaica, they represent highly trafficked areas in the region (RAC/REMPEITC, 2012). These areas of increased risk then funnel their traffic into channels within proximity to Jamaica, potentially increasing the chance of an incident or collision (e.g. Windward Passage, which is between the eastern tip of Cuba and Haiti)(RAC/REMPEITC, 2012). Additionally, with Jamaica's plans to establish itself as a maritime logistics hub, vessels may choose to alter their transit routes in order to pass through Jamaica. This would allow vessels to gain access to resources and facilities, but would also lead to an increase in marine traffic, and a higher risk of potential incidents.

4.6. Coastal Environment Factors

The type of environment in the vicinity of a spill is an important factor when considering the overall sensitivity to oil spills (Nansingh and Jurawan, 1999). In previous work, coastal environments have been classified and ranked based on their level of exposure (Nansingh and Jurawan, 1999). The rationale has been that highly exposed sites subjected to stronger levels of wave action would be less vulnerable than sheltered

sites because any oil or oil residue would be quickly removed from the coastline and dispersed more widely offshore (Nansingh and Jurawan, 1999).

Similar indices were also created as a model for tropical environmental sensitivity to oil spills, which characterize related criteria, but with slightly differing susceptibilities (Georges, 1983; Agard, 1983). A summary of the classification of coastal environments based on an exposure scale from the more recent study (Nansingh and Jurawan, 1999) can be seen in Table 7.

Table 7. Coastal Environments and their exposure classification ranking. Obtained from Nansingh and Jurawan (1999).

Coastal Environment	Exposure
Mangrove Swamps	Sheltered
Sheltered Tidal Flats	Sheltered
Exposed Tidal Flats	Exposed
Sheltered Fine-Grained Sand Beaches	Fairly Sheltered
Exposed Medium to Coarse-Grained Sand Beaches	Exposed
Eroding Wavecut Platforms	Fairly Sheltered
Mixed Sand and Gravel Beaches	Sheltered
Sheltered Rocky Shores	Sheltered
Exposed Rocky Shores	Exposed
Coral Reefs	Exposed

4.7. Vulnerable Habitats in Jamaica

The Jamaica Ecoregional Planning Project (JERP) has undertaken several initiatives for environmental analysis and environmental spatial planning around Jamaica. The JERP Analysis provided information for this project on conservation targets and their distribution around Jamaica (Figures 7 and 8).

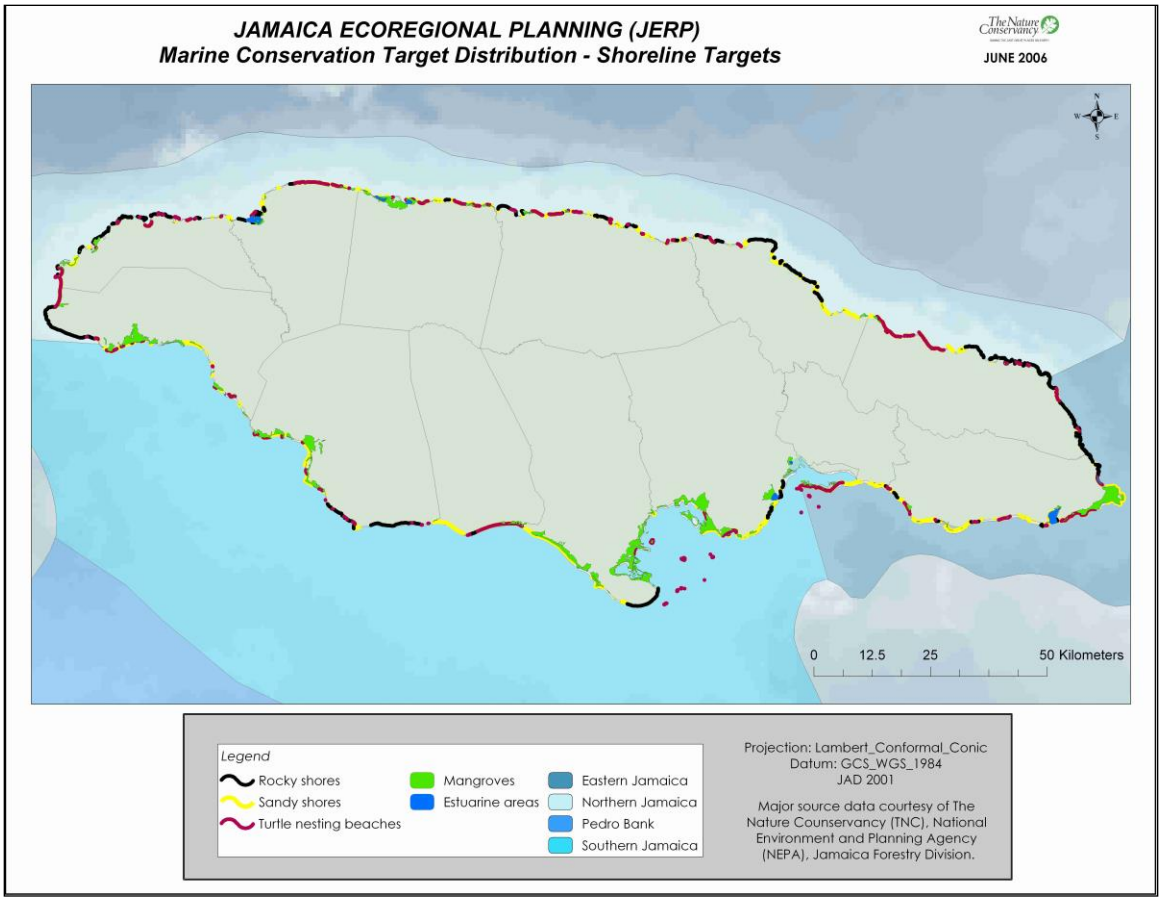

Figure 7. Marine Conservation Target Distribution around Jamaica (Shoreline Targets). Figure obtained from Zenny (2006).

The shoreline conservation target distribution indicates that Jamaica is comprised extensively of sandy shores, mangroves, and rocky shores (Zenny, 2006). The extent of the rocky shores is limited mainly to the western and eastern most parts of the islands, with a slight presence in areas on the north and south coasts (Zenny, 2006). The level of exposure cannot be determined from the given figures, nor is it stated within the report, therefore it is difficult to determine if they are exposed or sheltered. Jamaica's coastline consists of approximately 30% soft-grained sandy beaches with a high level of wave action (UWI, 2013). Nansingh and Jurawan (1999) identified fine-grained sandy beaches as "somewhat sheltered" on the exposure level, and therefore slightly vulnerable to oil

spill impacts. That being said, sandy beaches are a key element of tropical tourism, and oil spills within these areas are likely to be very detrimental not only to the environment, but also the economic situation in the region. Several sandy beaches on the Spanish coast were studied 5 years after the Prestige oil spill, and it was determined that buried oil was present up to depths of 4 m (Bernabeu et al. 2009). This indicates that beaches can remain contaminated for a long period of time, despite beach dynamics and possible clean-up efforts. The beaches of Jamaica have the potential to be extremely susceptible to this issue, which could impact tourism and the environment.

Mangroves are ubiquitous around Jamaica, and have been given an exposure level of "sheltered", therefore they represent vulnerable areas to oil spills (Zenny, 2006; Nansingh and Jurawan, 1999). Their presence along shorelines increases their potential exposure to oil spills because the oil can be retained within the root area, as well as within the substratum (Duke et al. 1997). There appear to be many habitat and environment types around Jamaica's coasts that are particularly vulnerable to potential oil spills and the subsequent impacts. Figure 8 depicts additional conservation targets (benthic) and their distribution around the island (Zenny, 2006). From Nansingh and Jurawan (1999), coral reefs represent very exposed environments that would not likely retain oil from a spill; however, they also exhibit extremely high biodiversity that has the potential to be negatively impacted. The distribution of coral reefs around Jamaica is primarily on the north coast, and in a select region on the south coast, in proximity to Kingston and Port Esquivel (Zenny, 2006).

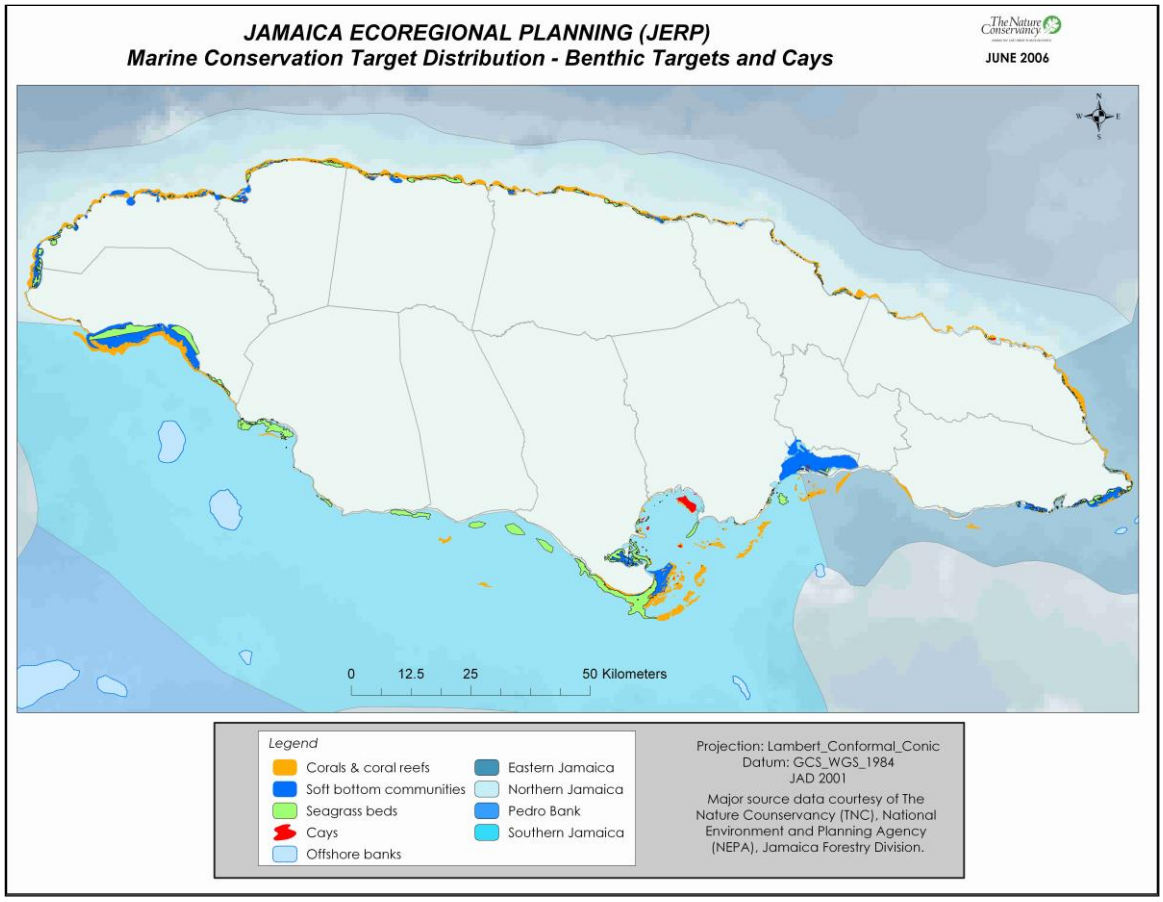

Figure 8. Marine Conservation Target Distribution around Jamaica (Benthic Targets & Cays). Figure obtained from Zenny (2006).

4.8. Conclusion on Marine and Ship Source Pollution

Seeing as marine pollution is ubiquitous in the Caribbean and around the world, it is reasonable to assume that Jamaica is at risk for continued, if not worse impacts to its marine environment. The nature of shipping has resulted in extensive oil pollution in the oceans and on coastlines, with different environment types determining the nature and degree of the impact (Nansingh and Jurawan, 1999). Jamaica has an extensive array of biodiversity and environment types that put it at a high risk to oil spills (Zenny, 2006). Therefore, precautions should be taken to minimize impacts to the marine environment

should an incident occur, which is why the topic of Places of Refuge is extremely relevant to this region.

CHAPTER 5: METHODOLOGY

5.1. Data Acquisition

A 5-week internship was completed at the Maritime Authority of Jamaica, located in downtown Kingston in May and June 2014, during which data were obtained and experts consulted. Scheduled consultations with experts were completed in order to gain more information on the state of Jamaica's current approach towards Places of Refuge, in addition to the level of stakeholder involvement. The goal of consultation was mainly focused on gaining insight into the various efforts that several government departments and NGOs were currently taking, and to explore ways in which the issue of Places of Refuge could be integrated. Discussions with government agencies such as the Ministry of Agriculture and Fisheries, Marine Police, Jamaican Defence Force (JDF) (Coast Guard), Port Authority, National Environment and Planning Agency (NEPA), and the Office of Disaster Preparedness and Emergency Management (ODPEM) were conducted during the initial week of the internship. The Nature Conservancy of Jamaica (a NGO) was also consulted on their current approaches and past work relating to environmental monitoring/biodiversity analysis.

Data were compiled from various sources (e.g. annual reports, policies, technical summaries, guidelines, etc.) and used for analysis in this project. Both primary literature and grey literature were used in discussions on background information and content.

5.2. Selected Sites

This section provides an overview of the 14 sites used in the analysis.

Figure 9. Distribution of sites around Jamaica. Adapted from Google Earth (2013).

1) Kingston Harbour

Kingston harbour is the main port of call for cargo vessels, averaging over 2000 vessel visits per year (PAJ, 2014). It receives shipments in the form of containers, RO/RO, general cargo, dry bulk, and tankers (PAJ, 2014). Kingston is a main industrial port, seeing very little tourism activity (e.g. 0-2 cruise ship visits per year)(PAJ, 2014). The port of Kingston is classified as the 7th deepest natural harbour in the world and is one of the leading container transhipment ports in the Caribbean (Figure 10)(UWI, 2013).

Figure 10. Kingston Harbour. Obtained from Google Earth (2013).

2) Port Esquivel

Port Esquivel is located at the head of Portland Bight and mainly exports alumina (UWI, 2013). It consists of a jetty and cargo pier for large vessels, and averages approximately 70-90 vessel visits per year (see Figure 11)(UWI, 2013; PAJ, 2014). Tugs are not available at this location (NGIA, 2013).

Figure 11. Port Esquivel. Obtained from Google Earth (2013).

3) Great Pedro Bluff

Great Pedro Bluff is not a designated port, and only offers anchorage for vessels.

Figure 12. Great Pedro Bluff. Obtained from Google Earth (2013).

4) Black River

Black River is a smaller port facility that exports mainly sugar products (UWI, 2013). There are many reefs within the area, in addition to submarine cables that need to be avoided if anchoring (NGIA, 2013).

Figure 13. Black River. Obtained from Google Earth (2013).

5) Belmont Point

Belmont Point is not a designated port, and only offers anchorage for vessels.

