ACCEPTABLE RISK IN CARIBBEAN TERRACE AND PORT ROYAL, JAMAICA.

A Research Paper

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Rishma Ramnath Maharaj

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Centre for Environmental Management

University of the West Indies, Mona

Kingston 7, Jamaica

ABSTRACT

Acceptable Risk in Caribbean Terrace and Port Royal, Jamaica.

Rishma Ramnath Maharaj

Caribbean Terrace and Port Royal are high risk coastal communities, located on south east of Kingston on the south coast of Jamaica. Despite susceptibility to atmospheric and seismic hazards, permanent settlements continue to occupy both areas, as the upper middle class residents of Caribbean Terrace as well as the low income inhabitants of Port Royal, display a reluctance to leave. This risk acceptance is motivated by social, economic, and environmental factors, acting as both constraints and benefits to create strong ties to the community. The impact of these factors on risk acceptance varied in each community resulting in differing levels of acceptable risk.

In order to assess the extent of acceptable risk in each community, an instrument was developed, comprising of a three part tool for data collection, an assortment of risk tables to calculate risk acceptance scores and a scale to compare and rank each score. This scale divided acceptable risk into two categories, voluntary and forced, using a ten point system to reflect intensity of risk acceptance. The assessment of both communities showed results on separate ends of the spectrum, as the community of Caribbean Terrace showed high levels of forced acceptable risk while in Port Royal analysis of the data showed that risk acceptance was primarily mostly voluntary.

Keywords: Acceptable risk; Caribbean Terrace; Port Royal; Risk assessment; Vulnerability.

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DEDICATION

This research is dedicated to my grandparents, Mrs. Samdai Raghoonanan and the late Mr. Lalman Raghoonanan who believed in me, even before I believed in myself.

TABLE OF CONTENTS

ABSTRACT i

ACKNOWLEDGEMENTS ii

DEDICATION iii

LIST OF ABBREVIATIONS vii

LIST OF FIGURES viii

LIST OF PLATES ix

LIST OF TABLES x

CHAPTER 1:Introduction 1

1.1 Background 1

1.2 Problem Statement 1

1.3 Objectives 2

1.4 Research Questions 2

1.4.1 Primary Research Questions 2

1.4.2 Secondary Research questions 2

1.5 Conceptual Framework 3

1.6 Methodology 6

1.6.1 Primary Data Collection 6

1.6.2 Secondary Data Collection 8

1.6.3 Data Analysis and Presentation 8

1.7 Limitations 8

Chapter 2 : Literature Review 11

2.1 Disaster Occurrence and Losses 12

2.2 Vulnerability and Risk 13

2.3 Acceptable Risk 13

2.4 Settlement of high risk areas 13

Chapter 3 : Overview of the Study Area 15

3.1 Location 15

3.2 Environmental Conditions 19

3.2.1 Geological Setting 19

3.2.2 Climatology 23

3.2.2.1 Temperature 23

3.2.2.2 Precipitation 23

3.3 Community Status 24

3.3.1 Income level 24

3.4 Demographics 26

3.5 Vulnerability Analysis 28

3.5.1 Hazards 28

3.5.2 Critical Facilities and Economic Analysis 31

3.5.3 Social Analysis 33

3.5.4 Environmental Analysis and Mitigation 34

Chapter 4 :Awareness and Perception of Existing Risk 35

4.1 Awareness of Residents 35

4.2 Risk Perception 38

4.3 Risk Communication and Information 39

Chapter 5: Underlying Factors Responsible for Settlement 43

5.1 Economic Factors 44

5.2 Social Factors 46

5.3 Environmental Factors 48

5.4 Political Factors 49

5.5 Approaches to Risk Reduction 49

Chapter 6: The Acceptable Risk Assessment Tool 53

6.1 Applicability of the Tool 53

6.2 Using the Acceptable Risk Assessment Tool 54

6.2.1 Phase 1 Vulnerability Analysis 54

6.2.2 Phase 2 Awareness 55

6.2.3 Phase 3 The level of Acceptable Risk 57

6.3 The Acceptable Risk Scale 62

6.4 Testing the Acceptable Risk Tool 65

6.5 Limitations and Recommendations 68

Chapter 7: Conclusions and Recommendations 70

References 74

Appendix 1 :The Questionnaire xi

Appendix 2 : **Risk Tables** xviii

Appendix 3: Terms and Definitions xxiv

LIST OF ABBREVIATIONS

B-tool - Benchmarking Tool.

CRED- Centre for Research on the Epidemiology of Disasters

EIA - Environmental Impact Assessment

EM-DAT- The CRED International Disaster Database

GPS - Global Positioning System

IRIN –Integrated Regional Information Network

JMD - Jamaican Dollar.

NOAA CVAT- National Oceanic Atmospheric Administration Community Vulnerability Assessment Tool

SPSS - Statistical Package for Social Sciences

UNDRO- United Nations Disaster Relief Organization

UN- United Nations

UNDP- United Nations Development

WRA- Water Resources Authority

LIST OF FIGURES

Figure 1:Conceptual Framework Flow Chart 5

Figure 2: Location of Caribbean Terrace and Port Royal.....17

Figure 3 : Map of Caribbean Terrace study area 18

Figure 4: Map of Port Royal study area.....18

Figure 5: Structural map of fault traces in Jamaica 21

Figure 6: Geological Zonation map of Jamaica 22

Figure 7: Average monthly income in Caribbean Terrace.....25

Figure 8:Average monthly income in Port Royal 25

Figure 9: Size of households in Port Royal 27

Figure 10:Size of households in Caribbean Terrace 27

Figure 11:Damaged homes in Caribbean Terrace 29

Figure 12: Kingston Zonation Map 32

Figure 13: Risk Awareness in Caribbean Terrace 35

Figure 14:Risk Awareness in Port Royal 36

Figure 15: Risk Communication in Caribbean Terrace.....39

Figure 16:Risk Communication in Port Royal 40

Figure 17:Flowchart outline of Acceptable Risk Procedure 58

Figure 18: The Acceptable Risk Assessment Tool 59

Figure 19:The Acceptable Risk Scale 64

LIST OF PLATES

Plate 1: Damaged homes along the seaside in Caribbean Terrace……30

Plate 2: Abandoned severely damaged home in Caribbean Terrace……30

Plate 3: Homes in Port Royal ……42

LIST OF TABLES

Table 1 Elderly and disabled population within the study area……..33

Table 2: Knowledge prior to settlement in Caribbean Terrace……..37

Table 3: Knowledge prior to settlement in Port Royal……37

Table 4: Factors affecting settlement……43

Table 5: Perception of mitigation in Caribbean Terrace and Port Royal…..51

Table 6: Types of Insurance used in Caribbean Terrace……..51

Table 7: Phase 2 Awareness Scores……55

Table 8: Phase 2B Categories of Unawareness……56

Table 9: Risk Table……63

Table 10: Test 1 results……65

Table 11: Test 2 results……67

Chapter 1

1.1 Background

This study was conducted in order to address the issues regarding the settlement of Caribbean Terrace and Port Royal, two areas which face significantly high risk from natural hazards and their associated processes. It seeks to examine the major factors responsible for the settlement of the area despite the existing risk, taking into account, both the perceptions of the residents as well as the physical and societal conditions present .This study also seeks to make a contribution to the field of disaster management in the creation of a tool to aid disaster managers in determining the level of acceptable risk in an area. It is the hope of the researcher that this instrument will become an effective tool in disaster management planning, and will be used to provide insight on various levels of risk acceptance within communities and contribute to the risk reduction process.

1.2 Problem Statement

The island of Jamaica is susceptible to a variety of different hazards which emphasizes the need for proper disaster management. One of the most fundamental roles of disaster agencies is to promote and create conditions for disaster risk reduction, but in order for this to be efficiently executed; the concept of risk must first be understood in its entirety. In the past, greater focus has been placed on the different categories of risk rather than the different types. As such, there has been a lack of focus on the issues regarding acceptable risk which in

turn, creates gaps in the risk reduction process. In order to address this inadequacy, this study will investigate the underlying factors responsible for acceptable risk, and will seek to design a tool that can be used in its assessment.

1.3 Objectives

For this research two major objectives were outlined. These were:

1. To determine the underlying factors responsible for acceptable risk in Caribbean Terrace and Port Royal, Jamaica.
2. To produce a tool to be used in the assessment of acceptable risk within communities.

1.4 Research Questions

In order to achieve the outlined objectives, specific research questions were structured to give direction to the study in terms of research and data collection. These questions were divided into primary and secondary categories.

1.4.1 Primary Research Question

This study was intended to address a two pronged question; the first part questioned the underlying factors responsible for acceptable risk in both Caribbean Terrace and Port Royal, Jamaica. The second part examined what would be the most appropriate tool for assessing the levels of acceptable risk.

1.4.2 Secondary Research Questions

Two secondary research questions were used to structure the study and supplement findings. The first question examined the possibility of any

dominant trends concerning perceptions of risk and factors for settlement, while the second question focused on the origins of these factors.

1.5 Conceptual Framework

The conceptual framework was designed based on the issues governing the research. This framework was able to provide additional guidance and distinct direction to the research highlighting the major theories on which this research was grounded; this is illustrated in Figure 1. Within the study area, many hazards occur, namely those of a seismic and atmospheric nature, such as earthquakes, hurricanes, flooding and storm surges which have the capacity to cause considerable damage to the existing communities' of Caribbean Terrace and Port Royal.

Within the communities, the impacts of hazards are felt in the different aspects of the society, specifically the economic, socio-cultural, political and environmental sectors. At the interface between these societal factors and hazards lies vulnerability, the interaction has a significant impact on the community directly affecting the level of risk within the area.

Vulnerability and risk play an integral role in the willingness of the population to inhabit certain areas. In most cases however, elements may exist or action is taken to reduce vulnerability and in doing so minimize risk. For example, the frequency at which hazards may occur, the availability and affordability of insurance as well as, the introduction of structural and non structural mitigation methods can all act as push or pull factors for

settlement. These characteristics can either encourage residents to stay, by increasing home and livelihood safety or may prove to be ineffective or unattainable therefore deterring settlement.