Figure 14. Belmont Point. Obtained from Google Earth (2013).

6) Savanna la Mar

Savanna la Mar is a community within close proximity to the western side of the island (NGIA, 2013). There are several reefs surrounding the bay, however, vessels can obtain anchorage in this area (see Figure 15)(NGIA, 2013). The port is not presently commercially active (NGIA, 2013).

Figure 15. Savanna la Mar. Obtained from Google Earth (2013).

7) Lucea Harbour

The port of Lucea is a small harbour on the north west side of the island. Berthing is available from a large wharf, where shipments of food products (bananas and molasses) are often loaded (NGIA, 2013).

Figure 16. Lucea Harbour. Obtained from Google Earth (2013).

8) Mosquito Cove

Mosquito Cove is a small and sheltered inlet that is only available for anchorage and for small vessels (NGIA, 2013). Navigation is difficult; therefore local knowledge of the region is crucial (NGIA, 2013).

Figure 17. Mosquito Cove. Obtained from Google Earth (2013).

9) Rio Bueno Harbour

Rio Bueno harbour is a relatively small port located on the north coast of the island that receives approximately 20-30 vessel visits per year (PAJ, 2014). The port receives cargo, mainly in the form of grain (UWI, 2013). Berthing and anchorage are available (see Figure 18)(NGIA, 2013)

Figure 18. Rio Bueno Harbour. Obtained from Google Earth (2013).

10) Discovery Bay

Discovery Bay, also the location of Port Rhodes, is a fairly large sized bay on the north coast of Jamaica. The bay has been dredged to accommodate ships navigating to the port, which is the main exporter of bauxite on the island (NGIA, 2013). The port is quite active, receiving approximately 80-130 vessel visits per year (PAJ, 2014). Both berthing and anchorage are available (see Figure 19)(NGIA, 2013).

Figure 19. Discovery Bay. Obtained from Google Earth (2013).

11) St. Ann's Bay

St. Ann's Bay is a small harbour within proximity to Ocho Rios. The bay offers anchorage for small to medium sized vessels, however, since the outer portion of the area is fringed by coral reefs, caution in navigation must be exerted (NGIA, 2013).

Figure 20. St. Ann's Bay. Obtained from Google Earth (2013).

12) Oracabessa Bay

Oracabessa Bay is a relatively sheltered bay on the northern coast of the island that offers anchorage for vessels in fairly deep water (NGIA, 2013). Berthing is not available.

Figure 21. Oracabessa Bay. Obtained from Google Earth (2013).

13) Port Antonio (East Harbour)

Port Antonio (East Harbour) is located on the eastern side of the island, and is directly adjacent to Port Antonio (West Harbour)(see Figure 22). West Harbour is a commercially active port (a cruise ship wharf was recently constructed) but receives usually no more than 10 vessel visits per year (PAJ, 2014; UWI, 2013). Berthing and port facilities are available in West Harbour, with East Harbour limited to anchorage only (NGIA, 2013). East Harbour does not receive any commercial activity and its infrastructure is limited to a private marina (NGIA, 2013).

Figure 22. Port Antonio (East Harbour). Obtained from Google Earth (2013).

14) Port Morant

Port Morant is a small, highly sheltered bay on the south east coast of the island. It has anchorage and berthing facilities available (UWI, 2013). The port is currently closed to commercial activity, which has resulted in the lack of maintenance to navigational aids (UWI, 2013).

Figure 23. Port Morant. Obtained from Google Earth (2013).

5.3. Site Selection & Criteria

Sites were initially chosen based on the physical level of refuge provided (i.e. secluded areas were preferred over non secluded areas). Major tourism areas were also avoided where possible (no sites were chosen within Negril, Montego Bay, or directly in Ocho Rios). This resulted in 27 preliminary options. Any other physical, environmental, or socioeconomic criteria were not considered at this point. Consultation with a senior employee and the Director of the Maritime Authority of Jamaica was conducted to determine the most suitable areas. During this consultation, several sites were removed from the list due to physical restrictions that were not considered in the initial selection process. Then data were compiled on the remaining 14 locations to determine the suitability of each site as a Place of Refuge. The results of the site assessment and comparison form the bulk of the analysis for this project.

When defining appropriate criteria to include in the site comparisons, it was determined that the most fitting method would be to follow the standards set out in the IMO Guidelines on Places of Refuge. There exist nation-specific plans for places of refuge (e.g. in Canada); however, the IMO Guidelines set an international framework that can provide a suitable context for countries to abide by. Therefore, the criteria outlined in Table 8 provided a basis for this project.

Table 8. IMO criteria for designating Places of Refuge. Criteria underlined indicate those used in the analysis. Obtained from: IMO (2004)

Environmental and Social Factors	Natural Conditions	Navigational Characteristics
• Environmental Areas • High Ecological Value/Biodiversity Areas • Fisheries • Industrial/Economic Facilities • Tourism/Amenity Facilities • Response Facilities • Level of Pollution • Public Safety Threat	• Level of Natural Shelter • Bathymetry • Prevailing Winds • Currents/Tides • Sea Conditions • Seasonal Effects	• Maneuverability • Dimensions of Ship & Restrictions • Stranding Risk • Anchorage & Mooring Facilities • Pilotage • Tugs

It is important to note that not all criteria were analyzed in this report. When considering a legal designation of a place of refuge, or when determining a location for shelter in response to an emergency, managers and decision makers need to ensure that all aspects are addressed and included. However, for the purpose of this report, data were only available for select criteria, and finding or generating more extensive data was deemed to be outside the scope of this project.

5.3.1. Scaling of Criteria

Scaling of criteria was an important step in the analysis. Each individual criterion was assessed to determine its appropriate scale, and subsequently allotted a numerical value (Table 9). The possible values for the various criteria are all categorical, except for one that is continuous, as follows:

- Yes/No
- Yes/No/In Proximity
- Low/Medium/High
- Very Low/Low/Medium/High/Very High
- Continuous scale using individual data points (e.g. quantities, distances, depths, lengths, etc.)
- Enclosed/Partially Enclosed

Overall, the sites with the highest final numbers (i.e. sites that scored the best with respect to the combined criteria) were the sites identified as the most suitable for designation as a Place of Refuge. To be able to combine these diverse attributes, each must first be assigned to a dimensionless scale, from 0 (worst outcome) to 1 (best outcome), and then a weight is applied to each criteria to reflect its importance, then they can be added. In determining the appropriate values for each scaled criterion, the higher number corresponded to the most ideal scenario. The corresponding numbers differed depending on the criterion, for example: a high conservation target presence would equal a more vulnerable environment; therefore it would receive a 0 for that specific level. If a site were within a protected area, it would not be ideal as a Place of Refuge; therefore it would receive a 0 for a "yes" response. Conversely, a "yes" to the criterion asking whether or not berthing is available would receive a 1, because in this situation berthing a vessel would provide further support against inclement weather, and also provide opportunity for easy transfer of cargo. The overarching message is that each criterion

requires individual assessment, which must then be assigned the appropriate value on its respective scale.

For criteria with multiple possible outputs (e.g. low/medium/high; very low/low/medium/high/very high), scale values were allotted based on an equal distribution for the purpose of simplicity (see Table 9 for examples). Existing numerical values (e.g. depths, distances, quantities, etc.) were transformed through linearly scaling to be between 0 and 1.

Table 9. Criteria scaling breakdown for each category within analysis.

Environmental Criteria	**Scaling Used**
Is it within a protected area? (Yes/No/In Proximity)	Yes = 0; No = 1; In Proximity = 0.5
Is it within a Special Fishery Conservation Area? (Yes/No/In Proximity)	Yes = 0; No = 1; In Proximity = 0.5
Is it within a highest priority conservation area? (Yes/No/In Proximity)	Yes = 0; No = 1; In Proximity = 0.5
Conservation Target Presence (Low/Medium/High)	Low = 1; Medium = 0.5; High = 0
Socioeconomic Criteria	**Scaling Used**
Fishing pressure/intensity (Very Low/Low/Medium/High/Very High)	Very Low = 1; Low = 0.75; Medium = 0.5; High = 0.25; Very High = 0
Number of attractions within parish	Closer to 1 = Ideal, Closer to 0 = Not Ideal
Is it within a town of culture and heritage themes? (Yes/No/In Proximity)	Yes = 0; No = 1; In Proximity = 0.5
Is it within a major heritage site? (Yes/No/In Proximity)	Yes = 0; No = 1; In Proximity = 0.5
Resort density within the area (Low/Medium/High)	Low = 1; Medium = 0.5; High = 0

Proximity to industrial ports (Km)	Closer to 1 = Ideal; Closer to 0 = Not Ideal
Physical and Response Criteria	**Scaling Used**
Average depth (m)	Closer to 1 = Ideal; Closer to 0 = Not Ideal
Maximum vessel length permitted (m)	Closer to 1 = Ideal; Closer to 0 =Not Ideal
Maximum draught permitted (m)	Closer to 1 = Ideal; Closer to 0 = Not Ideal
Is berthing available? (Yes/No)	Yes = 1; No = 0
Is anchorage available? (Yes/No)	Yes = 1; No = 0
Is pilotage compulsory? (Yes/No)	Yes = 1; No = 0
Proximity to Response Facilities (Km)	Closer to 1 = Ideal, Closer to 0 = Not Ideal
Level of shelter in the area (Enclosed/Partially Enclosed)	Enclosed = 1; Partially Enclosed = 0

5.3.2. Environmental Criteria

IMO Guidelines on Places of Refuge identified various environmental and social factors that were important to consider in the designation of a Place of Refuge (IMO, 2004). An emphasis on national environmental protection policies and biodiversity projections were the focus of this section.

1) Is it within a protected area? (Yes/No/In Proximity)

All 14 sites that are potential Places of Refuge were analyzed based on the current distribution of marine reserves/protected areas around Jamaica. Values were given based on the location of the particular site, i.e. within a designated marine reserve, not within a designated marine reserve, or within proximity (<10 km) to a designated marine reserve. The 10 km threshold was chosen because marine reserves are known to benefit from the spill over effect, in which fish biomass can increase in unprotected areas within proximity to reserves due to larval transport (Stamoulis and Friedlander, 2013). It has been seen on

a local scale (i.e. < 1 km)(Stamoulis and Friedlander, 2013), however the 10 km threshold was arbitrarily chosen as a more suitable number. The rationale was that, similarly to positive effects, negative effects could have a comparable potential of spilling over to a protected area. It is therefore assumed that sites within a protected area are not ideal, due to their legal protection and conservation goals.

2) Is it within a special fishery conservation area? (Yes/No/In Proximity)

Similar to the marine reserve classification, spatial data on special fishery conservation zones (SFCZs) were obtained and used in determination of the values for the place of refuge assessment. Values were allotted to each site depending on its location with respect to the SFCZs (within a designated SFCZ, not within a designated SFCZ, or within proximity (<10 km) to a designated SFCZ). The 10 km threshold was used again in this category for similar reasons as previous criteria. Sites within SFCZs were determined to be less ideal since they are legally protected and biologically important.

3) Is it within a highest priority conservation area? (Yes/No/In Proximity)

Experts in the field of biodiversity research identified high priority conservation areas in the Jamaican Ecoregional Planning Project (JERP) analysis (Zenny, 2006). They were identified according to relative biological significance, relative threat intensity and conservation feasibility (Zenny, 2006). The highest priority sites were used because they represent the areas with the greatest conservation need (Zenny, 2006). Sites were examined by determining the locations of the high priority conservation areas and were given a corresponding value (Yes/No/In Proximity) depending on their location. The 10 km threshold was used again in this category for similar reasons as previous criteria.

Sites within a highest priority conservation area were assumed to be less ideal, due to their environmental vulnerability.

4) Conservation Target Presence (Low/Medium/High)

Conservation targets have been identified in the JERP analysis (i.e. benthic targets, sea and shorebird areas, manatee distribution, and shoreline targets)(Zenny, 2006). These included the presence of sandy shores, rocky shores, mangroves, coral reefs, estuarine areas, sea grass beds, and soft bottom communities (Zenny, 2006). The JERP report outlines the spatial distributions of the various conservation targets along Jamaica's coastline. For this analysis, the presence of conservation targets within each of the 14 sites was analyzed. It was assumed that the higher the level of targets present, the more vulnerable the area would be to potential oil spills or environmental effects from its use as a Place of Refuge. The total number of conservation targets was determined, and then classified on a scale of low/medium/high.

5.3.3. Socioeconomic Criteria

Socioeconomic criteria were briefly identified in the IMO Guidelines, with the focus in this section being on economic pressures, including tourism, fishing, and industrial port activity. Social impacts on the population were not included in the analysis.

1) Fishing Pressure/Intensity (Very Low/Low/Medium/High/Very High)

Fishing pressure/intensity has been determined in the JERP analysis around the island of Jamaica (Zenny, 2006). For this project, a map of the fishing pressure was examined, which classified the pressure as follows: very low, low, medium, high, very

high (Zenny, 2006). Each site location was identified on the map, and the corresponding level of fishing pressure indicated. Sites within areas of high fishing intensity were assumed to be less ideal due to the potential for industry disruption or harm to fish stocks, should a spill occur.

2) Number of Attractions Within Parish

The tourism master plan (Commonwealth Secretariat, 2002) was consulted for this criterion. A detailed list of attractions was given in the plan, which included separation by parish. Given the listed attractions, the total number within each parish was then calculated and indicated. The corresponding parish for each of the 14 sites was determined and then the respective quantities of attractions were noted. If a site is within a parish with a high level of attractions, the theory is that a ship in distress may negatively impact tourism, thus affecting Jamaica's economy.

3) Is it Within a Town of Culture & Heritage Themes? (Yes/No/In Proximity)

The tourism master plan (Commonwealth Secretariat, 2002) was consulted for this criterion. The plan outlines areas that are theoretically classified as "towns of culture & heritage themes". If any of the sites were within a listed town (Black River, Falmouth, Lucea, Port Antonio, St. Ann's Bay and Seville, or Kingston), it was recorded as "yes". Any sites not within a listed town were recorded as "no", and sites within proximity were indicated as such. It was assumed that the designation of a site within a town of culture and heritage themes would result in negative economic impacts to tourism. There is the risk that a ship being brought in to such a region would detract aesthetically from the

natural beauty of the area, and also the risk that marine-based tour groups would be faced with delays in order to accommodate the effort for assistance.

4) Is it Within a Major Heritage Site? (Yes/No/In Proximity)

The tourism master plan (Commonwealth Secretariat, 2002) was consulted for this criterion as well. The plan also outlines areas that are classified as "Major Heritage Sites". If any of the 14 locations were within a listed site (Port Royal, Spanish Town, Falmouth, and Seville – St. Ann's Bay), it was recorded as "yes". Any sites not within a listed town were recorded as "no", and sites within proximity were indicated as such. Site designations within a major heritage site were also assumed to negatively affect tourism, as was the approach for the "town of culture and heritage themes" criterion.

5) Resort Density Within Area (Low/Medium/High)

This criterion was more subjective, but also based off of the Tourism Master Plan (Commonwealth Secretariat, 2002). It is indicated that the resort density within the northern and western parts of the island is the highest, with the south coast of the island having fewer resorts and less tourism (Commonwealth Secretariat, 2002). Therefore, all of the sites on the north and west coasts were assigned "high" densities, while the resorts on the south coast were given "low" densities. One site on the eastern part of the country (Port Antonio) was given a "medium" density since it is an attractive tourism region due to its cruise ship terminal. Regions with lower resort densities were assumed to be more ideal, due to less of a potential impact on tourism.

6) Proximity to Industrial Ports (Km)

Industrial port proximity was calculated by the "measure distance" tool in Google Maps. Major industrial ports are shown in the Caribbean Maritime Traffic database, and represent potential socioeconomic barriers for use as Places of Refuge (RAC/REMPEITC, 2014b). It is not likely that the government would want to disrupt operations to an industrial port in order to accommodate a ship in distress. Port locations were identified in Google Maps, followed by the approximate position of each of the 14 sites. The distance from each individual site to the nearest industrial port was then calculated (in kilometres), based on a marine transit route (i.e. not over land). The assumption is that sites further from industrial ports that are less likely to disrupt commercial activities and have less of a socioeconomic impact would be more ideal.

5.3.4. Physical and Response Criteria

The following criteria were all calculated by consulting the publication "Sailing Directions (Enroute) – Caribbean Sea Volume 1" (NGIA, 2013): 1) Average Water Depth (m); 2) Maximum Vessel Length (m); 3) Maximum Vessel Draught (m); 4) Berthing Availability; 5) Anchorage Availability; and 6) Pilotage Requirements. The Sailing Directions manual was published by Jamaica's National Geospatial Intelligence Agency in 2013 and outlines updated maps, bathymetry information, descriptions of ports and anchorages, and other relevant material for seafarers. The majority of the information for the 14 sites was obtained from the referred publication, however several criteria had to be evaluated by "best estimates" from an expert in the field (Brady, personal communication, September 17 2014). The rationale was that deeper water and areas capable of accepting the largest vessels/draughts would be more ideal.

Additionally, sites with berthing and anchorage provide further means of securing a vessel. If pilotage is required, that also provides another level of assistance that could decrease the risk of human error (e.g. groundings, collisions, etc.).

7) Proximity to Response Facilities (Km)

The proximity to response facilities was also calculated by utilizing the "measure distance" tool in Google Maps. The National Oil Spill Plan for Jamaica outlines the locations of the oil spill response equipment, and their respective detailed inventory lists (ODPEM, 2008). The distance from each site (kilometres) was measured based on the closest response facility available. Similarly to the previous distance calculations, the routes were assumed to be marine-based transportation (i.e. not over land). The assumption was that sites closer to response facilities would be more ideal (i.e. capable of a more rapid and effective response).

8) Level of Shelter in Area (Enclosed/Partially Enclosed)

The level of shelter in the area was identified personally through the examination of maps, and purely subjective in nature. The assumption is that more enclosed areas are more ideal because they offer greater shelter.

5.4. Determining Criteria Weights

The weighting of criteria is an important step in the overall assessment of potential sites for use as Places of Refuge. While there are multiple criteria involved, not all possess the same weight, or "importance". It is therefore a crucial step in the analysis process to determine the significance of each factor. Following the assessment of criteria weights, all factors are combined to give an overall, weighted total. Different weighting

methods and specified levels of importance can also alter the overall results, thus utilizing more than one weighting method is beneficial for accurate results (Jozi et al. 2013). Additionally, changing the relative weighting of criteria can serve to represent the interests of various stakeholder groups (Wirtz et al., 2007).

For the sake of simplicity, weights of 1/3 (33.33/100) were given to each of the socioeconomic, environmental and physical/response criteria. It was determined that all three categories warranted equal weights, due to the fact that they are all crucial elements for determining a suitable Place of Refuge. Each category (environmental, socioeconomic, and physical/response) was further divided out of 100, with individual weights assigned to the criteria within each category. This resulted in two weighting processes – the first for all criteria within each category, and the second for the final total of all categories.

Within the scope of this study reasonable weights have been developed, but depending on the scenario, various weights may be increased if deemed important, or deemphasized if not. In the event of actual emergency, the model may be rerun to prioritize various options, in conjunction with a detailed consultation process. Due to scoping and time limitations a pre-consultation process with experts regarding the weights was not possible, but represents a potential goal for the future, and for a continuation of this project. One marine professional at the Maritime Authority of Jamaica was consulted on their views with respect to the weighting of criteria. They were in agreement with the criteria weights allotted in this project with respect to environmental and physical/response criteria (Spence, personal communication, October 13 2014). Within socioeconomic criteria, they were also in agreement with the weights,

with the exception of three criteria, which they believed should have equal weight. The original weights and rationales were still used for the analysis, however the initial consultation validates and reinforces the need for further discussion with marine professionals to determine criteria weights. The breakdown of the criteria weights for the three categories is as follows:

5.4.1. Environmental Criteria

The first two criteria (1. Is it within a protected area? 2. Is it within a special fishery conservation area?) were given higher weights because they both concern legislation surrounding protected areas, which would likely have a larger significance/political importance than theoretical biodiversity classifications. The last two criteria in this category (3. Is it within a high priority conservation area? 4. Conservation target presence) represent calculated values by previous studies, however they would likely provide more of a baseline for decisions, with a lower influence on the actual designation. Based on that reasoning, they were allotted smaller weights.

5.4.2. Socioeconomic Criteria

The criteria allotted the highest values were those relating to major economic sectors (tourism, industrial ports, fishing). The second highest value was given to the criterion "number of attractions within parish", because while it is tourism related, it is not specific to a coastal area. The rationale was that if there was a spill in proximity to a parish with a high level of attractions, it might suffer as a result (e.g. disruptions to activities, fewer tourists visiting the area because of aesthetic reasons, etc.). The final two criteria (i.e. within a town of culture and heritage themes; within a major heritage site)

were allotted their specific values because they represent key socioeconomic factors, but are more abstract in nature.

5.4.3. Physical and Response

The weights for all the criteria within this category were evenly distributed due to the fact that they are all deemed equally important factors in determining refuge feasibility.

CHAPTER 6: RESULTS

6.1. Preface and Sample Calculation

The following chapter outlines in detail the results of the assessment for each of the 14 potential sites based on multiple criteria.

In advance of the presentation of the results, a sample calculation for the site of Port Esquivel will be given to demonstrate the site assessment approach. The following section demonstrates a step-by-step calculation method. The steps outlined were applied to all 14 sites and criteria (i.e. environmental, socioeconomic, and physical/response).

Table 10 includes the specific environmental criteria for this site, as well as the details of the calculation results.

Step 1: Sites were assessed based on the questions/criteria outlined within each category.

Example for Port Esquivel:

1. Yes (= 0)
2. In Proximity (= 0.5)
3. Yes (= 0)
4. High (= 0)

Step 2: Each criterion was allotted a numerical value based on the product of the score on each criterion (from above), and the weight (importance) of that criterion (refer to methodology for details).

Example for Port Esquivel:

1. 0 x 30 = 0
2. 0.5 x 30 = 15
3. 0 x 20 = 0

4. 0 x 20 = 0

So the overall score of Port Esquivel on the Environmental criteria is the sum of the above, hence 15.

Step 3: The environmental score for this site is then transformed according to the overall weight of the category (i.e. 0.3333).

Example for Port Esquivel:

Total = 15/100. When transformed (15 x 0.3333 = 4.9995 or 5). Therefore, when considering the possible 33.33 points out of 100 for environmental criteria, Port Esquivel was allotted 5.

Table 10. Environmental criteria calculations.

Environmental Criteria (0.3333)	**Weight**	**Scaling**	**Site: Port Esquivel**	**Total: Weighted Values**
1. Is it within a protected area? (Yes/No/In Proximity)	30/100	Yes = 0, No = 1, In Proximity = 0.5	Yes (= 0)	0
2. Is it within a special fishery conservation area? (Yes/No/In Proximity)	30/100	Yes = 0 No = 1 In Proximity = 0.5	In Proximity (= 0.5)	15
3. Is it within a highest priority conservation area? (Yes/No/In Proximity)	20/100	Yes = 0 No = 1 In Proximity = 0.5	Yes (= 0)	0
4. Conservation Target Presence (Low/Medium/High)	20/100	Low = 1 Medium = 0.5 High = 0	High (= 0)	0
Total: Environmental Criteria				15/100
Total: Environmental Criteria Weighted and Scaled Overall	**33.33/100**			***5**

* Rounded final total

The same approach was used for both socioeconomic and physical/response criteria.

Table 11. Socioeconomic criteria calculations.

Socioeconomic Criteria (0.3333)	**Weight**	**Scaling**	**Site: Port Esquivel**	**Total: Weighted Values**
1. Fishing pressure/intensity (Very Low/Low/Medium/High/Very High)	20/100	Very Low = 1, Low= 0.75, Medium = 0.5, High = 0.75, Very High = 0	Very High (= 0)	0
2. Number of attractions within parish	15/100	Closer to 1 = Ideal, Closer to 0 = Not Ideal	0.5	7.5
3. Is it within a town of culture and heritage themes? (Yes/No/In Proximity)	12.5/100	Yes = 0, No = 1, In Proximity = 0.5	No = (1)	12.5
4. Is it within a major heritage site? (Yes/No/In Proximity)	12.5/100	Yes = 0, No = 1, In Proximity = 0.5	No (= 1)	12.5
5. Resort density within area (Low/Medium/High)	20/100	Low = 1, Medium = 0.5, High = 0	Low (= 1)	20
6. Proximity to industrial ports (Km)	20/100	Closer to 1 = Ideal, Closer to 0 = Not Ideal	0	0
Total: Socioeconomic Criteria				52.5
Total: Socioeconomic Criteria Weighted and Scaled Overall	**33.33/100**			***<u>17.5</u>**

*Rounded final total

Table 12. Physical and Response criteria calculations.

Physical and Response Criteria (0.3333)	**Weight**	**Scaling**	**Site: Port Esquivel**	**Total: Weighted Values**
1. Average depth (m)	12.5/100	Closer to 1 = Ideal, Closer to 0 = Not Ideal	0.44	5.5
2. Maximum vessel length (m)	12.5/100	Closer to 1 = Ideal, Closer to 0 = Not Ideal	0.93	11.6
3. Maximum draught (m)	12.5/100	Closer to 1 = Ideal, Closer to 0 = Not Ideal	0.96	12
4. Berthing available? (Yes/No)	12.5/100	Yes = 1, No = 0	Yes (= 1)	12.5
5. Anchorage available? (Yes/No)	12.5/100	Yes = 1, No = 0	Yes (= 1)	12.5
6. Is pilotage compulsory? (Yes/No)	12.5/100	Yes = 1, No = 0	Yes (= 1)	12.5
7. Proximity to response facilities (Km)	12.5/100	Closer to 1 = Ideal, Closer to 0 = Not Ideal	1	12.5
8. Level of shelter in area (Enclosed/Partially Enclosed)	12.5/100	Enclosed = 1, Partially Enclosed = 0	Partially Enclosed (= 0)	0
Total: Physical and Response Criteria				79.1
Total: Physical and Response Criteria Weighted and Scaled Overall	**33.33/100**			***26.4**

*Rounded final total

Following the calculations for each category, the totals were summed to produce the final overall score.

Example for Port Esquivel: 5 + 17.5 + 26.4 = 48.9

The identical methodology was applied for the remaining 13 sites.

6.2. Overall Results

Results shown in Table 13 indicate the criteria assessment values for each of the sites, as modelled in the previous example. Results can be interpreted in that the higher the score, the more suitable the site is in that given category. For example: a site with a score of 50 in environmental criteria may be less environmentally vulnerable if used as a Place of Refuge than a site with a score of 30. The three criteria categories are each individually ranked out of 100, and then weighted and summed to give a total overall score, which can be seen in the far right column of the table.

Table 13. Overall scores for environmental, socioeconomic, and physical/response criteria in each of the 14 sites. Total weighted scores are also shown.

Site and Ranking	Environmental Criteria	Socioeconomic Criteria	Physical and Response Criteria	Total
1. Lucea Harbour	90.0	41.2	78.5	**69.9**
2. Rio Bueno Harbour	80.0	42.8	76.8	**66.5**
3. Savanna la Mar	75.0	71.9	47.8	**64.9**
4. Mosquito Cove	90.0	46.1	49.1	**61.7**
5. Port Morant	50.0	62.4	72.4	**61.6**
6. Discovery Bay	50.0	39.5	92.9	**60.8**
7. Great Pedro Bluff	80.0	57.9	35.5	**57.8**
8. Belmont Point	60.0	69.3	33.0	**54.1**
9. Kingston Harbour	30.0	33.5	92.1	**51.9**
10. Oracabessa Bay	60.0	47.1	43.9	**50.3**
11. Port Esquivel	15.0	52.5	79.1	**48.9**
12. St. Ann's Bay	75.0	12.3	58.6	**48.6**
13. Port Antonio	40.0	30.8	64.3	**45.0**
14. Black River	25.0	51.0	35.4	**37.1**

Overall, the values varied significantly within each of the criteria. Sites that may be suitable for use as a Place of Refuge on environmental grounds may not be suitable for use as a Place of Refuge with respect to physical/response capabilities. The same can be said for any combinations of the above criteria. Therefore, weighing the criteria and determining the best course of action on an event-specific basis would be a very important factor in designating a Place of Refuge. Additionally, the weights may change due to incident specific conditions, or the perceived importance of the factors.

6.3. Individual Site Assessment Criteria Results

Descriptions of the results for each of the individual sites are presented in this section. Sites are classified based on their highest and lowest scoring criteria, as well as their overall rank. Each site is described as suitable from the perspective of its highest scoring category, but does not necessarily make it an overall suitable Place of Refuge. It is merely stating that in the absence of other factors, the site may be suitable from that perspective. The descriptions serve to inform the reader of the deficiencies and strengths of each location as a potential Place of Refuge. Sites are presented geographically around the island (i.e. from east to west, starting with Port Esquivel).

1) Port Esquivel

Port Esquivel received an overall score of 48.9, ranking 11/14 in overall suitability. Port Esquivel scored quite well in physical and response criteria, with its main deficiency in that category being a lack of shelter (only partially enclosed). In the socioeconomic category, Port Esquivel lost points due to its proximity to industrial ports, and high fishing intensity in the area. However, the lowest score was seen in

environmental criteria, where it was deficient in almost all aspects. Therefore, Port Esquivel may be suitable as a Place of Refuge from a physical and response point of view.