As illustrated in Figure 1 the instrument for assessing acceptable risk cannot be constructed without first understanding what the underlying reasons for acceptable risk are, and how interaction with other factors can influence settlement.

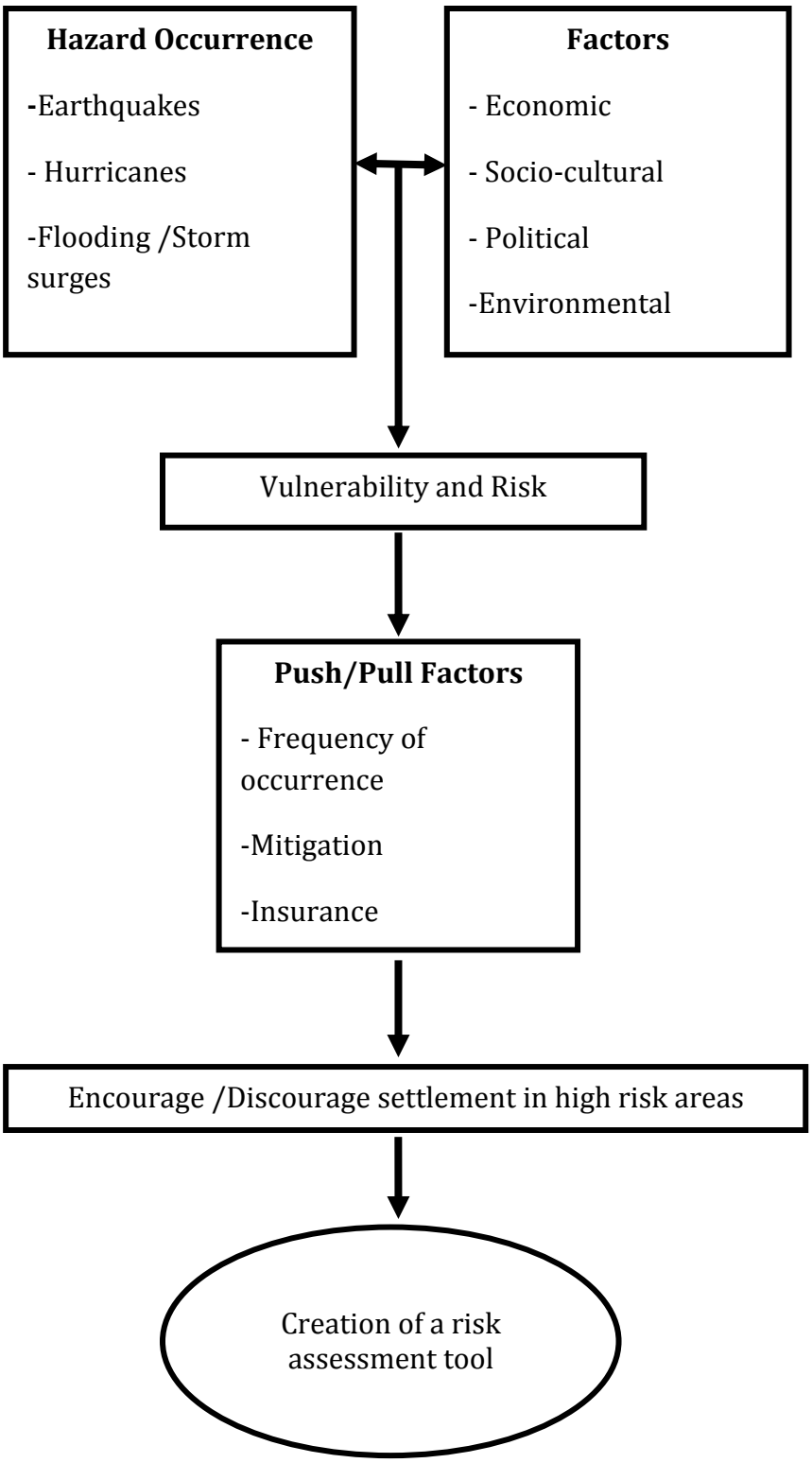

Figure 1: Conceptual Framework Flow Chart

1.6 Methodology

In order to address the research questions and achieve the stated objectives a mixed methodology approach was adopted. This was selected due to the nature of the project as it was based on deduction from a natural science point of view as well as induction based on the views of stakeholders within the communities. Quantitative analysis was used in the identification of hazards and the assessment of vulnerability existing within the study area. Qualitative analysis on the other hand, was used to examine the perceptions of risk held by the residents of the respective communities of Caribbean Terrace and Port Royal. Data collection was divided into primary methods, which involved mainly field work, and secondary methods which involved a review and analysis of existing literature.

1.6.1 Primary Data Collection

The field work component was carefully planned before it was executed in order to increase efficiency. The first field visit was essentially used for reconnaissance, where a general survey of the area was conducted, and this information was used to plan the next field visits. The second site visit was used to assess vulnerability of the area. This assessment was done according to the steps outlined in the National Oceanic and Atmospheric Administration Community Vulnerability Assessment Tool (NOAA CVAT). Photographs were also taken to supplement findings and record the condition of the site.

The second stage of field work utilized qualitative methods of data collection namely the distribution of questionnaires (Appendix 1) to residents of Caribbean Terrace and Port Royal. Prior to administering the questionnaire, the researcher familiarized herself with the layout of the communities during the vulnerability assessment; utilizing the opportunity to pilot test the questionnaire. This also allowed for the researcher to introduce herself and her study to the members of the community and encourage their participation.

The instrument was divided into different sections to obtain baseline data, and uncover the driving forces responsible for settlement of the area. The method of sampling used for questionnaire distribution was random sampling; this technique was selected in an attempt to collect a true and unbiased representation of the views of the community and also to ensure that statistical conclusions will be valid.

Finally, focus group interviews (Appendix 1) were conducted with a select group of residents from each community in order to obtain additional information and more detailed answers than allowed for in the questionnaire. This method allowed residents to openly address questions and share their comments, concerns and experiences, thereby producing a more comprehensive response. Structured, formal interviews were also prepared for interviews with representatives from insurance and planning

agencies. These however were not fully utilized due to limitations in the interview process.

1.6.2 Secondary Data Collection

Secondary sources of data collection played an integral role in this study and were used ascertain additional information, before and after field visits. The sources used were from previous and ongoing studies, peer reviewed articles, publications and reports from local disaster agencies, books and credible internet sources. The data were analyzed and integrated into the primary research findings.

1.6.3 Data Analysis and Presentation

As mentioned before the vulnerability of the area was assessed and analyzed using the National Oceanic and Atmospheric Administration Community Vulnerability Assessment Tool (NOAACVAT). This tool was selected because of its ability to link economic, environmental social data and target key areas within communities which were impacted on by hazards and for its applicability to coastal communities.

The data collected from focus group interviews were subjected to content analysis, while the data obtained from the questionnaires were analyzed using the Statistical Package for Social Sciences (SPSS) software .This software was selected for its utility in the analysis of empirical data. The results of the questionnaires were first coded and then entered into the programme to create variables. This data were then used to generate

frequencies, graphs, tables and charts, which allowed the data to be easily represented and interpreted. Further analysis was then conducted by creating cross tabs and administering the statistical tests. The degree of freedom was calculated, and the Chi squared test administered in order to uncover any existing relationships between the variables. The data were then further manipulated to determine the strength and direction of these relationships. This was done by using the Contingency coefficient and Strength tables. The information was then compiled and presented in the form of a literature write up, with the aid of maps, charts, graphs, diagrams and photographs.

1.7 Limitations

In the execution of this study, several limitations arose. Obstacles were experienced in the data collection process, specifically with the distribution and answering of the questionnaires. The primary problem was the risk that the questions would be misunderstood. There was also the issue of reluctance in some instances by residents to share information. Attempts to overcome these limitations were made by having the researcher and assistants administer the questionnaire to the subjects, and by structuring questions so that they were easily understood and correctly interpreted, and at the same time, not requesting sensitive information.

The greatest obstacles were encountered in conduction of interviews with representatives from government ministries and agencies. Due to the

sensitivity of the issues regarding risk, disasters, building permits and insurance, the interviewees were uncomfortable answering questions, and not only refused to give certain information, but also did not allow the researcher permission to use their names and job titles in this paper.

Limitations also arose in the secondary data collection process, as there was limited demographic information available on the study area, and the time frame and scope of the project did not allow for it to be collected, therefore, dependence was placed on the limited existing demographic information. Finally, the amount of literature on the topic of study was limited, as acceptable risk with respect to disaster management scenarios, is still a relatively new concept.

Chapter 2

Literature Review

2.1 Disaster Occurrence and Losses

According to IRIN reports (2005) natural disasters are becoming increasingly frequent occurrences, and with that, are having a more significant impact on the world. According to EM-DAT records (2008), a global disaster database maintained by the Centre for Research on the Epidemiology of Disasters (CRED) based in Brussels, Germany, 600 disasters occur globally each year. “Over the past decade, the total affected by natural disasters has tripled to 2 billion” (IRIN 2005). In fact the IRIN reports indicate that “while the number of lives lost has declined in the past 20 years - 800,000 people died from natural disasters in the 1990s, compared with 2 million in the 1970s - the number of people affected has risen” (2005). Despite advances in mitigation and early warning systems, hazards continue to cause “tens of thousands of deaths, hundreds of thousands of injuries, and billions of dollars in economic losses each year around the world” (Dilley et al. 2005).

It is then needless to say that, the extent of losses incurred is significant. Dilley and others (2005) state that “disaster losses are caused by interactions between hazard events and the characteristics of exposed elements that make them susceptible to damage.” A hazard's destructive potential is a function of the magnitude, duration, location and timing of the event (Burton *et al.,* 1978).To be damaged, however, elements exposed to a given type of

hazard must also be vulnerable to that hazard; that is, the elements must have intrinsic characteristics, or vulnerabilities, that allow them to be damaged or destroyed (UNDRO 1979).