2) *Great Pedro Bluff*

Great Pedro Bluff received an overall score of 57.8, ranking 7/14 in overall suitability. In contrast to Port Esquivel, Great Pedro Bluff scored quite well in environmental criteria, with its fault being its inclusion as a high priority conservation area. The lowest score occurred in physical and response criteria, where navigational and response deficiencies (e.g. berthing unavailable, pilotage not compulsory, not in close proximity to clean-up facilities) were the main drawbacks. Therefore, Great Pedro Bluff may be suitable as a Place of Refuge from an environmental point of view.

3) Black River

Black River received an overall score of 37.1, ranking 14/14 in overall suitability. The category with the highest score was socioeconomic, with the main deficiencies being that it is within an area of high fishing pressure, as well as a town of culture and heritage themes. The lowest scoring category was environmental, with protected area and biodiversity deficiencies being seen. Therefore, Black River may be suitable as a Place of Refuge from a socioeconomic point of view.

4) Belmont Point

Belmont Point received an overall score of 54.1, ranking 8/14 in overall suitability. The category with the highest score was socioeconomic, with the main drawback being that it is within an area of high fishing pressure. Other socioeconomic

factors scored quite well. Environmental criteria also scored quite well in comparison, falling approximately ten points behind socioeconomic criteria. The lowest scoring category for Belmont Point was physical and response criteria, with deficiencies in shelter, berthing, and pilotage. Therefore, Belmont Point may be suitable as a Place of Refuge from a socioeconomic point of view.

5) Savanna la Mar

Savanna la Mar received an overall score of 64.9, ranking 3/14 in overall suitability. The category with the highest score was environmental, with the deficiencies being that it is close to a special fishery conservation zone, and has a medium level of conservation targets present within the area. Similarly to Belmont Point, Savanna la Mar also scored quite well on socioeconomic criteria, but was ultimately outscored by the environmental criteria. The lowest scoring category was physical and response, with deficiencies seen in berthing availability, the level of shelter, as well as the proximity to response facilities. Therefore, Savanna la Mar may be suitable as a Place of Refuge from an environmental point of view.

6) Lucea Harbour

Lucea Harbour received an overall score of 69.9, ranking 1/14 in overall suitability. This site represents the highest-ranking site out of the 14 chosen. Lucea Harbour received the best ranking in environmental criteria, with physical and response criteria placing second. The only drawback within the environmental category is that is possesses a medium level of conservation target presence. The lowest scoring category for Lucea Harbour was on socioeconomic criteria. Points were deducted on the basis of it

being within a town of culture and heritage themes, as well as within a region of high resort/tourism density. Therefore, Lucea Harbour may be suitable as a Place of Refuge from an environmental point of view.

7) Mosquito Cove

Mosquito Cove received an overall score of 61.7, ranking 4/14 in overall suitability. The category with the highest score was environmental, with its deficiency being identical to Lucea Harbour (i.e. medium level of conservation target presence). The lowest scoring category was socioeconomic criteria, however, the category for physical and response criteria was not significantly better. Major deficiencies in socioeconomic criteria include being in a region with high resort density, as well as being in close proximity to industrial ports. Therefore, Mosquito Cove may be suitable as a Place of Refuge from an environmental point of view.

8) Rio Bueno Harbour

Rio Bueno Harbour received an overall score of 66.5, ranking 2/14 in overall suitability. The category with the highest score was environmental, with the drawbacks being that it possesses a medium level of conservation target presence, and that it is within proximity to a high priority conservation area. The lowest scoring category was socioeconomic, with deficiencies seen in terms of proximity to industrial ports and a high level of resort density in the region. Therefore, Rio Bueno Harbour may be suitable as a Place of refuge from an environmental point of view.

9) Discovery Bay

Discovery Bay received an overall score of 60.8, ranking 6/14 in overall suitability. The category with the highest score was physical and response, with this site a strong potential refuge area due to its significant depths and high level of shelter. The main drawback was the relatively long distance from major response facilities. However, Discovery Bay scored extremely well in almost all of the other criteria relating to the physical and response category. The lowest scoring category was socioeconomic, with major deficiencies arising in terms of its existing use as an industrial port, its high level of resort density in the area, and the relatively high level of attractions within the region. Therefore, Discovery Bay may be suitable as a Place of Refuge from a physical and response point of view.

10) St. Ann's Bay

St. Ann's Bay received an overall score of 48.6, ranking 12/14 in overall suitability. The highest scoring category was environmental, with the main drawbacks being that it is in proximity to a MPA, and has a medium level of conservation target presence. The lowest scoring category was socioeconomic, with this site additionally being characterized as the worst of all potential sites within this criterion. Deficiencies include: being within an area of cultural and heritage themes, being within a major heritage site, a high resort density in the area, being in proximity to an industrial port, and possessing a high number of attractions within the area. Socioeconomically, this does not represent an ideal site as a Place of Refuge. However, St. Ann's Bay may be suitable as a Place of Refuge from an environmental point of view.

11) Oracabessa Bay

Oracabessa Bay received an overall score of 50.3, ranking 10/14 in overall suitability. The highest scoring category was environmental, with the main drawbacks being that it is within a special fishery conservation zone, and has a medium level of conservation target presence. The lowest scoring category was physical and response, with deficiencies being seen in berthing and pilotage availability, as well as the overall level of shelter in the area. Additional faults can be seen in vessel length and draught limitations. Therefore, Oracabessa Bay may be suitable as a Place of Refuge from an environmental point of view.

12) Port Antonio

Port Antonio received an overall score of 45.0, ranking 13/14 in overall suitability. The highest scoring category was physical and response, with the main drawbacks being a lack of berthing availability and a large distance from response facilities. The lowest scoring category was socioeconomic, with deficiencies being that it is within an industrial port area, within a town of culture and heritage themes, has a moderate level of fishing pressure, and a relatively high level of attractions within the region. Therefore, Port Antonio may be suitable as a Place of Refuge from a physical and response point of view.

13) Port Morant

Port Morant received an overall score of 61.6, ranking 5/14 in overall suitability. The highest scoring category was physical and response, with socioeconomic criteria in second. The main drawbacks in the physical and response category included a somewhat

large distance to response facilities, as well as depth limitations. The lowest scoring category was environmental, with deficiencies being seen through its inclusion as a special fishery conservation zone, as well as it being within a high priority conservation zone. Therefore, Port Morant may be suitable as a Place of Refuge from a physical and response point of view.

14) Kingston Harbour

Kingston Harbour received an overall score of 51.9, ranking 9/14 in overall suitability. The highest scoring category was physical and response, with the only drawback being that it is slightly limited by depth in comparison to some other sites. The lowest scoring category was environmental, with deficiencies appearing in several criteria: Kingston Harbour is within a protected area, within a high priority conservation area, and also possesses a high level of conservation target presence. Therefore, Kingston Harbour may be suitable as a Place of Refuge from a physical and response point of view.

6.4. Potential Drawbacks of Analysis

Table 14 illustrates the best and worst ranked criteria between the 14 sites. It can be seen that seven sites scored highest in environmental criteria, two scored highest in socioeconomic criteria, and five scored highest in physical and response criteria. This indicates that as many as half of the sites may be suitable for designation from an environmental point of view, but may be lacking in other categories. The overall suitability was weighted equally between categories since consultation would be required to determine alternate approaches to weighting. Undeniably, there are additional

methods to weigh the criteria depending on the scenario, the specific incident, and the factors that the coastal state perceives as important. Therefore, this analysis serves to inform readers of an overall perspective of the factors to examine. The list is not exhaustive, but for the purpose of this project, and because of time limitations, only a limited number of factors could be examined.

Table 14. Overall rank of the 14 sites, based on total weighted score. Sites are colour coded based on each of their individual scores. Green = highest scoring category within site. Yellow = second highest scoring category within site. Red = lowest scoring category within site.

Rank	Site	Total Score	Environmental Criteria	Socioeconomic Criteria	Physical & Response Criteria
1	Lucea Harbour	69.9			
2	Rio Bueno Harbour	66.5			
3	Savanna la Mar	64.9			
4	Mosquito Cove	61.7			
5	Port Morant	61.6			
6	Discovery Bay	60.8			
7	Great Pedro Bluff	57.8			
8	Belmont Point	54.1			
9	Kingston Harbour	51.9			
10	Oracabessa Bay	50.3			
11	Port Esquivel	48.9			
12	St. Ann's Bay	48.6			
13	Port Antonio	45.0			
14	Black River	37.1			

Table 15 illustrates the best and worst scores for each of the three criteria. It is important to note that the sites with the best and worst scores in an individual category

did not necessarily receive the best or worst scores overall. The only case in which that was seen was Lucea Harbour, which scored the best in environmental criteria, in addition to best overall. Conversely, sites scoring low overall should not be disregarded based solely on that number. For example, Port Esquivel scored quite low overall, but received a high score within the physical and response category. Therefore, if an incident occurred where there was a low risk of negative environmental impacts/social effects (e.g. fire onboard the vessel), Port Esquivel would be quite suitable to receive the ship in distress.

Table 15. Site assessment criteria across all locations, showing the most suitable and least suitable sites within each category. Red = least suitable. Green = most suitable.

Site	Environmental Criteria	Socioeconomic Criteria	Physical & Response Criteria	Total
Port Esquivel	15.0	52.5	79.1	48.9
Great Pedro Bluff	80.0	57.9	35.5	57.8
Black River	25.0	51.0	35.4	37.1
Belmont Point	60.0	69.3	33.0	54.1
Savanna la Mar	75.0	71.9	47.8	64.9
Lucea Harbour	90.0	41.2	78.5	69.9
Mosquito Cove	90.0	46.1	49.1	61.7
Rio Bueno Harbour	80.0	42.8	76.8	66.5
Discovery Bay	50.0	39.5	92.9	60.8
St. Ann's Bay	75.0	12.3	58.6	48.6
Oracabessa Bay	60.0	47.1	43.9	50.3
Port Antonio	40.0	30.8	64.3	45.0
Port Morant	50.0	62.4	72.4	61.6
Kingston Harbour	30.0	33.5	92.1	51.9

6.5. Decision Analysis

In the event of an actual emergency, event-specific decisions must be made. For example, if a ship in distress is not posing a threat to the environment, but requires considerable response (e.g. off-loading of cargo), the sites with high physical and response capabilities will be a factor in the decision. An overview of the strengths and weaknesses of each site as a potential Place of Refuge can be seen in Figure 24.

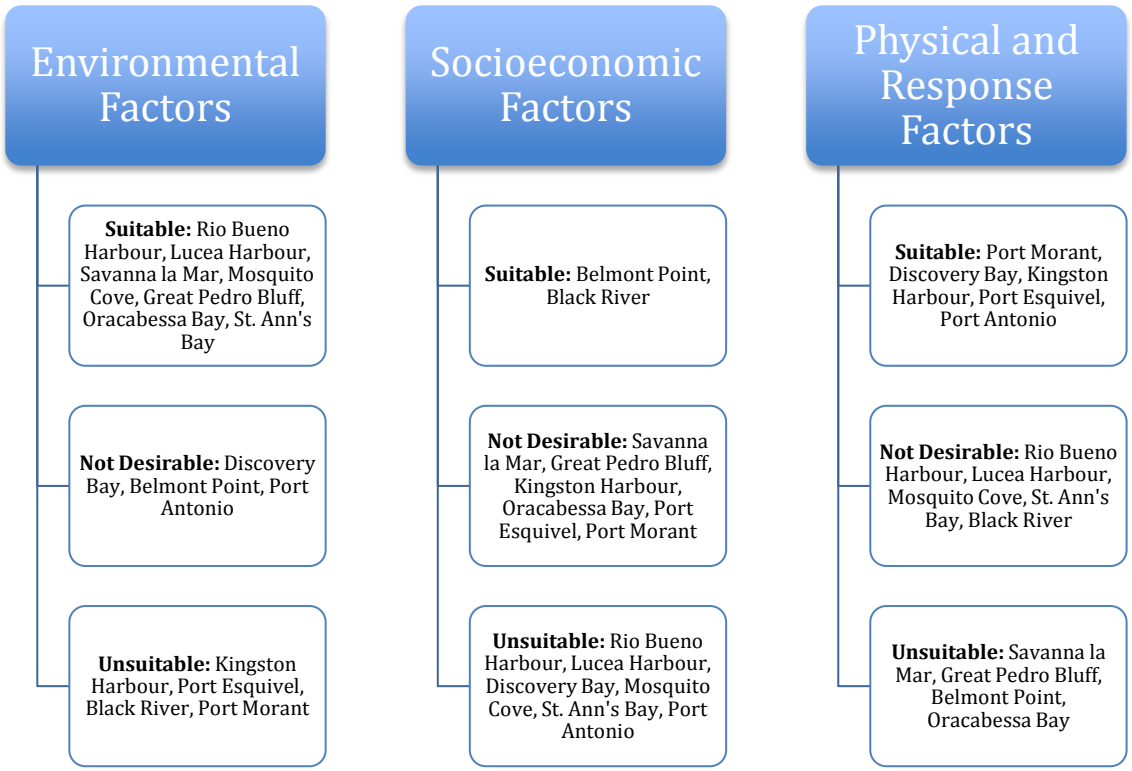

Figure 24. Decision analysis tree for each category. Sites are broken down between the three possible criteria (environmental, socioeconomic, and physical/response). Suitable, not desirable, and unsuitable sites based on the respective criteria are shown.

The following descriptions define the terms “suitable”, “not desirable”, and “unsuitable” with respect to each category.

6.5.1. Environmental Factors

Suitable: In the event of a high environmental impact, sites in this category could be subjected to the least environmental vulnerability.

Not Desirable: In the event of a high environmental impact, sites in this category could be subjected to a certain level of environmental vulnerability.

Unsuitable: In the event of a high environmental impact, sites in this category could be subjected to a high level of environmental vulnerability.

6.5.2. Socioeconomic Factors

Suitable: In the event of a high socioeconomic impact, sites in this category could be subjected to the least socioeconomic vulnerability.

Not Desirable: In the event of a high socioeconomic impact, sites in this category could be subjected to a certain level of socioeconomic vulnerability.

Unsuitable: In the event of a high socioeconomic impact, sites in this category could be subjected to a high level of socioeconomic vulnerability.

6.5.3. Physical and Response Factors

Suitable: In the event of designation as a Place of Refuge, sites in this category can accommodate the largest ships with the biggest draughts, and are capable of responding efficiently.

Not Desirable: In the event of designation as a Place of Refuge, sites in this category can accommodate relatively large ships with moderate draughts, and are somewhat capable of responding efficiently.

Unsuitable: In the event of designation as a Place of Refuge, sites in this category cannot accommodate very large ships, and are quite distanced from response capabilities and efficient assistance.