2.2 Vulnerability and Risk

There are many variations for the term vulnerability, Wisner et al. (1997) defines it as "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard." Coburn et al. (1994) describes risk as "the expected losses from a given hazard to a given element at risk, over a specified future time period. According to the way in which the element at risk is defined, the risk may be measured in terms of expected economic loss or in terms of numbers of lives lost or the extent of physical damage to property."

The concept of risk is not uniformly accepted, in fact Coburn (1994), goes on to explain, that the conditions within an area determine whether natural hazards take precedence within the community, stating that "decisions are made and actions are taken according to the way that risks are perceived" and that "perception of risk can differ from one group to another." Therefore, a relationship is said to exist between risk perception and risk response. Eventually however, the severity of the threat becomes too immense and "at some level the risk becomes unacceptable, what level constitutes the risk is always a complex issue" (Coburn et al. 1994).

2.3 Acceptable Risk

Lowrance (1976) wrote, "A thing is safe if its risks are judged to be acceptable" this is contrasts with Krewski's notion that "safety is a generally an unachievable goal" (2008). Krewski goes on to state that "acceptable risk describes the likelihood of an event whose probability of occurrence is small, whose consequences are so slight, or whose benefits are so great, that individuals or groups in society are willing to take or be subjected to the risk that the event might occur"(2008). The concept of acceptable risk is closely tied to that of tolerable risk as "a risk is acceptable when it falls below an arbitrary defined probability; it falls below some level that is already tolerated" (Fewtrell and Bartram 2001).

2.4 Settlement in high risk areas

With the increase in disaster occurrence, the rate of urbanization and population growth, it is becoming increasingly difficult to find suitable housing that has not at least once been exposed to some type of hazard. In fact, "there is greater settlement in high-risk areas such as flood plains, earthquake faults, coastal hurricane areas, unstable hillsides, areas subject to wild land fires, and areas adjacent to hazardous waste landfills, airports, and nuclear power plants" (Petak et al. 1985)

According to the UN's Bureau for Crisis Prevention and Recovery (2003), approximately 75 percent of the world's population resides in areas that have been affected at least once by an earthquake, a tropical cyclone, flooding

or drought between 1980 and 2000. The Manual for Development states that "poor site location is a common cause of the financial failure of housing developments" (1982).

In most cases however, the occurrence of hazards is not enough to deter settlement, for example with the case of flash flooding in the United States, it was found that "de-spite the fact that flood losses are increasing each year, people almost invariably move back into the same area after a flood, and sometimes in even greater numbers" (Cigler, 1986).

Chapter 3

Overview of the Study Area

In order to ensure a comprehensive study, baseline data was collected on the conditions existing within the study area of Caribbean Terrace and Port Royal. Caribbean Terrace was a planned, middle class residential, coastal settlement in eastern St .Andrew done without an EIA, and the aim was to create housing targeting mainly civil servants. Many of the residents who originally purchased the homes were workers at the nearby Caribbean Cement Company. Due to the fact that no vulnerability analysis was done prior to the construction of the settlement, the community was built in a very unsafe area, along the coast line and in close proximity to the Hope River Delta, making it highly susceptible to a variety of different hazards.

Port Royal on the other hand is another coastal town, but with a rich history, founded in 1518, what was once the centre of shipping and commerce in the Caribbean is now a small fishing town with great historic significance. At present, the government of Jamaica has plans set for further development of the area as a tourist attraction.

3.1 Location

The island of Jamaica situated in the north western portion of the Caribbean, to the west of Hispaniola and south of Cuba, with an area of 11,264 square km, with an additional 9,600 square km of offshore banks and shoals, lying at the eastern end of the Nicaraguan Rise (Donovan and Jackson, 1994). The communities of Caribbean Terrace and Port Royal both lie on the south

eastern side of the island. Port Royal is located at the end of the Palisadoes and Normal Manley Highway. Caribbean Terrace, is not only located along the coast line but also in close proximity to the Hope River Delta .It lies east of the Kingston the capital along the A4 roadway and near to the Harbour View community . It is important to note that due to the location of Port Royal, there is only one access route connecting the community to the main land, this route itself, is susceptible to flooding. The locations of both communities are shown in together in Figure 2 and in Figures 3 and 4 respectively.

Figure 2: Location of Port Royal and Caribbean Terrace. Source: National Land Agency.

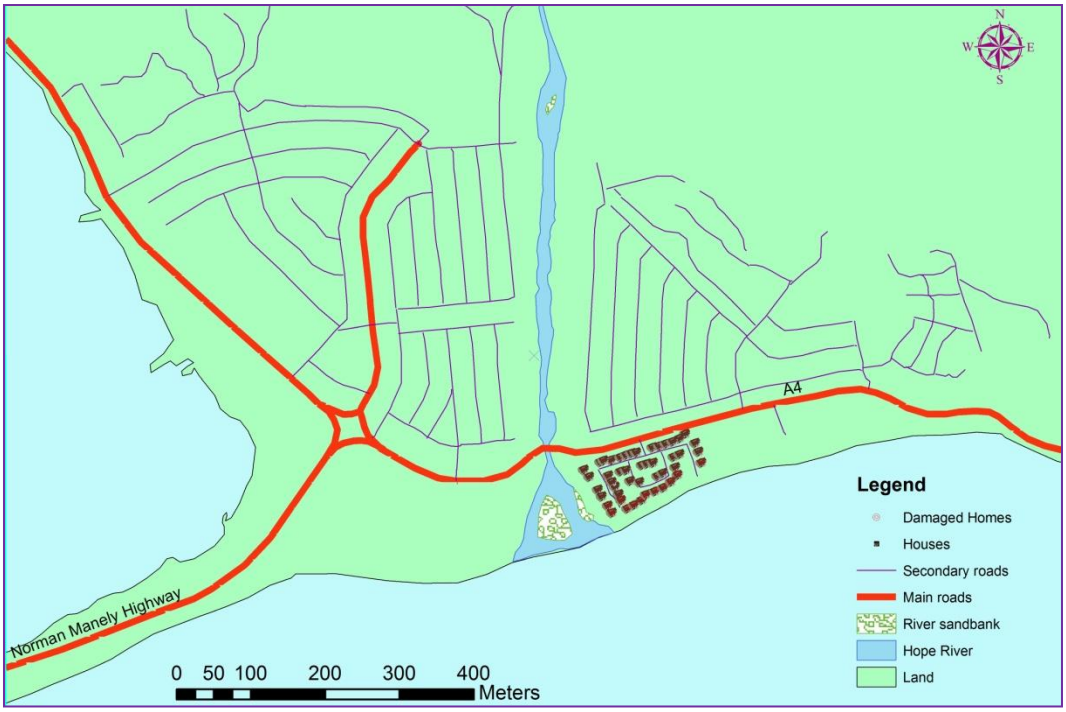

Figure 3: Map of Caribbean Terrace study area. Created by Rishma Maharaj (2010).

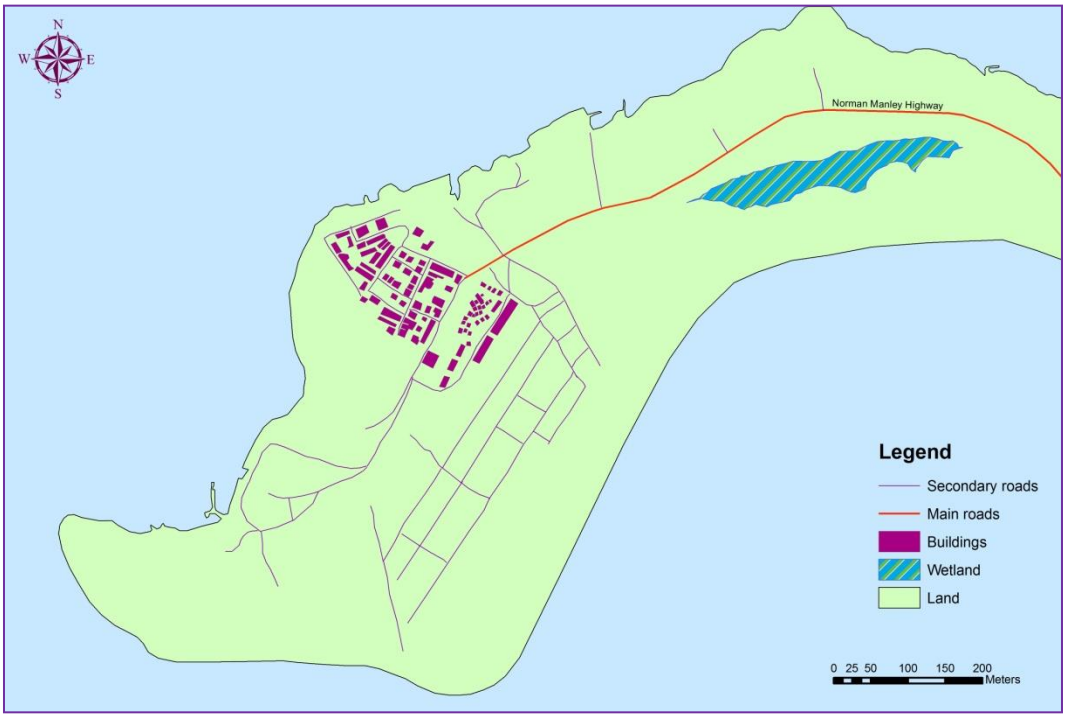

Figure 4: Map of Port Royal study area. Created By Rishma Maharaj (2010).

3.2 Environmental Conditions

The environmental conditions of an area have a major influence on the processes which occur .The importance of analyzing the environment can be seen when one considers that the majority of the world's environmental problems are largely the result of human social actions of behavior (Maxwell, 2000). Cave (1998) states that "our behavior is influenced by some aspect of the environment that we are in at the time; whether it is the buildings, the scenery or the people we are with".