From Figure 24, several conclusions can be drawn:

1. If the incident requiring a Place of Refuge is likely to cause a large environmental impact (e.g. considerable release of toxic substances, harm to wildlife and diversity, etc.), the sites under the "suitable" category can be evaluated. If there does not appear to be a significant environmental risk from the incident, then the range of potential sites can be expanded to include the "not desirable" and "unsuitable" sites, solely from an environmental perspective.
2. Following an analysis of the environmental factors, the socioeconomic status can be examined. If the incident is likely to cause extensive socioeconomic impacts (e.g. disrupting operations at industrial ports, aesthetic problems for tourism, fishing interruptions/die-offs, etc.), sites under the "suitable" category should be chosen. However, in this case, none of the socioeconomically suitable sites correspond with environmentally suitable sites. If the incident is not environmentally critical, then this would not be a significant issue, however in the case that environmental impacts may occur, the process becomes more difficult. Therefore, decision-makers must then critically evaluate and consult on the best

option. Do the environmental risks outweigh the socioeconomic risk, or vice-versa?

3. Once a site has been chosen that balances both environmental and socioeconomic considerations, the physical and response capabilities of the Place of Refuge need to be examined. If the vessel in question has extensive depth, draught, and length requirements, then the best sites would be those listed as "Suitable" in the physical and response category. Those sites have the greatest range in terms of depth, draught, and length accommodations, and are within proximity to response capabilities. Therefore, if the incident is one involving a larger vessel that requires considerable response, the environmental and socioeconomic factors may be outweighed by the physical and response factors. Alternatively, if the vessel in question is smaller, and does not require a considerable response (e.g. may be a manageable problem that can be solved by the crew once within an area of shelter), then sites listed under "Not Desirable" and "Unsuitable" may be chosen.

Ultimately, the designation and selection process will require considerable discussion on the merits and disadvantages of each site. While a site may be listed as "unsuitable" for various reasons in this analysis, there is no reason to say that it would not be selected as a Place of Refuge for reasons that are particularly event-specific.

The goal of this analysis was to provide an information source for future decision-makers relating to potential sites around Jamaica. In the event of a future shipping emergency requiring a Place of Refuge designation, this analysis will hopefully provide assistance in site selection.

CHAPTER 7: NATIONAL AND INTERNATIONAL POSITIONS ON PLACES OF REFUGE

7.1. Preface

National policies concerning Places of Refuge exist worldwide, including in Canada, Australia, and the United States. This chapter outlines various national policies on Places of Refuge and discusses some merits, as well as drawbacks, of the respective plans. In conclusion, this chapter explores various signed international agreements and the National Marine Pollution Contingency Plan that Jamaica has instated, in the absence of guidelines or policies on Places of Refuge.

7.2. United States

The United States created Guidelines on Places of Refuge coordinated by the National Response Team (USNRT, 2007). The purposes of the guidelines are as follows:

1. An incident-specific decision-making process to assist U.S. Coast Guard (USCG) Captains of the Port (COTPs) in deciding whether a vessel needs to be moved to a place of refuge and, if so, which place of refuge to use; and
2. A framework for developing pre-incident identification of potential places of refuge for inclusion in appropriate Area Contingency Plans (ACPs) (Retrieved from USNRT, 2007 p 7).

The United States has created a 10 Step Process to follow in the event that a Place of Refuge is required. The following steps were obtained from USNRT (2007), Appendix 1.

1. Place of Refuge Requested
2. Immediate Action Required by Coast Guard Captain of the Port

3. Coast Guard Captain of the Port/Unified Command Requests Input from Stakeholders and Other Technical Experts on Vessel Options
4. Coast Guard Captain of the Port/Unified Command Selects Vessel Option Based on Input from Stakeholders and Other Technical Experts
5. Coast Guard Captain of the Port/Unified Command Requests Input from Technical Experts on Operational Considerations for Potential Places of Refuge Locations.
6. Coast Guard Captain of the Port/Unified Command Selects Potential Place(s) of Refuge Location(s) Based on Operational Considerations
7. Coast Guard Captain of the Port/Unified Command Provides Stakeholders with Potential Place(s) of Refuge Location(s) Based on Operational Considerations
8. Stakeholders Provide Ranking of Potential Place(s) of Refuge Location(s) to Coast Guard Captain of the Port/Unified Command.
9. Coast Guard Captain of the Port/Unified Command Selects Place of Refuge Based on Input from Stakeholders and Other Technical Experts.
10. The Coast Guard Captain of the Port/Unified Command Prepares Documentation of the Places of Refuge Decision-Making Process

It appears that there is significant stakeholder involvement in the United States process, as is discussed by John et al. (2010). Additional merits of the plan include the use of a chain-of-command system that efficiently provides recommendations on various aspects of the process (John et al. 2010). Disadvantages of the plan include potential confusion related to decision-making, as there are many elements to the process, and many different departments/stakeholders being consulted (John et al. 2010). Furthermore, temporal issues and delays when performing an evaluation for site selection may occur due to the bureaucratic process and various levels of command involved (John et al. 2010). All things considered, step 8 of the United State's Places of Refuge Contingency plan strongly relates to the current approach of pre-identifying and ranking potential sites, except that the U.S approach does not specifically state that site evaluation is done prior to an incident, as was the aim of this study. Therefore it further emphasizes

the likelihood for rushed and incomplete analyses, which could be prevented by the undertaking of a preliminary assessment of all potential sites

7.3. Australia

Australia created National Maritime Place of Refuge Risk Assessment Guidelines, which were endorsed by the Australian Transport Council in 2009 (ATC, 2009). The purposes of the guidelines are as follows:

1. The National Maritime Place of Refuge Risk Assessment Guidelines (the Guidelines) are intended to assist Australian maritime administrations, the Maritime Emergency Response Commander (MERCOM), ship masters and the maritime industry in identifying: places of refuge in circumstances where an emergency cannot be dealt with at sea; and, the appropriate procedures to access a place of refuge.
2. The Guidelines have been prepared recognizing that there is a clear separation in responsibility between maritime security and maritime safety. These Guidelines are intended to assist maritime safety for commercial trading ships, to protect the environment. These Guidelines complement the IMO "Guidelines on Places of Refuge for Ships in Need of Assistance (ATC, 2009 p 3).

The Australian National Maritime Place of Refuge Risk Assessment Guidelines do not follow the same format as the United States' Guidelines, but rather outline detailed background material to better inform decisions. They provide useful contact information, as well as several appendices that outline the issues to be considered, but do not provide a structured framework in the same manner as the United States. The Australian plan does not identify potential sites to use as Places of Refuge, but determines it on a case-by-case basis, which can cause considerable delays in response (John et al. 2010). Another disadvantage of the Australian approach is that a resolution to the incident must first be

attempted at sea before consideration of refuge, which could ultimately cause further environmental and economic damage (John et al. 2010).

7.4. Canada

Canada implemented a National Places of Refuge Contingency Plan in 2007, mandated by Transport Canada (TC, 2007). As the lead agency responsible for the safety of ships and to implement the IMO Guidelines, a nationwide policy was created to better inform the public and decision makers (TC, 2007). The purpose of the National Places of Refuge Contingency Plan is as follows:

> To establish a national framework and approach which, with associated regional measures, will provide for an effective and efficient response to requests from ships in need of assistance seeking a place of refuge (TC, 2007 p 1).

Canada has provided a large amount of background information on Places of Refuge, including the importance, scope, and identifying all applicable authorities and their responsibilities (TC, 2007). They also outline steps to follow in the event of an incident, which can be identified as follows:

1. The Ship Request: Attaining information pertaining to the incident, identifying risk assessment team and relevant stakeholders (TC, 2007)
2. Risk Assessment: Analyze information, identify options, estimate risk, evaluate options (TC, 2007).
3. Action and Monitor: Grant or refuse refuge, monitor situation, obtain feedback (TC, 2007).

The Canadian National Places of Refuge Contingency Plan is relatively detailed and comprehensive, however they refer to an ongoing task of "communicating, consulting, and documenting" (TC, 2007 p 10). It is not clear as to how a high level of stakeholder engagement will be attained. It is identified in the guidelines that a list of

potential stakeholders is provided (e.g. TC, 2007 Annex 2), but the methods for engagement are not clear. Additionally, the plan also emphasizes that the idea of defining Places of Refuge in advance does not have a lot of merit, e.g. TC (2007, p 8): "To pre-designate places of refuge may be of limited value, as the limitations, operational considerations, hazards and associated risks will vary greatly with each incident." While it may appear that this reasoning is somewhat short sighted, they do further state that compiling information on relevant criteria in regions that may be suitable as areas of refuge is, in fact, valuable (TC, 2007). This would allow for a process that is smoother, more efficient, and hopefully more responsive than the alternative, where countries are forced to compile information in a short time span in order to respond to an incident.

7.5. Countries Where Designated Places of Refuge Exist

Approaches suggested for Canada's Places of Refuge Guidelines include the evaluation of potential sites prior to an incident, along with involvement of stakeholders (John et al., 2010). That recommendation could be applied to all countries that are seeking to create new guidelines or improve existing ones, since there appears to be such value in the pre-evaluation of potential areas. That was the mindset and the approach taken to this project, where the sites would not necessarily be expected as future "designated Places of Refuge", but instead as "potential Places of Refuge". Several countries have already pre-designated Places of Refuge as a precautionary approach (John et al. 2010). Norway has identified 69 areas along its coastline and Denmark has identified 14, consisting either of ports or anchorages (John et al. 2010). These sites have been evaluated for the purpose of providing a fast and efficient response, and in the event of an incident, will provide numerous options to best suit the specific scenario (John et al.

2010). Other European countries have been through the process of pre-designating potential Places of Refuge, for example: Latvia, Lithuania, Estonia, and Poland (Ohlson, n.d.). Finland has instated a simultaneous processes of pre-designation and determination on a case-by-case basis (Ohlson, n.d.). Therefore, it is possible to pre-designate Places of Refuge and still have event-specific consultation processes to suit the need. Canada's mindset of seeing little value in pre-designation is perhaps slightly naïve. While every event is unique, there are common criteria that need to be met for use as a Place of Refuge, which are acknowledged and outlined in various national plans, basing their framework off of the IMO Guidelines on Places of Refuge (e.g. Canada's National Places of Refuge Contingency Plan). Therefore it is very beneficial for coastal nations to be prepared for such situations and to proactively, rather than reactively gather information to respond to incidents.

7.6. Jamaica's Current Policies Relating to Places of Refuge

Jamaica does not have a national policy or guidelines on Places of Refuge. However, they are party to many international conventions and agreements, and have created a National Oil Spill Contingency Plan that closely relates to, or could contribute to a future national policy on Places of Refuge.

7.6.1. National Oil Spill Contingency Plan

Given that Jamaica has not recognized the IMO Guidelines on Places of Refuge nor outlined their own national policy, the extent of available frameworks to assist a specific ship-related scenario is limited to the National Oil Spill Contingency Plan (hereby referred to as "the plan"). Jamaica recognized the need for marine pollution

control and related policies in 1978, during the initiation of the Port Development Project (ODPEM, 2008). The plan's inception faced various amendments and drafts, due mainly to the conceptual nature of the proposed documents (ODPEM, 2008). The initial draft was completed by the Jamaican Defence Force (JDF) Coast Guard, utilizing IMO criteria, as well as frameworks from other countries (ODPEM, 2008). Several years later, a consulting company from Norway was commissioned to produce an amended version of the plan, which again resulted in a more conceptual rather than practical contingency plan (ODPEM, 2008). It was not until Jamaica's Office of Disaster Preparedness and Emergency Management (ODPEM) was instructed to further improve on the plan, that a more practical and "action-based" approach was taken (ODPEM, 2008). Throughout the process, consultation with the Canadian Coast Guard and Transport Canada took place, and resulted in the most recent version of the National Marine Pollution Contingency Plan (ODPEM, 2008).

The operational components of the plan are broken down into coordination, primary response, secondary response, and support agencies (ODPEM, 2008). This allows all parties responsible for oil spill response to clearly see where their roles would fit into a coordinated means of action. The overarching organization responsible for coordination, implementation, and maintenance of the plan is the ODPEM, while the primary supporting agencies are the JDF, JDF Coast Guard, and the Jamaica Fire Brigade (ODPEM, 2008). The secondary agencies responsible are The Port Authority, The Office of the Prime Minister, NEPA, and the Ministry of National Security and Justice (ODPEM, 2008). It is evident that there are many contributing parties, which may be a drawback in the event of an actual emergency. The overall coordination of the response

is left to the director of ODPEM, however, because there are so many secondary and supporting agencies, disagreements and confusion could arise when attempting to arrive at a decision. In the event of an incident, a National Response Team is initiated, which consists of representatives from governmental and non-governmental organizations (ODPEM, 2008). This arrangement could further reinforce the potential for disputes and bureaucratic issues that could delay the response. That being said, the plan has clearly outlined the roles and responsibilities of the various agencies, and if all steps are followed, a coordinated response should occur. The plan also provides contact information and templates on how to report and respond to an incident, which should facilitate the process for emergency management. The available facilities and inventory lists are also outlined, which unfortunately appear to be somewhat restricted. There are four locations that house oil spill clean-up equipment, which are limited to Kingston, Montego Bay and Ocho Rios (ODPEM, 2008). Therefore, this does not permit quick and effective response to other regions on the south shore, as well as the west and east coasts of the island.

As discussed previously, there are many departments and agencies involved in oil spill response. Table 16 outlines their roles and responsibilities, as well as their level of contribution to oil spill response.