3.2.1 Geological Setting

Jamaica can be divided into eleven different geological groups, these being the costal group, white limestone super group, yellow limestone group, Newcastle volcanic, Richmond formation, Wag Water formation, Granodiorite, Sedimentary and Volcanic rocks, Serpentine, and Schist. The island's interior is mountainous, with peaks in the east rising to as high as 2255m, the Blue Mountains, while the remainder is basically a dissected limestone plateau with heights of over 900m, and displays a rugged Karsts landscape. Approximately two thirds of the land is covered by soils which are underlain by limestone, the remaining portion is composed of Conglomerates, Tuffs, Shales, Igneous and Metamorphic rocks (Donovan and Jackson, 1994).

The topography of Jamaica can be divided into two major categories, a highland interior and off course a relatively flat coastal periphery (Donovan

and Jackson 1994). In terms of soils, the island is able to boast a wide variety, as a result of the variability of parent material, topography and rainfall. According to Figure 6, the Geological Zonation Map, the study area is composed primarily of alluvium, and lies at approximately sea level. Alluvium can be described as either unconsolidated, soils or sediments, which have been eroded or deposited, composed of a variety of different materials such as silt, clay sand or gravel. Alluvium is relatively young falling into the Quaternary age (Yilmaz and Karacan, 1997). As seen in Figure 5, a Structural Map of Fault Traces in Jamaica, faults are present in the area; with close proximity to Harbour View. Underlying faulting has a significant impact on the overlying stratigraphy as these geological conditions play an important role with respect to the level of vulnerability and can even impact hazard occurrence.

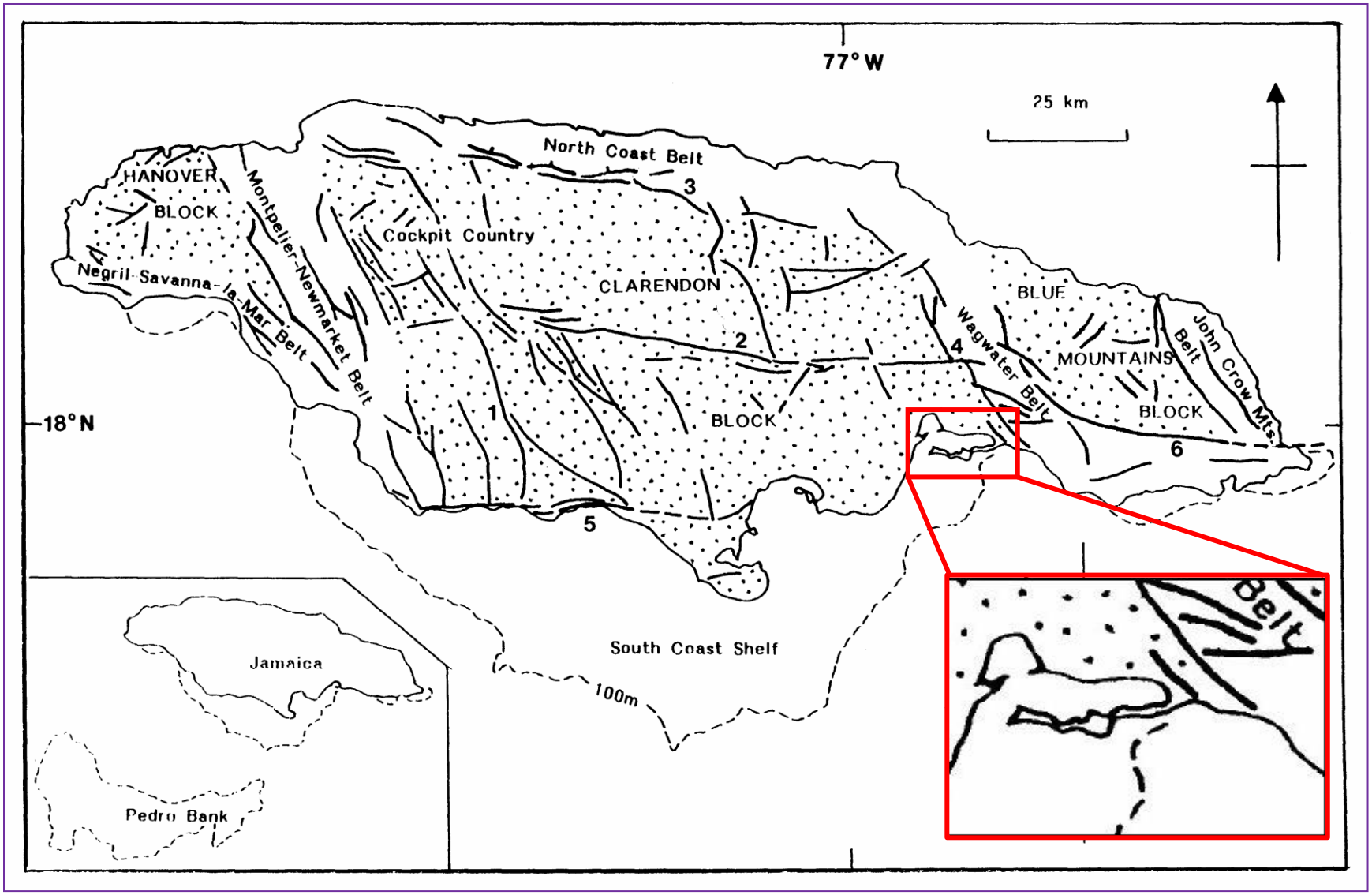

Figure 5: Structural Map of Fault Traces in Jamaica. Source Draper 1986

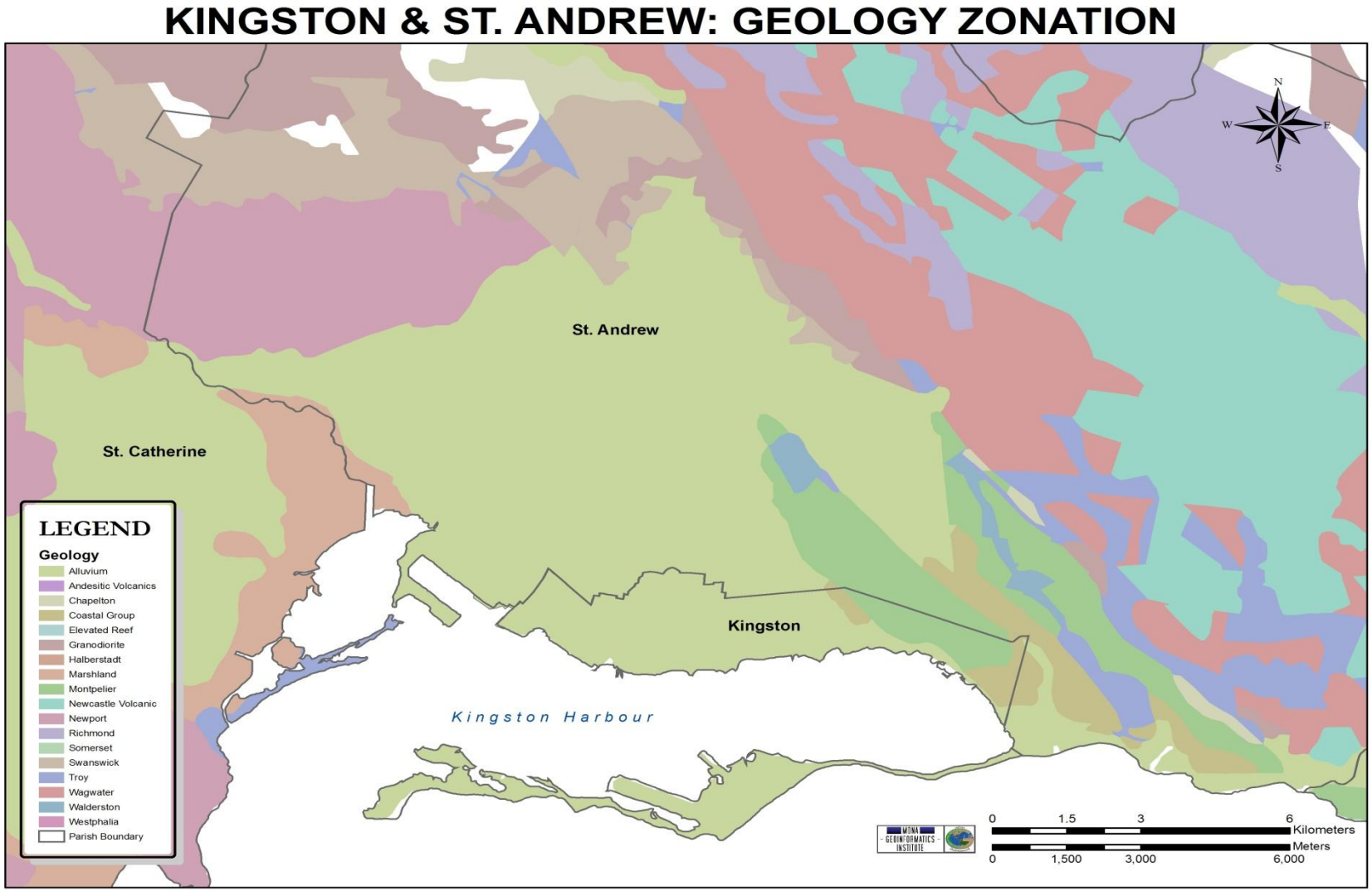

Figure 6: Geological Zonation map of Jamaica. Source: Mona Geoinformatics (2007)

3.2.2 Climatology

The climate of Jamaica is essentially tropical marine. Due to its coastal location, the area is heavily influenced by the ocean although it is possible for urban development to at times negate this effect.

3.2.2.1 Temperature

According to the Water Resources Authority (WRA) the mean daily temperatures range from seasonal lows of 26°C in February to a high of 30°C in August (2010). The average temperature change with altitude is by 2°C with every 300 meters .Kingston temperatures are similar with highs of 34°C and lows of 25°C.