Table 16. Agencies & Responsibilities in Oil Spill Preparedness/Response for Jamaica. Obtained from (ODPEM, 2008)

Responsible Agency	Roles & Responsibilities	Activities in Oil Spill Preparedness	Level of Response
ODPEM (Coordination)	Overall coordination of activities	Response Readiness Policies and Plans, International Conventions	Primary
		Communication	Primary
		Evacuation	Primary
		Emergency Care	Primary
		Legal Coordination	Support
		Clean-up and Decontamination	Support
Attorney General's Department (Support)	Coordination of legal action relating to pollution incidents Provide legal counsel to various parties	Legal Coordination	Primary
Bauxite Companies (Support)	N/A	Clean-up and Decontamination	Support
Caribbean Maritime Institute (Support)	Provide technical assistance for oil and hazmat spills Assist in Marine Surveys	N/A	

	Train ship inspectors		
Civil Aviation Authority (Support)	N/A	Evacuation	Support
		Transportation	Support
		Search and Rescue	Primary
Jamaica Bureau of Standards (Support)	Establish, maintain, monitor, and enforce safety standards for industrial plants Monitor emergency supplies	Response Readiness Policies and Plans, International Conventions	Support
		Clean-up and Decontamination	Secondary
Jamaica Constabulary Force (Support)	Traffic and crowd control Forensic sampling	Response Readiness Policies and Plans, International Conventions	Support
		Communication	Secondary
		Evacuation	Secondary
		Transportation	Support
		Security/Law Enforcement	Primary
		Emergency Care	Support
		Search and Rescue	Primary
		Fire Management	Support
		Legal Coordination	Secondary

JDF Coast Guard (Primary, Marine)	Coordination of National Pollution Control Efforts at scene of incident (marine)	Response Readiness Policies and Plans, International Conventions	Support
		Communication	Support
		Evacuation	Primary
		Transportation	Support
		Emergency Care	Support
		Security/Law Enforcement	Secondary
		Search and Rescue	Primary
		Fire Management	Support
		Clean-up and Decontamination	Support
JDF (Primary, Land)	Assist Jamaica Fire Brigade with direction and control at site	Response Readiness Policies and Plans, International Conventions	Support
		Communication	Support
		Evacuation	Primary
		Transportation	Support
		Emergency Care	Support
		Security/Law Enforcement	Secondary
		Search and Rescue	Primary
		Fire Management	Support

		Clean-up and Decontamination	Support
Jamaica Fire Brigade (Primary)	Coordination of National Pollution Control Efforts at scene of incident (land)	Response Readiness Policies and Plans, International Conventions	Support
		Communication	Support
		Evacuation	Primary
		Transportation	Secondary
		Emergency Care	Support
		Search and Rescue	Primary
		Fire Management	Primary
		Clean-up and Decontamination	Primary
Jamaica Public Service (Support)	N/A	Communication	Support
		Transportation	Support
		Fire Management	Support
Maritime Authority of Jamaica (Support)	Inspects ships that may be responsible for oil pollution incidents Prepare reports and claims	Response Readiness Policies and Plans, International Conventions	Support
		Legal Coordination	Primary
Ministry of Health – Environmental Health	Monitoring environmental health (e.g. water quality)	Response Readiness Policies and Plans, International Conventions	Support

(Support)	Controls use of chemical dispersants Hazardous material disposal		
		Communication	Support
		Emergency Care	Primary
Ministry of Land and Environment (Support)	N/A	Response Readiness Policies and Plans, International Conventions	Support
Ministry of National Security and Justice (Secondary)	N/A	Security/Law Enforcement	Primary
Ministry of Transport and Works (Support)	Regulates transport of hazardous materials Implements IMO conventions	Communication	Primary
		Transportation	Primary
		Fire Management	Secondary
		Clean-up and Decontamination	Support
National Irrigation Commission (Support)	N/A	Fire Management	Primary
		Clean-up and Decontamination	Primary

NEPA (Secondary)	Sampling, analyzing, and monitoring pollution incidents Recommend protection priorities Provide clean-up recommendations, monitoring support, etc. Arrange disposal of contaminated materials	Response Readiness Policies and Plans, International Conventions	Secondary
		Clean-up and Decontamination	Primary
National Water Commission (Support)	N/A	Fire Management	Secondary
Office of the Prime Minister (Secondary)	(Tourism Section) Coordinate, prepare, and release information to tourist organizations Provide information on claims	Security/Law Enforcement	Secondary
Parish Disaster Committee (Coordinator Parish Level)	Coordinate beach clean-up efforts	Response Readiness Policies and Plans, International Conventions	Primary
		Communication	Primary
		Evacuation	Primary
		Fire Management	Support

		Clean-up and Decontamination	Support
Parks and Markets – National Waste Management Authority (Support)	N/A	Clean-up and Decontamination	Support
Petrojam and Oil Marketing Companies (Support)	Provide logistical support and clean-up equipment	Clean-up and Decontamination	Support
Port Authority (Secondary)	Control vessels entering and leaving ports Report on incidents involving oil spills Provide available vessels/equipment for assistance	Transportation	Support
Water Resources Authority (Support)	Assist in land spills for rivers/streams	N/A	

7.6.2. Legislation in Jamaica

Jamaica has adopted various legislation relating to ship incidents, including the MARPOL convention, SOLAS, as well as countless oil pollution related statutes (see Table 17). In addition, Jamaica has adopted legislation concerning environmental framework, endangered species, and conservation of natural resources. Table 17 outlines the various international legislation relating to environmental protection and sustainable development to which Jamaica is a signatory.

Table 17. International agreements that have been adopted in Jamaica. Obtained from (NEPA, 2011).

International Agreement	Date of Accession for Jamaica
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (as amended), London, Mexico City, Moscow, Washington, 1972	22 March 1991
International Convention for the Prevention of Pollution from Ships (MARPOL), London, 1973	13 June 1991
United Nations Convention on the Law of the Sea, Montego Bay, 1982	21 March 1983
Beijing Amendment to the Montreal Protocol on Ozone Depleting Substances, Beijing, 1999	24 September 2003
United Nations Framework Convention on Climate Change New York, 1992	6 January 1995
Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto, 1997	28 June 1997
Convention on Biological Diversity, Rio de Janiero, 1992	6 January 1995
Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Montreal, 2000	4 June 2001
Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)	22 July 1997
Convention on Wetlands of International Importance especially as Waterfowl Habitats (RAMSAR)	7 October 1997
Convention on Transboundary Movement of Hazardous Waste and their Disposal (Basel Convention), Basel, 1989	23 January 2003
Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, Cartagena de Indias, 1983 (Cartagena Convention)	24 March 1983
Protocol Concerning Cooperation in Combating Oil Spills in the	24 March 1983

Wider Caribbean Region, 1983	
Protocol to the Cartagena Convention on Specially Protected Areas and Wildlife (SPAW Protocol), 1983	18 January 1990
Convention on the Territorial Sea and the Contiguous Zone, Geneva, 1958	8 October 1965
Convention of the High Seas, Geneva, 1958	October 1965
Convention on Fishing and Conservation of the Living Resources of the High Seas, Geneva, 1958	16 April 1968
Convention on Civil Liability for Bunker Oil Pollution Damage, 2001	28 July 2003
International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990	30 January 2001
International Conventional for the Safety of Life at Sea (SOLAS) 1974	14 October 2001

7.7. Caribbean-Wide Oil Spill Response Awareness

Jamaica's National Marine Pollution Contingency Plan stems from its inclusion in the Regional Marine Pollution Emergency, Information and Training Centre of the Wider Caribbean (RAC/REMPEITC-Caribe) initiative. RAC/REMPEITC-Caribe was established in 1995 in Curacao arising from the request of island states and territories for IMO support (RAC/REMPEITC, 2014a). The IMO assented to the request and established an activity centre to serve as a hub for awareness, training, and oil spill response preparedness for the Wider Caribbean (RAC/REMPEITC, 2014a). The purpose of RAC/REMPEITC-Caribe is to support countries in the development of their national policies and to ensure that they are implementing various IMO conventions and protocols relating to oil pollution preparedness and response (RAC/REMPEITC, 2014a). RAC/REMPEITC-Caribe published a Regional Caribbean Island Oil Pollution Response and Cooperation Plan in 2012 (OPRC), with the objective being to "provide a framework under which Island States and Territories may cooperate at the operational level in responding to oil spill incidents as required by Article 8 of the Oil Spill Protocol to the

Cartagena Convention" (RAC/REMPEITC, 2012 p 1). All participating countries within the regional response planning jurisdictions require their own national response plans that incorporate the required elements outlined in the regional plan (RAC/REMPEITC, 2012). Therefore, Jamaica's National Marine Pollution Contingency Plan encompasses the components based on the OPRC plan while customizing it to suit their specific needs. A potential future initiative could be for RAC/REMPEITC-Caribe to establish a regional Places of Refuge contingency plan. This could alleviate pressure on individual coastal states within the Caribbean to provide nation-specific plans since ensuring the capacity for plan creation, implementation, and response would be difficult in developing countries.

7.8. Compensation and Liability

The issue of compensation and liability with respect to Places of Refuge is an extremely dense topic, and could be explored in detail quite extensively. The legal aspects of the issue were not investigated in this study, but represent a void that needs to be addressed in the future. Compensation issues that arise with a vessel in distress include damage to the vessel, damage to third parties, fixed and floating objects that may be damaged as a result of the vessel, the cost of wreck removal, passenger liabilities, pollution liabilities, and the problem of abandoned vessels (Donner, 2008). Therefore, the financial implications of the issue are vast. Currently, Jamaica employs the "polluter pays" principle in their National Oil Spill Contingency Plan, where the polluter assumes financial liability for environmental damage (ODPEM, 2008). The Caribbean Island Oil Pollution Response and Cooperation Plan (OPRC Plan) has outlined in detail the civil liabilities and applicable conventions that govern compensation funds for oil pollution

damage on an international scale (RAC/REMPEITC, 2012). The following excerpt outlines the relevance to Places of Refuge, with respect to marine pollution:

> The international system of liability and compensation created by conventions is unique in the field of environmental pollution. Of particular importance is the fact that the regime applies regardless of whenever or not the tanker (ship) causing the spill was at fault. Claimants can therefore receive compensation promptly, without the need for lengthy and costly legislation. This also ensures that Government authorities can take action to prevent or minimize pollution damage in the knowledge that, as long as their actions are reasonable for the circumstances, the cost they incur will normally be reimbursed (RAC/REMPEITC, 2012 Section 8.4.2.).

The compensation funds available also provide benefits for those affected through indirect impacts, which is also quite important when assessing the potential socioeconomic risks of allowing refuge:

> If a pollution incident occurs involving a tanker, compensation is available to governments or other authorities which have incurred costs for clean up operations or preventive measures and to private bodies or individuals who have suffered damage as a result of the pollution. For example, fishermen whose nets have become polluted are entitled to compensation, and compensation for loss of income is payable to fishermen and to hoteliers at seaside resorts. This is independent of the flag of the tanker, the ownership of the oil or the place where the incident occurred, provided that the damage is suffered within a State Party (RAC/REMPEITC, 2012 p 38).

Further legal issues emerge when considering Places of Refuge. First and foremost "States and Territories have a general duty under customary international law to warn other States or Territories of a marine pollution threat of which it becomes aware and which is likely to affect them" (RAC/REMPEITC, 2012 Section 8.17.3). Therefore, international liabilities may materialize as a result of legal violations, in addition to civil liabilities with respect to claims relating to damage as a result of the refuge decision (John, 2011). The greatest contention surrounding Places of Refuge would most likely be

attributed to liability and compensation issues. While issues relating to environmental protection are vested interests for a coastal state, financial implications may prove to have more sway in decision-making. That being said, the liability and compensation risks should not discourage coastal states from accommodating ships in distress, as their refusal may lead to further financial implications from related damages (Luttenberger, n.d.).

CHAPTER 8: DISCUSSION AND RECOMMENDATIONS

This section discusses content relating to site analysis, criteria selection, and data availability. Limitations in the study are addressed, in addition to recommendations for going forward with a Places of Refuge contingency plan in Jamaica. Lastly, challenges for implementing said plan are considered, along with concluding remarks.

8.1. Site Analysis

Through an analysis of various criteria (environmental, socioeconomic, and physical/response), sites around Jamaica were evaluated on their potential viability as a Place of Refuge. Following the IMO Guidelines on Places of Refuge, various factors and impacts of an area's use as a refuge were determined. The results indicated that the top-scoring site was Lucea Harbour, while the lowest scoring site was Black River. However, when individual site assessments are broken down by criteria, different results could be interpreted. It was found that several sites had "strength" areas, in addition to "weakness" areas, and could thus be suitable for different reasons. It has been suggested that existing ports are the most suitable sites for Places of Refuge simply due to their support facilities and capacity for response (John et al., 2011). Nevertheless, alternatives have been suggested, including anchorages further offshore, and areas with little to no commercial value (John et al., 2011). The issue with those sites is that the main goal is containment, and it has been suggested that communities would react negatively to their local waters being used as sacrificial (John et al., 2011). In the effort to explore as many options as possible, sites with existing ports and others with merely anchorage facilities were analyzed in this study. Therefore it is up to the local authorities, governing

officials, and community members to provide input regarding their views towards a Places of Refuge allowance.

Pre-selecting or pre-designating sites of refuge for ships in distress is something that not all countries have elected to do – however, the European Union has instated *Directive 2002/59/EC* (Article 20) that requires all participating member countries to have some form of plan outlined in the event that it is needed. Countries within the EU are not required to adopt Article 20, but of those who have, the majority do not legally designate sites, but rather take an inventory of possible areas (Constantinou, n.d.). The latter was the approach taken to the current study in Jamaica. With the country not having recognized the IMO Guidelines, an inventory of possible sites represents a reasonable starting point. If the concept of Places of Refuge constitutes an issue that the Jamaican government would like to address in the future, the process of legal designation could be explored. That being said, all incidents and circumstances surrounding a ship in distress are unique, and legally binding sites could pose potential problems regarding future accidents. A more appropriate approach would be to identify all possible sites in advance, characterize their benefits and drawbacks, legally designate all potential sites, and then ultimately make a final decision on an event-specific basis.

8.1.1. Limitations of Site Analysis

This study was limited in time and scope when deciding the best course of action for site analysis. A better scenario would have incorporated GIS and other methods of analysis that would have given as accurate results as possible. A Decision Support System (DSS) represents another option of using GIS with the objective being to organize

all data in a spatial context, in order to facilitate emergency management planning (Bradaric et al., 2008). However, given the time frame for this project, the data obtained were from existing information and literature. Additionally, consultation on potential sites for use as Places of Refuge was limited to two personnel. Therefore, it is likely that there are additional sites and areas that could be used as potential Places of Refuge, but were overlooked due to the nature of the consultation process. Originally, a risk assessment was planned for the chosen sites, but specific likelihood values of hazards to the areas and sensitivity levels could not be obtained within the time frame and scope of this project. Consequently, the risk values of each site as a Place of Refuge constitute a limitation for this project. This project represents a baseline study for potential locations as areas of refuge, however a more extensive study needs to be completed that incorporates original and updated research, as well as extensive stakeholder engagement/consultation.

8.1.2. Recommendations for Site Analysis

1. Initiate a consultation process that will bring together members of various governmental departments in Jamaica. In doing so, various interests and mandates can be considered, which could potentially lead to different sites being selected. This would also allow a more in-depth dialogue on the merits and drawbacks of each potential site as a Place of Refuge. Also allow open consultation with the general public to ensure that members of various communities with vested interests in coastal resources have the opportunity to voice their opinions and concerns regarding the allowance of refuge for a ship in distress in Jamaican waters.

2. Ensure that GIS is integrated into the final process of site evaluation, as spatial data can provide invaluable information and insights for those involved in decisions relating to Places of Refuge. Should the results from this project be used in future planning endeavours, they should be supplemented with GIS.
3. Initiate a formal risk assessment of potential Places of Refuge around Jamaica. Experts in the field of risk analysis should be consulted in order to properly establish risk levels.
4. Complete a final inventory of potential Places of Refuge around Jamaica, including possible additions from further consultations.

8.2. Criteria Selection

This study incorporated environmental, socioeconomic, and physical/response criteria for determining potential Places of Refuge around Jamaica. Environmental criteria were fairly well explored, with certain limitations (see following section), in addition to an assessment of physical and response feasibility. Socioeconomic impacts were mainly focused on industries and sectors important for sustaining the economy of Jamaica, rather than health aspects and the well-being of the general population.

8.2.1. Limitations in Criteria Selection

The exclusion of certain criteria for this analysis was due to limitations in time and resources. This project may be expanded upon to include the missing elements in order to produce a comprehensive analysis of potential Places of Refuge. The criteria of the socioeconomic category were limited in terms of social impacts on the population, and did not delve into potential pressures on the human population. Issues relating to

human health (toxic contaminant spills), livelihoods, and overall well-being were not addressed in this study. Fishing constitutes an important source of self-identity in Jamaica, with fishers associating their livelihood with a sense of personal ownership for the environment and its resources, as well as freedom and independence (Pugholm, 2009). The potential harm to these livelihoods that may occur due to potential oil spills as they relate or not to places of refuge would be quite high. Therefore, social impacts represent a large issue that was not thoroughly analyzed, but also not completely overlooked, for this study.

8.2.2. Recommendations for Criteria Selection

1. Conduct studies and/or collect information that was not included in the analysis relating to environmental and social factors, natural conditions, and navigational characteristics. Various elements can include oceanographic and physical data surrounding the island (i.e. currents, tides, prevailing wind speeds/directions, and seasonal effects). Sea conditions would also be a crucial factor, but the analysis depends on both prevailing conditions in an area, as well as ad hoc evaluation of the current conditions at the time of an incident. Navigational characteristics that were not incorporated in the analysis include maneuverability, stranding risk, and tug availability. The effects of these elements should be determined through consultation with experts (e.g. port captains, risk analysts, port authority officers, etc.). Environmental and social factors that were not analyzed include the level of pollution (which can only be determined on an ad hoc basis), as well as the public safety threat.

2. Conduct a social impact assessment that clearly outlines potential drawbacks of sites based on influences on the general population. Include extensive studies on potential impacts to human health, as well as on general livelihoods. For example, approximately 85% of Jamaicans have access to safe drinking water, therefore polluting water systems that affect freshwater inputs could prove detrimental (NEPA, 2011).

8.3. Data Availability/Viability

The data availability was quite limited in terms of socioeconomic and environmental information. Physical and response data were more readily available in the form of charts and reports, albeit quite dated. The reports and articles concerning environmental and socioeconomic studies were also out of date, including various publications on government websites. The most recent State of the Environment Report was completed in 2010; therefore an update should be done in the near future in order to properly categorize the ecological sensitivity of various sites around Jamaica. The same can be said for the Tourism Master Plan, which was published in 2002 with no updated version in the past 12 years. It is likely due to the lack of funding and resources available that updates to studies and amendments to plans have not been completed to date. The capacity to conduct large-scale biodiversity studies, as well as comprehensive tourism studies would require a lot of monetary input and time.

8.3.1. Limitations Regarding Data Availability/Viability

The biggest limitation with respect to data availability/viability was the lack of recently published information. Of the data available on environmental criteria, the

majority had to be obtained from the JERP analysis report, which may have resulted in a bias of information. Certain information sources (e.g. ship traffic database) are likely still relevant, however when the Panama Canal expansion is completed, the database should be updated to include new levels of traffic in the wider Caribbean. Access to some documents was also challenging (specifically with statistical reports), therefore a limitation was simply in procuring certain information.

8.3.2. Recommendations for Data Availability/Viability

1. Improve information access on websites for external parties, and create a more user-friendly interface for document storage/retrieval.
2. All environmental and socioeconomic studies relating to the criteria required for Places of Refuge should be updated. If the capacity exists, studies should be initiated or continued in the effort to obtain the most accurate information possible.
3. The State of the Environment Report should be updated to better convey the biodiversity risks facing the island.
4. An update on the Tourism Master Plan should be conducted, including the status on goals/objectives, the current level of tourism, and recommendations/initiatives for the future.
5. Once the Panama Canal expansion project is complete, the Caribbean Maritime Traffic database should be updated. Currently, data from 2007 and 2008 are displayed; therefore it would be ideal to show the vessel transit routes at present. This could allow future risk modelling for vessel collisions or groundings around Jamaica.

8.4. Challenges to Implementation of a Places of Refuge Plan in Jamaica

In the event that future guidelines on Places of Refuge are created, there will be challenges for implementing this in Jamaica. First and foremost, buy-in and acceptance from all levels of government must be obtained; otherwise confusion and disagreements will occur throughout every level of decision-making. Since the issue of Places of Refuge affects multiple stakeholders, a clear and concise plan should be created. Following the example of the National Oil Pollution Contingency Plan, all interested parties/stakeholders should be identified, in addition to clearly outlining their goals. A responsible authority needs to be determined, with possible candidates including ODPEM, The Port Authority of Jamaica, or the Maritime Authority of Jamaica. Since the initial consultation process for the project involved the Maritime Authority of Jamaica, it is logical to assume that they would have a leading role and a resulting high level of involvement in the plan's inception and implementation. Challenges at the onset of the plan include diverse opinions on its necessity. Throughout the initial consultation process, several government authorities had varied levels of interest in the idea. Therefore, convincing all of the key establishments that would be included in Jamaica's Guidelines on Places of Refuge poses a large potential barrier. However, it is a personal belief that through effective communication, the benefits of having a plan could be convincingly addressed. Following buy-in and acceptance of a plan, other challenges would arise. Resources (both financial and regarding human capacity) are limited in Jamaica for many different types of initiatives due to the global financial crisis, as well as Jamaica's high level of national debt (NEPA, 2011; Sullivan, 2006). Expenditure on programs has been cut in order to allocate money to other budgeting needs (NEPA,

2011). The amount of resources that would be required to initiate the process for a Places of Refuge contingency plan is quite high. Data and information are also required, which would result in the need for additional studies and publications; all of which necessitates funding and support. Experts must be consulted, many of which could be accessed in Jamaica, however if there were to be any external consultation, additional capital would need to be procured. Jamaica's disaster relief also heavily relies on external international aid (Grove, 2013). Capacity-building initiatives should be suggested in a potential contingency plan in order to employ and train Jamaicans to become involved more extensively in disaster relief and aid. While the reliance on external sources of funding may be inevitable, this would allow potential increases in employment and skill development, and decreases in outsourcing of response workers. Should Jamaica require assistance from other regional response centres, they are responsible for costs relating to personnel and equipment (RAC/REMPEITC, 2012). If financial aspects were not a significant issue for Jamaica, problems would still exist relating to legislation and enforcement that could pose additional difficulties in the uptake of a contingency plan. Jamaica has adopted many international policies, however many of them are dated and as a result have limited the possibilities for national legislation and subsequent allocation of legal authority to various agencies (NEPA, 2011). This could create logistical challenges in designating official guidelines, which could lead to lack of compliance from other departments. Enforcement has also been a large issue for Jamaica in terms of environmental guidelines, and there is a lack of common ground and effective communication in resolving compliance issues (NEPA, 2011). All this being said, the benefits for having a Places of Refuge Contingency Plan remain substantial. Jamaica

faces many challenges in implementing one, as would most countries worldwide that are subject to similar adversity and difficulties. If Jamaica creates a comprehensive Places of Refuge contingency plan, it will support the country's future logistics hub initiative by empowering visiting flag states with a sense of security and safety. Knowing that their vessel is in capable hands should they be faced with a problematic situation would only promote Jamaica's reputation on an international scale.

CHAPTER 9: CONCLUSION

Places of Refuge for ships in distress constitute a highly debated and contentious subject internationally. Cross-sectoral issues emerge when considering refuge allowance for a compromised vessel. Environmental risks, socioeconomic concerns, and physical/response feasibilities all need to be addressed before refuge is allowed. The challenge is balancing all relevant stakeholders' concerns, in addition to accepting facts and figures surrounding the analysis and assessment of potential sites. International guidelines on designating Places of Refuge and responding to a vessel in distress have been created, but are not legally binding or enforceable. This has led to the creation of nation-specific policies on Places of Refuge. Various policies have acknowledged the benefits of pre-evaluating or assessing potential sites for the sake of efficiency in the event of an emergency. Nevertheless, many countries have either not adopted that approach, nor formally recognized Places of Refuge, and therefore a divide on internationally agreed upon procedures is seen. This results in refuge refusals, confusion surrounding incidents, and extensive environmental and socioeconomic impacts. It is recommended that all coastal states re-evaluate their approach regarding response to these incidents, and aim to implement IMO criteria on Places of Refuge into future contingency plans.

Jamaica, like many countries, has not formally recognized Places of Refuge, and it is uncertain as to how they would respond to an incident. This study examined potential locations for future designation or recognition as Places of Refuge, and found 14 sites with varying degrees of suitability. Sites were classified based on environmental, socioeconomic, and physical/response criteria, which can provide

government officials with a framework for assessment in the event of an actual incident. Further work needs to be completed in order to establish a Places of Refuge contingency plan, however this study can provide a baseline for the initiative and assist Jamaica in becoming a leader in marine emergency preparedness throughout the Caribbean.

REFERENCES

Agard, J.B., (1983). Sensitivity of the Trinidad and Tobago coastline to spilled oil. In: *Oil Spill Pollution Control Seminar*. Ministry of Energy and Natural Resources, Trinidad, pp. 1-10.

Australian Transport Council (ATC)(2009). *National Maritime Place of Refuge Risk Assessment Guidelines*. National Plan Management Committee. Retrieved from: https://www.amsa.gov.au/environment/legislation-and-prevention/documents/Refuge_Risk_Assessment_Guidelines.pdf

Autoridad del Canal de Panama (ACP)(2010) *Panama Canal Expansion Program. Expansion Components (Part 1*). Retrieved from: http://www.pancanal.com/eng/expansion/rpts/components/components-2010-01.pdf

Baringa, M (1989). Alaskan oil spill. Health risks uncovered. *Science*. 245:463

Bernabeu, A. M., Rey, D., Rubio, B., Vilas, F., Domínguez, C., Bayona, J. M., Albaigés, J. (2009). Assessment of cleanup needs of oiled sandy beaches: lessons from the Prestige oil spill. *Environmental Science & Technology*, *43*, 7, 2470-5.

Bradaric, Z., Srdelic, M., Mladineo, N., Pavasovic, S. (2008). Places of refuge selection for ships aiming at reduction of environmental hazards. *WIT Transactions on the Built Environment*. 99:127-135. doi:10.2495/CENV080121nou.pdf

Cedre (2009a). *The Erika*. Retrieved from: http://www.cedre.fr/en/spill/erika/erika.php).

Cedre (2009b). *The Castor*. Retrieved from: http://www.cedre.fr/en/spill/castor/castor.php

Cedre (2014). *The Prestige.* Retrieved from: http://www.cedre.fr/en/spill/prestige/prestige.php

Central Intelligence Agency (CIA)(2014). *The World Factbook. Central America and Caribbean. Jamaica.* Retrieved from: https://www.cia.gov/library/publications/the-world-factbook/geos/jm.html

Chircop, A. (2002). Ships in Distress, Environmental Threats to Coastal States, and Places of Refuge: New Directions for an Ancien Regime? *Ocean Development and International Law, 33,* 2, 207-226.

Commonwealth Secretariat (2002). *Master Plan for Sustainable Tourism Development. Government of Jamaica*. Retrieved from: http://www.jtbonline.org/tourism_jamaica/Major%20Tourism%20Laws/Tourism%20Master%20Plan%20Full.pdf

Constantinou, A.A. (n.d). Places of Refuge – A Myth of Reality? Conference Proceedings. International Symposium on Maritime Safety, Security, and Environmental Protection. Retrieved from: http://www.martrans.org:8093/symposium/papers/Track%20A/A42%20constanti

Devanney, J (2000). The Consequences of Providing and Refusing Refuge. Centre for Tankship Excellence. Retrieved from: http://www.c4tx.org/ctx/pub/refuge.pdf

Directive 2002/59/EC of 27 June 2002 establishing a Community vessel traffic monitoring and information system and repealing Council Directive 93/75/EEC [2002] OJ L208/10

Donner, P. (2008). Offering refuge is better than refusing. *WMU Journal of Maritime Affairs, 7,* 1, 281-301.

Duke, N. C., Pinzon-M, Z. S., Prada-T, M. C. (1997). Large-Scale Damage to Mangrove Forests Following Two Large Oil Spills in Panama. *Biotropica, 29,* 1, 2.

Electoral Commission of Jamaica (2014). *Parishes.* Retrieved from: http://www.eoj.com.jm/content-69-188.htm

Freire, J., Fernandez, L., Muino, R. (2006). Role of the Spanish scientific community in t he initial assessment and management of the environmental damages caused by the Prestige oil spill. *Marine Policy, 30,* 4, 308-314.

Georges, C., (1983). A coastal classification for Trinidad. *I.M.A. Report,* Institute of Marine Affairs, Trinidad.

Grove, K. J. (2014). Adaptation Machines and the Parasitic Politics of Life in Jamaican Disaster Resilience. *Antipode, 46,* 3, 611-628.

Google Earth (2013) (2013) Version 7.1.2.2041 <http://www.google.com/earth/index.html> [Viewed October 2014].

Hayle, C. (2003). The Application of a Jamaican Idiosyncrasy as a Management Tool for Tourism. *Caribbean Quarterly, 49,* 3, 74-91.

IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)(1993). *Impact of oil and related chemicals on the marine environment*. London: International Maritime Organization.

IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)(2007). *Estimates of oil entering the marine environment from sea-based activities*. London: International Maritime Organization.

International Maritime Organization (IMO)(2004). *Guidelines on Places of Refuge for Ships in Need of Assistance*. Resolution A.949(23). Retrieved from: http://www.imo.org/blast/blastDataHelper.asp?data_id=9042&filename=949.pdf

International Maritime Organization (IMO)(2012) *International Shipping Facts and Figures – Information resources on trade, safety, security, environment. Maritime Knowledge Centre*. Retrieved from: http://www.imo.org/KnowledgeCentre/ShipsAndShippingFactsAndFigures/TheRoleandImportanceofInternationalShipping/Documents/International%20Shipping%20-%20Facts%20and%20Figures.pdf

International Maritime Organization (IMO)(2014). *International Convention for the Prevention of Pollution from Ships (MARPOL).* Retrieved from: http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx

Jamaica Logistics Hub (2014a). *About the Jamaica Logistics Hub*. Retrieved from: http://jamaicalogisticshub.com/about/).

Jamaica Logistics Hub (2014b). *The Ports*. Retrieved from: http://jamaicalogisticshub.com/ports/

Jamaica Protected Areas Trust (JPAT)(2013). *Welcome Page*. Retrieved from: http://www.jpat-jm.com/index.html

Jernelov, A. (2010). The Threats from Oil Spills: Now, Then, and in the Future. *Ambio: a Journal of the Human Environment, 39,* 6, 353-366.