3.2.2.2 Precipitation

Precipitation in Jamaica varies seasonally and spatially, the island experiences two main rainy periods, the first from May to June and the second from September to November. During these periods the island is susceptible to the influence of tropical storms and hurricanes which can produce high intensity and magnitude rainfall. Long term mean annual rainfall is 1,981 mm (WRA, 2010). The heaviest rainfall is over the Blue Mountains, which receive over 5,080 mm. The Kingston St. Andrew area is located within the rain shadow of the Blue Mountains, this affects the moisture brought in by the Northeast trade winds, indicating that Kingston is very dry in comparison to parishes on the windward side of the mountains, as it receives less than 726 mm annually (WRA, 2010).

3.3 Community Status

Caribbean Terrace, as mentioned before is an upper to middle class community. There is some existing controversy over the establishment of this community with conflicting information collected from residents, stating that it was purposefully constructed for permanent settlement, however sources from government agencies who wish to remain anonymous revealed to the researcher that this community was originally planned for vacation homes rather than permanent residents. However, in both the study areas of Caribbean Terrace and Port Royal, 100% of the population sampled stated that they were permanently settled in their respective communities.

3.3.1 Income level

In terms of the financial standing, significant differences were found within both study areas. Results of the questionnaire indicated that in Caribbean Terrace 30% of the population sampled made over $120000.00 JMD per month and 50% earned between $80000.00 to $120000.00 JMD with the final 20% earning between $40000.00 and $80000 JMD per month. This is illustrated in Figure 7 which shows average monthly income of the sampled Caribbean Terrace residents.

As seen in Figure 8, average monthly income of Port Royal, the results suggest that it is a significantly poorer community with 30% of the 60 respondents sampled earning less than JMD $40000.00 per month, and 13.3% having no regular income at all. Only 10% of respondents sampled

earned between $80000.00 and $120000.00 JMD, while the remaining 46.7% fell into the $40000.00 to $80000.00 JMD income bracket.

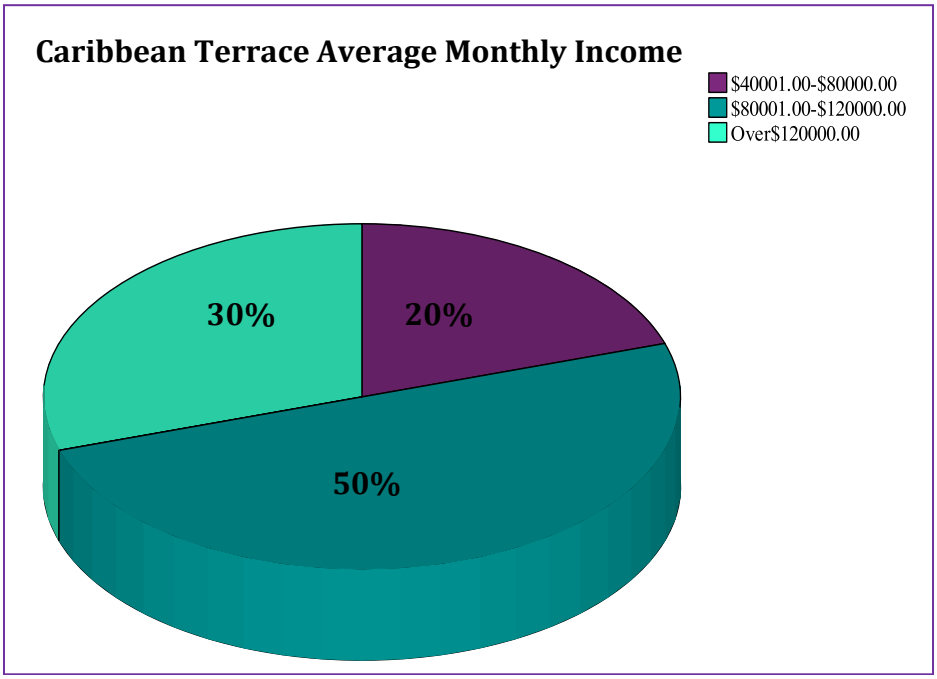

Figure 7: Average monthly income in Caribbean Terrace

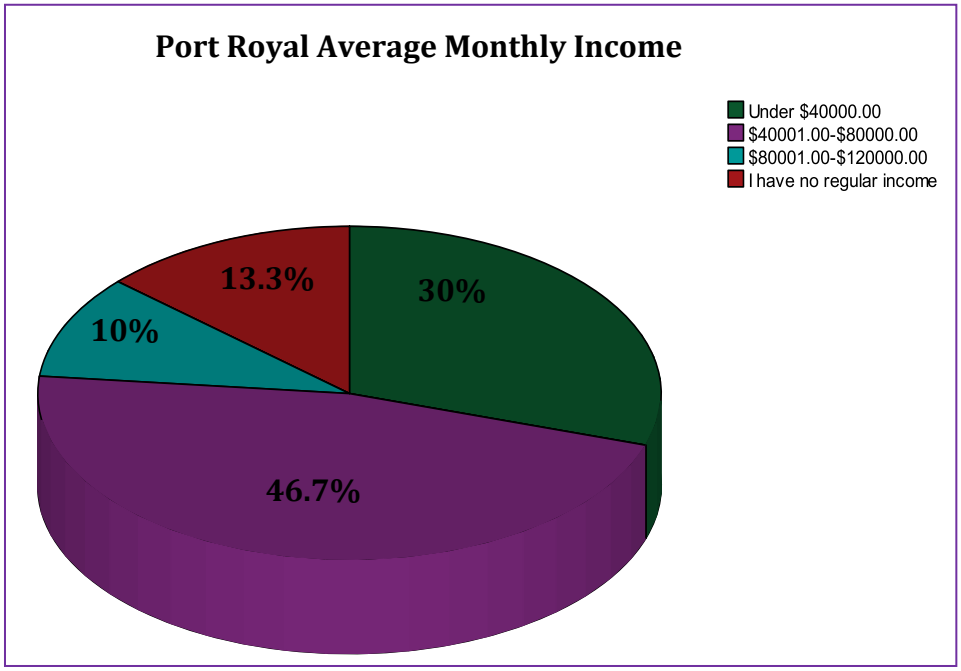

Figure 8: Average monthly income in Port Royal.

During focus group interviews it was found that the majority of the residents in Caribbean Terrace were employed in the private or public sector, the majority being public sector employees, mainly civil servants. In Port Royal however, the majority of the population sampled were self employed, typically fishermen or fishmongers. Significant percentages of the population sampled were unemployed, and supported themselves on remittance from foreign relatives. The small percentage who maintained a substantial steady income were involved in small businesses operating within the area such as small restaurants or shops.

3.4 Demographics

Another variation between both communities was the size of household. Results of the questionnaire indicate that the average size of household in Caribbean terrace was significantly smaller than that of Port Royal. As illustrated in Figure 9, 76.6 % of households in Caribbean Terrace were occupied by 2-5 people and 23.3 % by 6-10 people. Figure 10 shows that only 10% of the population sampled in Port Royal lived in households with 2-5 people but the majority lived either with 6-10 people (53.3%) or over 10 people (36.7%).

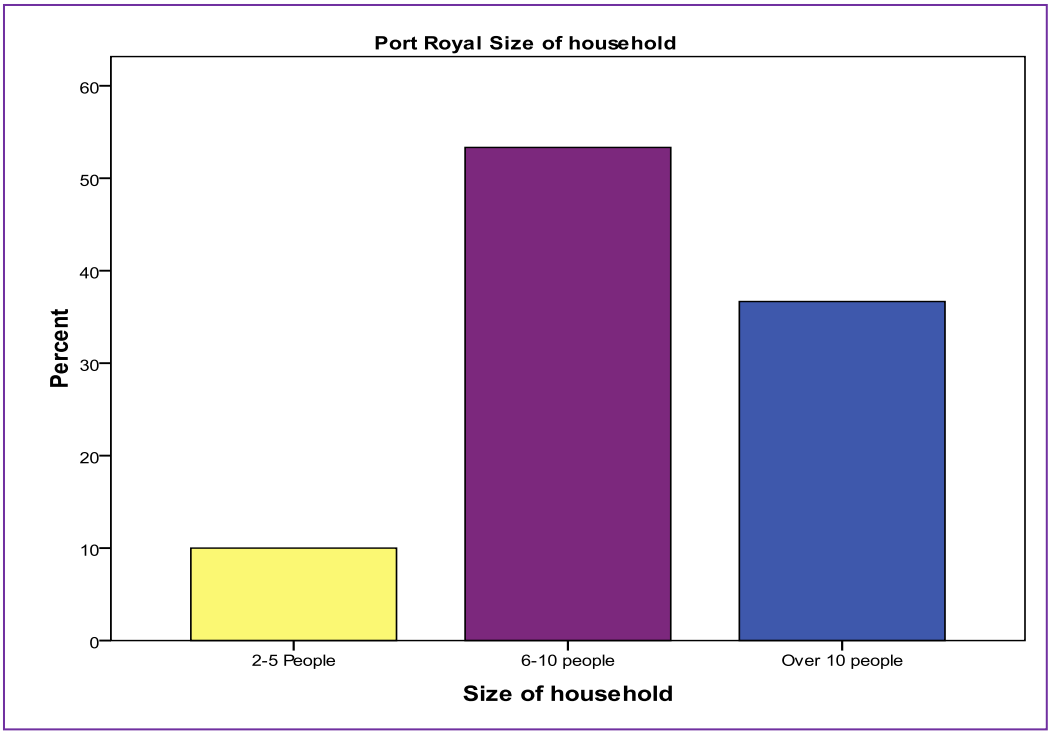

Figure 9: Size of households in Port Royal

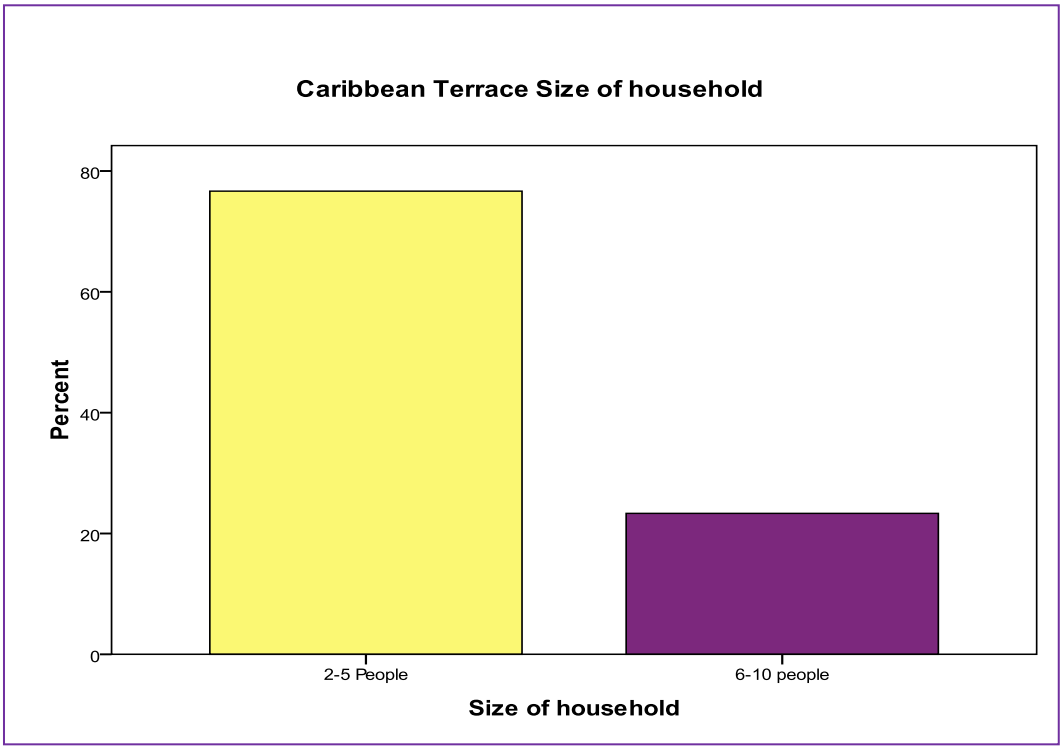

Figure 10: Size of households in Caribbean Terrace.

3.5 Vulnerability Analysis

The nature of the study area played a significant role in the selection of a vulnerability and risk assessment tool. For the purposes of this research the NOAA CVAT was selected, based on time constraints and the fact that both study areas were small coastal communities. The main purpose of this tool is to uncover and link the different aspects of vulnerability, namely economic, environmental and social data in the coastal zone. The following is an analysis of the data collected at each step.

3.5.1 Hazards

Burton (1978) defines natural hazards as "those elements of the physical environment, harmful to man and caused by forces extraneous to him", however, with time the definition of a hazard has evolved to encompass causes from both natural and anthropogenic factors, and at times, a combination of both. Linkages are apparent between the different hazardous process occurring in Caribbean Terrace, the primary hazards are namely storm surges and resulting flooding. These storm surges are generated by high winds moving over the ocean surface, which are typically triggered by atmospheric hazards such as hurricanes and storms. Many of the homes located directly along the coast have been so severely damaged that residents have been forced to evacuate. These are seen in Figure 11, the homes in red are unoccupied as the damage inflicted by hazards have been so severe that they are now uninhabitable. Plates 1 and 2 show the extent of the damage to the houses located directly along the coastline.

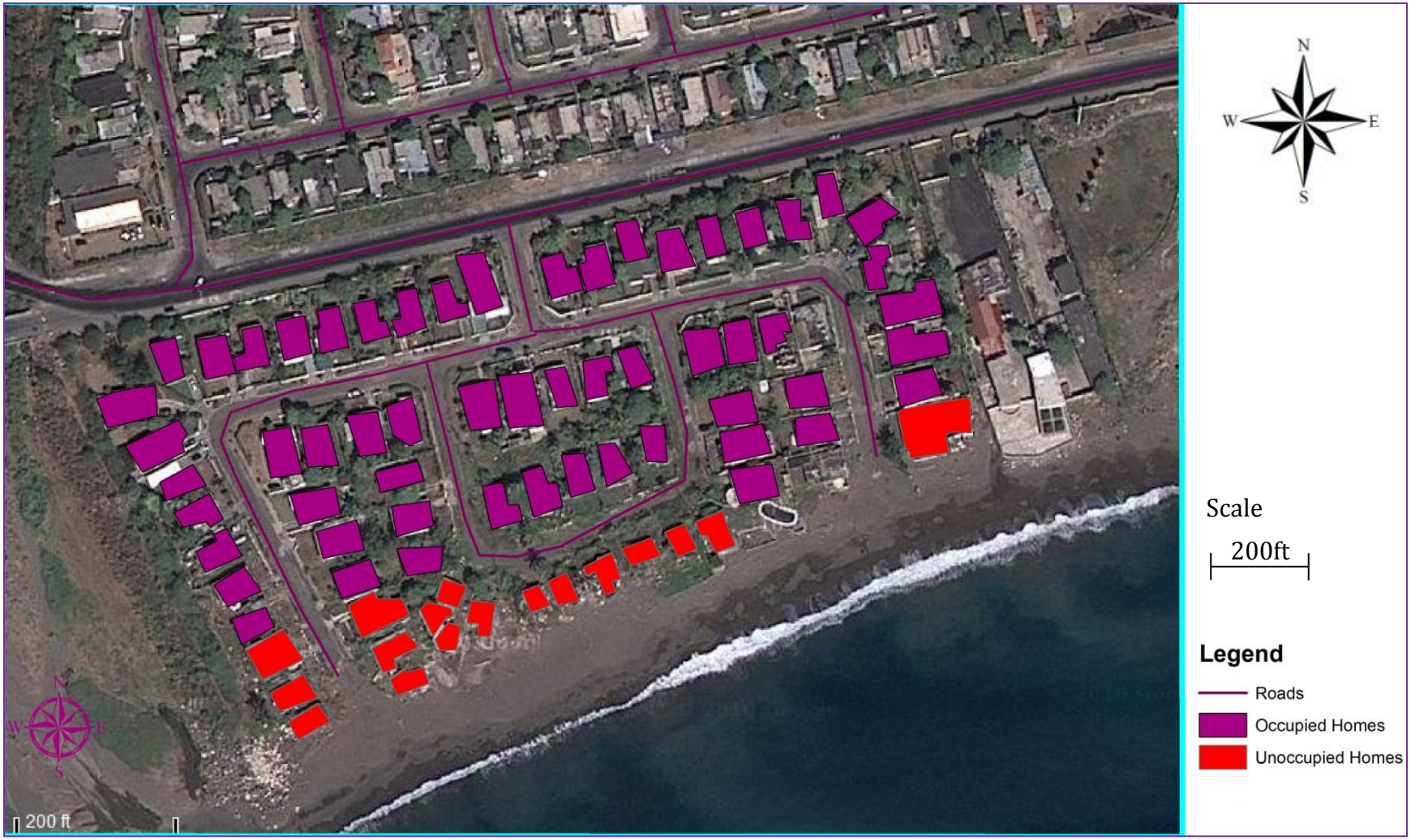

Figure 11: Damaged homes in Caribbean Terrace.

Created by Rishma Maharaj; source image: Google Earth 2010.

Plate 1: Damaged homes along seaside in Caribbean Terrace.

Plate 2: Abandoned severely damaged home in Caribbean Terrace.

The seaside community of Port Royal is highly susceptible to flooding, storm surges and tsunamis generated by earthquakes or submarine landslides. Port Royal is built on a giant sand bar, when this sand becomes loose and saturated with water it's integrity is compromised. The soil type in the area, due to large amounts of deposits and alluvium, makes the area prone to earthquakes and its related processes such as liquefaction.

3.5.2 Critical Facilities and Economic Analysis

The primary land use in both study areas are for residential purposes, as seen in Figure 12, hence only two critical facilities were identified, these are the Donald Quarrie High School(on the periphery of Caribbean Terrace) and the Port Royal Police Post. There are also no economic sectors within the communities aside from small local restaurants and shops in the Port Royal area.