John, P., Christie, J.S., Ircha M.C. (2010). Places of Refuge for Ships in Need of Assistance in Canada: Policy Lessons from Other Maritime Nations. *Conference Proceedings. Canadian Transportation Research Forum*. Retrieved from: http://www.ctrf.ca/conferences/2010Toronto/2010Proceedings/22JohnChristieIrchaPlacesofRefuge.pdf

John, P (2011). Towards a Canadian Policy on Places of Refuge for Ships in Need of Assistance. *PhD. Dissertation*. University of New Brunswick.

John, P., Christie, J.S., Ircha M.C. (2011). Places of Refuge: Port Suitability. *Conference Proceedings. Canadian Transportation Research Forum*. Retrieved from: http://www.ctrf.ca/conferences/2011Gatineau/2011Proceedings/34JohnChristieIrchaPortSuitability.pdf

Jozi, S. A., Shoshtary, M. T., & Zadeh, A. R. K. (2013). Environmental Risk Assessment of Dams in Construction Phase Using a Multi-Criteria Decision-Making (MCDM) Method. *Human and Ecological Risk Assessment, 21,* 1, 1-16.

Luttenberger, A. (n.d.). *Coastal States Responsibility with Regard to Places of Refuge for Ships in Distress*. University of Rijeka, Croatia. Retrieved from: https://bib.irb.hr/datoteka/357325.scan0001_3.pdf

Maritime Connector (2014). *Ship Sizes*. Retrieved from: http://maritime-connector.com/wiki/ship-sizes/

Ministry of Agriculture & Fisheries (MOAF)(2014). *Special Fishery Conservation Areas (SFCA).* Retrieved from: http://www.moa.gov.jm/Fisheries/fish_sanctuary.php

Morrison, A. (2011a). Places of refuge for ships in distress: the Australian position. *Australian Journal of Maritime & Ocean Affairs, 3,* 3.)

Morrison, A. (2011b). Shelter from the Storm – the problem of places of refuge for ships in distress and proposals to remedy the problem. *Doctor of Philosophy thesis*, University of Wollongong, Faculty of Law, University of Wollongong. Retrieved from: http://ro.uow.edu.au/theses/3218

Morrison, A (2012). Places of Refuge for Ships in Distress: Problems and Methods for Resolution. Martinus Nijhoff Publishers, Leiden. 401 p.

Murray, C.F. (2002). Any Port in a Storm? The Right of Entry for Reasons of Force Majeure or Distress in the Wake of the Erika and the Castor. *Ohio State Law Journal, 63,* 1465-1506.

Nansingh, P., & Jurawan, S. (1999). Environmental Sensitivity of a Tropical Coastline (Trinidad, West Indies) to Oil Spills. *Spill Science & Technology Bulletin, 5,* 2, 161-172.

National Environment and Planning Agency (NEPA)(2011). *State of the Environment Report*. Retrieved from: http://www.nepa.gov.jm/publications/SOE/2010/state-of-The-environment-report-2010-Jamaica.pdf

National Geospatial Intelligence Agency (NGIA)(2013). *Sailing Directions (Enroute). Pub. 147. Caribbean Sea: Volume 1.* 14th Edition. United States Government. Retrieved from:

http://msi.nga.mil/MSISiteContent/StaticFiles/NAV_PUBS/SD/Pub147/Pub147bk.pdf

Nichols, J.A., Parker, H.D. (1989). Effects of oil pollution on industrial water intakes. *Proceedings of the 1989 International Oil Spill Conference*, Baltimore, USA, American Petroleum Institute, Washington, DC. A.P.I. Publ. No. 4479, p 473-478

ODPEM (2008). *National Oil Spill Contingency Plan. Office of Disaster Preparedness and Emergency Management*. Retrieved from: http://www.odpem.org.jm/disastersdohappen/nationaldisasterplans/tabid/57/default.aspx

Ohlson, J.H. (n.d.). *The National Designation of Places of Refuge in the Baltic Sea Area*. Kalmar Maritime Academy. Sweden. Retrieved from: http://www.balticmaster.org/media/files/general_files_705.pdf

Pugholm, M. L. (2009). Fishing and Environmental Regulation in the Caribbean: Acts of Freedom and Control in a Jamaican Coastal Town. *Landscape Research, 34,* 2, 241-256.

Port Authority of Jamaica (PAJ)(2014). *Statistical Publication*. Retrieved from: http://www.portjam.com/nmCMS.php?p=stats

RAC/REMPEITC (2012). *Regional Caribbean Island Oil Pollution Response and Cooperation Plan*. Regional Activity Center/Regional Marine Pollution Emergency Information and Training Center – Wider Caribbean Region. Retrieved from: http://cep.unep.org/racrempeitc/regional-oprc-plans/caribbean-island-oprc-plan

RAC/REMPEITC (2014a). *About Us*. Retrieved from: http://cep.unep.org/racrempeitc/about-us

RAC/REMPEITC (2014b). *Caribbean Maritime Traffic Database*. Retrieved from: http://www.caribbeanmaritimetraffic.org/

Siung Chang, A. (1997). A Review of Marine Pollution Issues in the Caribbean. *Environmental Geochemistry and Health*. 19:2. 45-55.

Stamoulis, K. A., Friedlander, A. M. (2013). A seascape approach to investigating fish spillover across a marine protected area boundary in Hawai'i. *Fisheries Research, 144*, 2-14.

Stopford, M (2010). How shipping has changed the world, and the social impact of shipping. *Global Maritime Environmental Congress*. Retrieved from: http://ec.europa.eu/competition/consultations/2012_maritime_transport/euda_8_en.pdf

Sullivan, M.P. (2006). *CRS Report for Congress. Jamaica: Political and Economic Conditions and U.S. Relations*. Retrieved from: http://fas.org/sgp/crs/row/RS22372.pdf

Transport Canada (TC)(2007). National Places of Refuge Contingency Plan. *Government of Canada*. Retrieved from: https://www.tc.gc.ca/eng/marinesafety/tp-tp14707-menu-1683.htm

United Nations Conference on Trade and Development (UNCTAD)(2013). Review of Maritime Transport *United Nations Publication*. Retrieved from: http://unctad.org/en/publicationslibrary/rmt2013_en.pdf

United States National Response Team (USNRT)(2007). *Guidelines for Places of Refuge Decision Making*. Retrieved from: http://www.nrt.org

University of the West Indies (UWI)(2013) *National Ballast Water Status Assessment for Jamaica*. Technical Report. Centre for Marine Sciences.

World Port Source (2014). *Jamaica: Satellite Map of Ports*. Retrieved from: http://www.worldportsource.com/ports/JAM.php

White, M., Maddern Q.C., Knight, S. (2003). *Refuge for ships in distress: International developments and the Australian position*. Maritime Law Association of Australia and New Zealand

Wirtz, K. W., Baumberger, N., Adam, S., & Liu, X. (March 01, 2007). Oil spill impact minimization under uncertainty: Evaluating contingency simulations of the Prestige accident. *Ecological Economics, 61,* 417-428.

Zenny, N. (2006). *Jamaica Ecoregional Planning (JERP) Marine Analysis Report & Technical Summary*. The Nature Conservancy Jamaica Country Program.

Appendix 1

Criteria Data With Responses (Un-Scaled)

	Port Esquivel	Great Pedro Bluff	Black River	Belmont Point	Savanna la Mar	Lucea Harbour	Mosquito Cove	Rio Bueno Harbour	Discovery Bay	St. Ann's Bay	Oracabessa Bay	Port Antonio	Port Morant	Kingston Harbour
Environmental Criteria														
1. Is it within a protected area? (Yes/No/In Proximity)	Y	N	Y	N	N	N	N	N	N	IP	N	Y	N	Y
2. Is it within a special fishery conservation area? (Yes/No/IP)	IP	N	IP	Y	IP	N	N	N	Y	N	Y	N	Y	N
3. Is it within a highest priority conservation area? (Yes/No/IP)	Y	Y	Y	N	N	N	N	IP	IP	N	N	Y	Y	Y
4. Conservation Target Presence (L/M/H)	H	L	M	M	M	M	M	M	M	M	M	M	L	H
Socioeconomic Criteria														
1. Fishing pressure/intensity (VH/H/M/L/VL)	VH	VH	VH	VH	VH	M	M	M	M	H	H	H	VH	VH
2. Number of attractions within parish	25	23	23	27	27	11	11	24	35	35	9	39	50	5
3. Is it within a town of culture and heritage themes? (Y/N/IP)	N	N	Y	N	N	Y	IP	N	N	Y	N	Y	N	Y
4. Is it within a major heritage site?	N	N	N	N	N	N	N	N	N	Y	N	N	N	Y
5. Resort density within area (Low/Medium/High)	L	L	L	L	L	H	H	H	H	H	H	M	L	L
6. Proximity to industrial ports (Km)	0	17	37	62	71	25	20	0	0	10	17	0	62	0
Physical/Response Criteria														
1. Average depth (m)	12.2	8.2	8.2	14.2	14	9	7.8	28	24.1	18	25.5	21	9	15.5
2. Maximum vessel length (m)	198	70	122	100	152	167	90	61	213	122	80	149	137	182
3. Maximum draught (m)	11	5	5	5	5.8	9.1 (7.3 anchoring)	5.5	7	11.4	6.9	5	7.9	6.9	11.1
4. Berthing available? (Yes/No)	Y	N	N	N	N	Y	N	Y	Y	N	N	N	Y	Y
5. Anchorage available? (Yes/No)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
6. Is pilotage compulsory? (Yes/No)	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y
7. Proximity to response facilities (Km)	0	17	37	62	71	25	20	60	34	10	17	79	62	0
8. Level of shelter in area (E/PE)	PE	PE	PE	PE	PE	E	E	E	E	PE	PE	E	E	E

Appendix 2

Criteria Data With Responses (Scaled and Weighted)

			Port Esquivel	Great Pedro Bluff	Black River	Belmont Point	Savanna la Mar	Lucea Harbour	Mosquito Cove	Rio Bueno Harbour	Discovery Bay	St. Ann's Bay	Oracabessa Bay	Port Antonio	Port Morant	Kingston Harbour
Environmental Criteria	**Weight**	**Scaling**														
1. Is it within a protected area? (Y/N/IP)	30	Y = 0 N = 1 IP = 0.5	0	1	0	1	1	1	1	1	1	0.5	1	0	1	0
2. Is it within a special fishery conservation area? (Y/N/IP)	30	Y = 0 N = 1 IP = 0.5	0.5	1	0.5	0	0.5	1	1	1	0	1	0	1	0	1
3. Is it within a highest priority conservation area? (Y/N/IP)	20	Y = 0 N = 1 IP = 0.5	0	0	0	1	1	1	1	0.5	0.5	1	1	0	0	0
4. Conservation Target Presence (L/M/H)	20	L = 1 M = 0.5 H = 0	0	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0
Total Scaled	100		**15**	**80**	**25**	**60**	**75**	**90**	**90**	**80**	**50**	**75**	**60**	**40**	**50**	**30**
Total Weighted and Scaled			**5**	**26.7**	**8.3**	**20**	**25**	**30**	**30**	**26.7**	**16.7**	**25**	**20**	**13.3**	**16.7**	**10**

Socioeconomic Criteria	**Weight**	**Scaling**														
1. Fishing pressure/intensity (VH/H/M/L/VL)	20	VH = 0, H = 0.25, M = 0.5, L = 0.75, VL = 1	0	0	0	0	0	0.5	0.5	0.5	0.5	0.25	0.25	0.25	0	0

2. Number of attractions within parish	15	Closer to 1 = ideal, Closer to 0 = not ideal	0.5	0.54	0.54	0.46	0.46	0.78	0.78	0.52	0.3	0.3	0.82	0.22	0	0.9
3. Is it within a town of culture and heritage themes? (Y/N/IP)	12.5	Y = 0 N = 1 IP = 0.5	1	1	0	1	1	0	0.5	1	1	0	1	0	1	0
4. Is it within a major heritage site?	12.5	Y = 0 N = 1 IP = 0.5	1	1	1	1	1	1	1	1	1	0	1	1	1	0
5. Resort density within area (Low/Medium/High)	20	L = 1 M = 0.5 H = 0	1	1	1	1	1	0	0	0	0	0	0	0.5	1	1
6. Proximity to industrial ports (Km)	20	Closer to 1 = ideal, Closer to 0 = not ideal	0	0.24	0.52	0.87	1	0.35	0.28	0	0	0.14	0.24	0	0.87	0
Total Scaled	100		**52.5**	**57.9**	**51**	**69.3**	**71.9**	**41.2**	**46.1**	**42.8**	**39.5**	**12.3**	**47.1**	**30.8**	**62.4**	**33.5**
Total Weighted and Scaled			**17.5**	**19.3**	**17**	**23.1**	**24**	**13.7**	**15.3**	**14.3**	**13.2**	**4.1**	**15.7**	**10.3**	**20.8**	**11.2**

Physical/Response Criteria	**Weight**	**Scaling**														
1. Average depth (m)	12.5	Closer to 1 = ideal, Closer to 0 = not ideal	0.44	0.29	0.29	0.51	0.5	0.32	0.28	1	0.86	0.64	0.91	0.75	0.32	0.55
2. Maximum vessel length (m)	12.5	Closer to 1 = ideal, Closer to 0 = not ideal	0.93	0.33	0.57	0.47	0.71	0.64	0.42	0.29	1	0.57	0.38	0.7	0.64	0.85
3. Maximum draught (m)	12.5	Closer to 1 = ideal, Closer to 0 = not ideal	0.96	0.44	0.44	0.44	0.51	0.64	0.48	0.61	1	0.61	0.44	0.69	0.61	0.97

4. Berthing available? (Yes/No)	12.5	Y = 1 N = 0	1	0	0	0	0	1	0	1	1	0	0	0	1	1
5. Anchorage available? (Yes/No)	12.5	Y = 1 N = 0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6. Is pilotage compulsory? (Yes/No)	12.5	Y = 1 N = 0	1	0	0	0	1	1	0	1	1	1	0	1	1	1
7. Proximity to response facilities (Km)	12.5	Closer to 1 = ideal, Closer to 0 = not ideal	1	0.78	0.53	0.22	0.1	0.68	0.75	0.24	0.57	0.87	0.78	0	0.22	1
8. Level of shelter in area (E/PE)	12.5	E = 1 PE = 0	0	0	0	0	0	1	1	1	1	0	0	1	1	1
Total Scaled	100		**79.1**	**35.5**	**35.4**	**33**	**47.8**	**78.5**	**49.1**	**76.8**	**92.9**	**58.6**	**43.9**	**64.3**	**72.4**	**92.1**
Total Weighted and Scaled			**26.4**	**11.8**	**11.8**	**11**	**15.9**	**26.2**	**16.4**	**25.6**	**31**	**19.5**	**14.6**	**21.4**	**24.1**	**30.7**

Total Overall			**48.9**	**57.8**	**37.1**	**54.1**	**64.9**	**69.9**	**61.7**	**66.5**	**60.8**	**48.6**	**50.3**	**45.0**	**61.6**	**51.9**