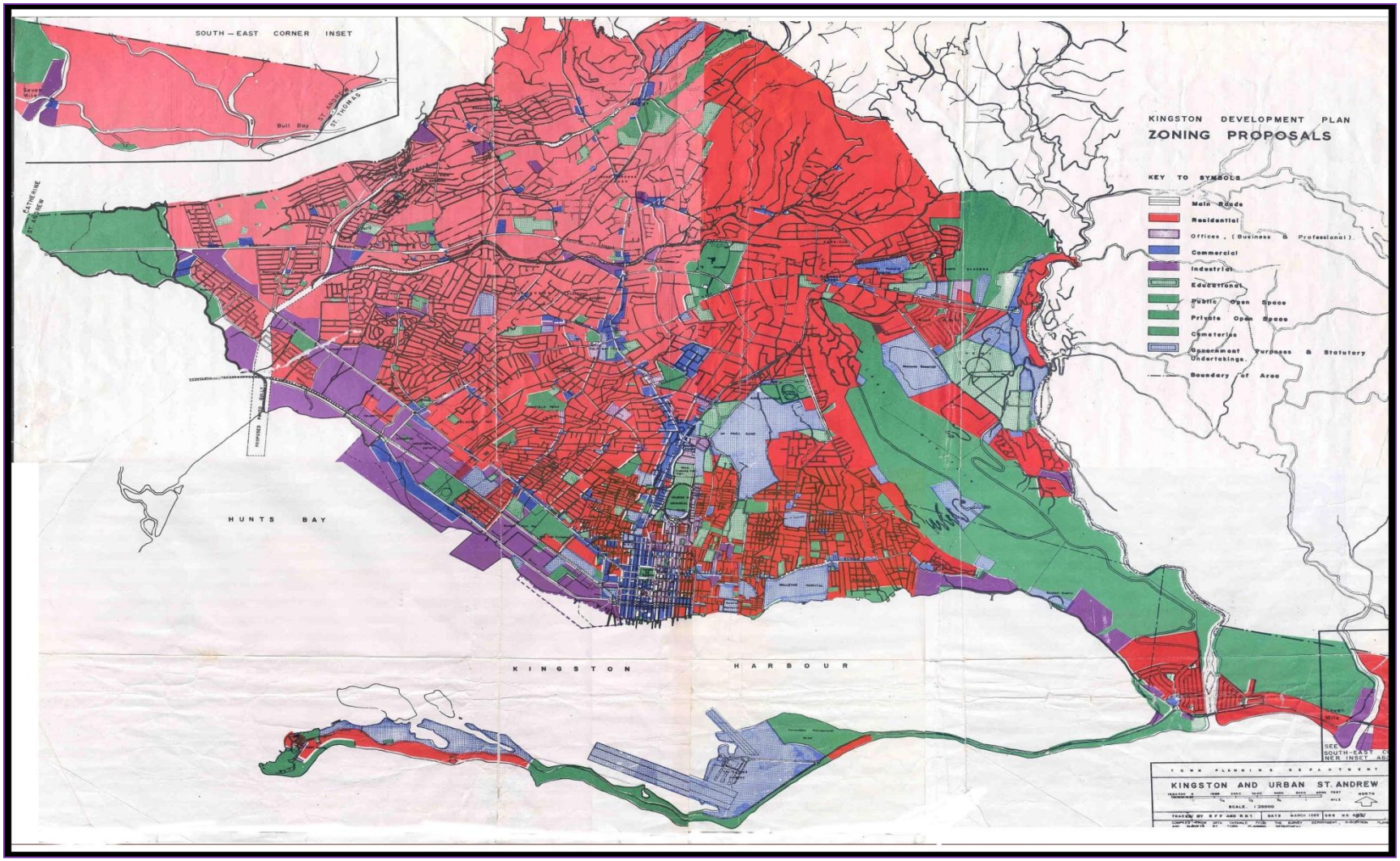

Figure 12: Kingston Zonation map. Source: Kingston and Urban St. Andrew Town Planning Department.

3.5.3 Social Analysis

The social analysis took into account areas of special concern such as situations where personal resources for dealing with the hazards are limited or where there is heavy reliance on public resources. These are essentially the more vulnerable members of society. In every community there are members who are less able to look after themselves even in regular situations, which highlight the requirement for extra care during disaster events.

The elderly and disabled are two groups which make up a significant percentage of the dependant population, due to their need for assistance with mitigation and evacuation if the need should arise. In both study areas, households with elderly or disabled persons were found as seen in Table 1, indicating that there is a need for disaster planning which catered to their special needs.

Population	Caribbean Terrace	Port Royal
Elderly	13.3%	10%
Disabled	5%	8%

Table 1: Elderly and disabled population within the study area.

The issue of ownership can also be a cause for vulnerability, mainly because of the perception of residents, for example people are less likely to insure and spend money on mitigation such as retrofitting on rented property. This can lead to significant losses and increased risk. Aside from housing, mobility

should also be taken into consideration, as households without vehicles indicate serious mobility issues which can pose problems in certain situations, for example when immediate evacuation orders are issued. A large percentage of the respondents sampled, 46.7% in Caribbean Terrace and 86.7 % in Port Royal, did not own vehicles.

Finally, what makes Port Royal a special area of concern aside from its susceptibility to hazards, is the attachment resident's show towards the community. Many residents refuse to leave their homes and property to seek shelter elsewhere, and in many situations, shelters are located in Kingston, which the residents believe to be even more unsafe than their homes.

3.5.4 Environmental Analysis and Mitigation

The purpose of this specific analysis is to identify the different locations where there is potential for secondary environmental impacts from natural hazards as well as to target the vulnerable locations for implementing hazard mitigation activities. Coastal erosion and sedimentation are secondary hazards which can affect the natural and built environment. Several opportunities for mitigation were uncovered. Firstly, homes along the coastline can be retrofitted, and those under serious threat can be relocated. Structures to reduce wave energy and coastal erosion can also be put in place, specifically in the Caribbean Terrace area.

Chapter 4

Awareness and Perception of Existing Risk

4.1 Awareness of Residents

By its definition Acceptable Risk can only be applied when the risks are known, as it is possible that individuals can choose to settle and then inhabit an area for an extended period of time without being fully aware of the level of risk. The survey however, revealed that the majority of residents in both study areas, 93.3% in Caribbean Terrace and 86.7% in Port Royal, were presently aware of the hazards that affect the area . These are illustrated in Figures 13 and 14.

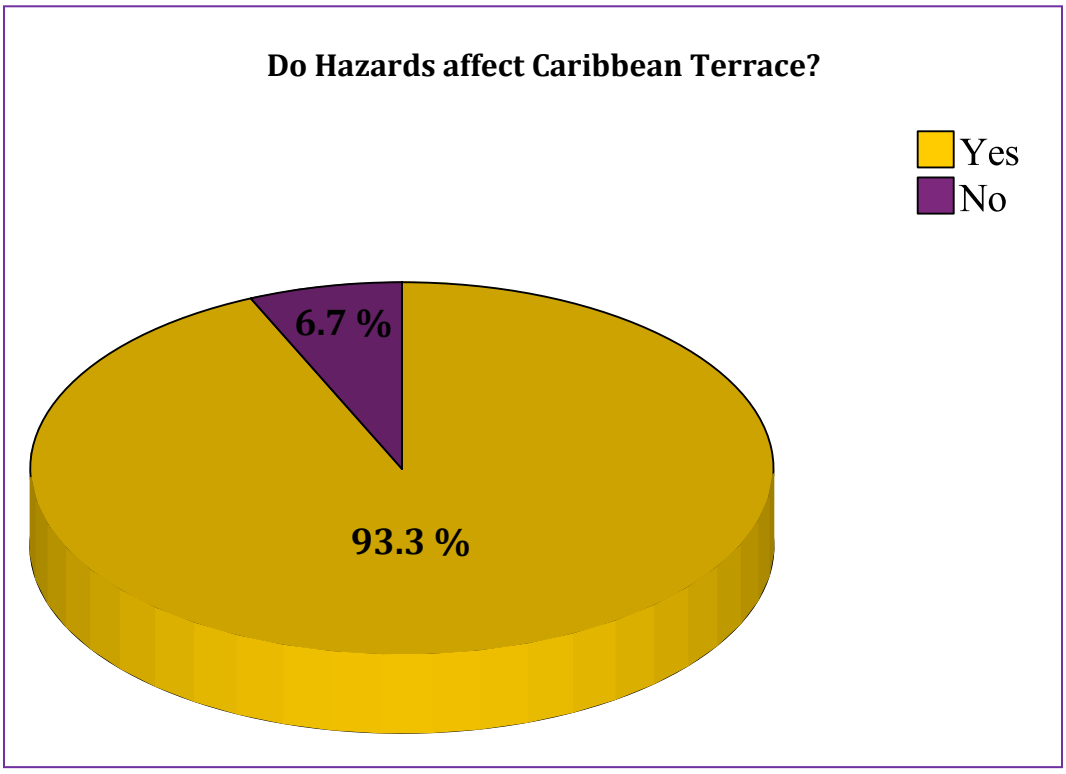

Figure 13: Hazard Awareness in Caribbean Terrace.

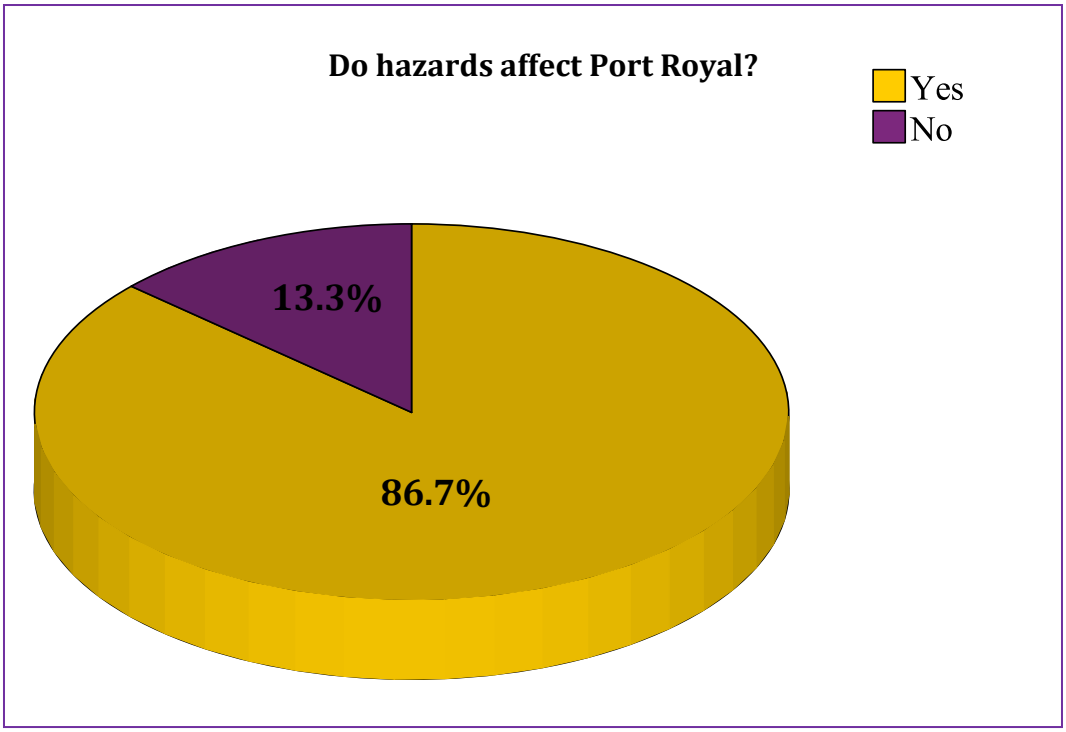

Figure 14: Hazard awareness in Port Royal.

Residents of hazard prone areas must be thought of in two dimensions, those that have always lived there, essentially natives to the area, and those who have moved to the area. Uncovering whether residents knew of existing hazards before settling in an area, is an important indicator of acceptable risk. Contrasting results from both study areas were obtained, firstly, none of the respondents who migrated to Caribbean Terrace had any knowledge of hazards affecting the area prior to settlement. The results to the question of awareness are shown in Table 2.

Knowledge prior to settlement of Caribbean Terrace

Were you aware of existing hazards before moving to the area?		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	0	0.0	0.0	0.0
	No	58	96.7	96.7	96.7
	I have always lived here	2	3.3	3.3	3.3
	Total	60	100.0	100.0	100.0

Table 2: Knowledge prior to settlement in Caribbean Terrace.

The results obtained from the Port Royal respondents were found to be the exact opposite, as all of the residents who chose to settle in the area were well aware of the community's vulnerability to hazards. These results are shown in Table 3.

	Were you aware of risks before moving to the area?	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	38	63.3	63.3	63.3
	No	0	0.0	0.0	0.0
	I have always lived here	22	36.7	36.7	36.7
	Total	60	100.0	100.0	100.0

Table 3: Knowledge prior to settlement of Port Royal.

During focus group interviews respondents were questioned as to whether having knowledge of hazards would have an affect their decision to settle in the area, and again contrasting results were obtained. The opinion of Caribbean Terrace respondents were divided as some stated that they would

indeed have reconsidered settling here, while others stated that they would not. All of the Port Royal respondents on the other hand, were in complete agreement that knowledge of vulnerability to hazards would not have any impact on their decision to settle in the community.

4.2 Risk Perception

Perception is an important factor to consider when dealing with acceptable risk, as different people or communities can have very distinct perceptions of risk. In this study, it was discovered that risk perception was linked to cultural and social factors and the individual reasoning of the person exposed to the risk .One significant finding of this study was that hazard awareness does not necessarily ensure that residents will perceive themselves to be at risk.

As mentioned before, the majority of the respondents in both communities were aware of existing hazards, but when questioned it was found that 100% of the 60 respondents from Caribbean Terrace considered themselves to be at risk contrasting greatly with the 5% from Port Royal. The way risks are perceived have a direct effect on the way residents respond to risk messages and warnings. A statistical relationship ($p=0.025$) was observed in both study areas between risk perception and response to evacuation orders. It was found, that those who considered their lives to be at risk from hazards, were more likely to evacuate, while those who considered the effects of risk to be minimal opted to ignore evacuation warnings. It was also found that

residents from both areas, who considered their property to be at risk from looters, refused to evacuate, staying behind to guard their possessions, perceiving that the economic losses suffered during and in the aftermath of the disaster would be the greatest threat to themselves and their families.

4.3 Risk Communication and Information

Risk communication, as defined by the Society for Risk Analysis as "the method by which the public can be informed as to the potential risks and benefits of specific projects and programs", they go on to describe the it as "an interactive process of exchanging of information and opinion among individuals, groups, and institutions"(2003). A variety of methods of risk communication exist, but results of the questionnaire show that three methods of risk communication dominated both areas, these are the media, literature and word of mouth.

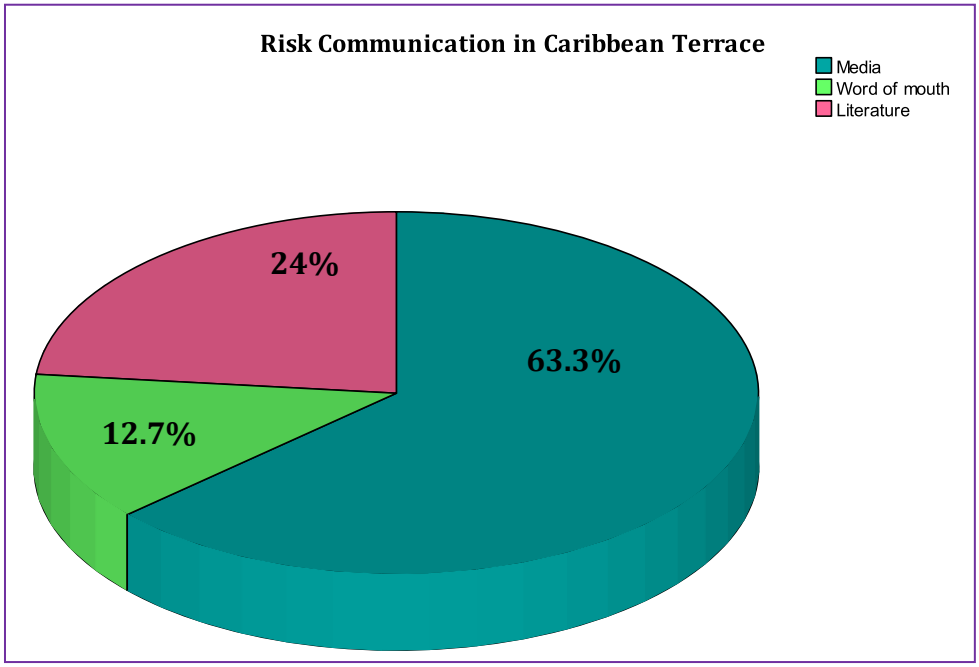

Figure 15: Risk communication in Caribbean Terrace

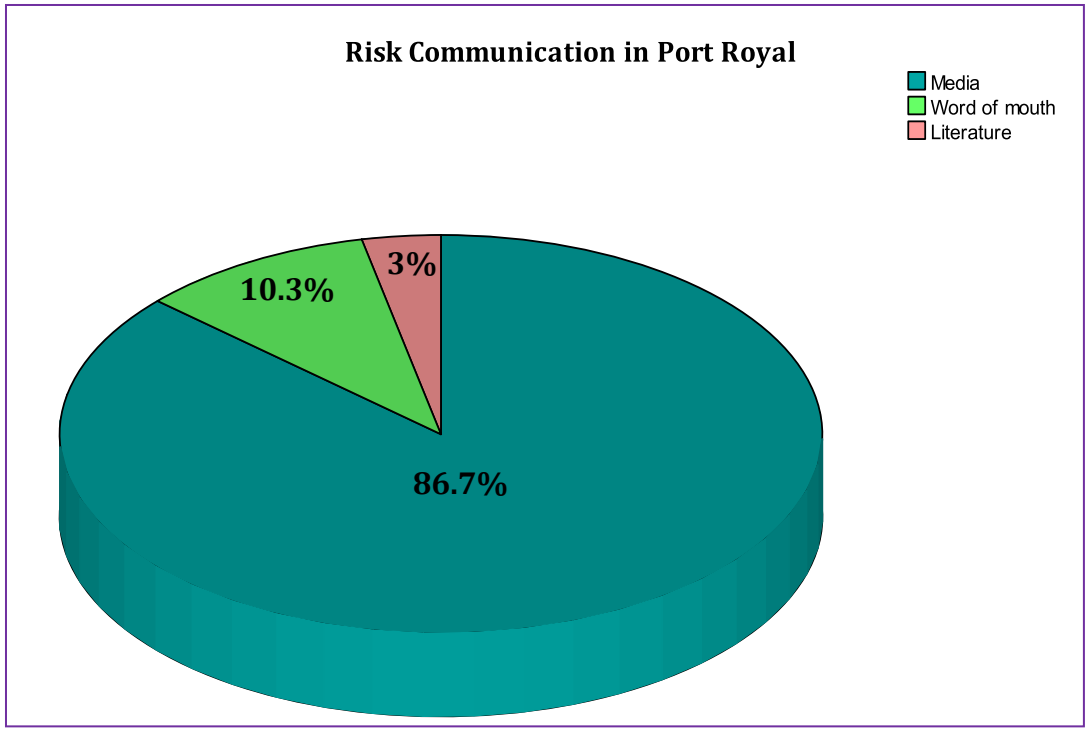

Figure 16: Risk Communication in Port Royal.

As seen in figures 15 and 16 the media was the most popular method of risk communication in both areas, with 63.3 % and 86.7% of 60 respondents in Caribbean Terrace and Port Royal respectively, citing it as their primary source of information on exiting risks and impending hazards. The results also showed that literature as a source of information was more popular in Caribbean Terrace than in Port Royal, whereas in Port Royal word of mouth as a means of diffusing risk information took precedence over literature.

These preferences in risk communication may be directly linked to the social and physical conditions existing in both communities. Firstly, all of the households sampled had access to a several forms of media, the most popular to which were television and radio broadcasting, which explains its

dominance. Also, the media is an effective means by which messages can be easily and swiftly relayed to communities, allowing broadcasts to be modified so that they are easily understood and properly interpreted by a wide audience.

Secondly, respondents from Caribbean Terrace exhibited a higher level of education, than those of Port Royal, in order to determine the significance of education with respect to methods of risk communication; the Pearson chi squared test was administered. The results obtained showed p values of 0.010 which shows that there was indeed a statistical relationship between both variables, indicating that literature, such as safety pamphlets were better utilized by educated individuals, explaining why literature was the second most popular source of information in Caribbean Terrace.

Finally, the physical location of the different households and the level of community integration can account for the effectiveness of word of mouth as a means of risk information transfer. In Port Royal, many of the homes are closely spaced or connected in the form of housing complexes, as seen in Plate 3, these close living arrangements coupled with the increased time for socializing, due to the unemployed and self employed lifestyle of residents allows for familiarity to be fostered, contributing to the creation to a strong sense of community among residents. This allows for increased integration amongst community members, as the close quarters, and lighter work

schedules increases interaction and enables risk messages to be transferred during casual conversations or planned meetings.

Plate 3: Homes in Port Royal

Chapter 5

Underlying Factors Responsible for Settlement

In this study, no single factor was found to be solely responsible for settlement in the high risk areas of Caribbean Terrace and Port Royal. Residents who knowingly moved into vulnerable areas, as well as those who chose to stay after learning of the level of vulnerability, did so because they accepted these risks. Though these conditions varied, they can be divided into four major categories, namely economic, social, environmental and political. In both communities a combination of these factors were found to exist, but significant differences were observed in the dominance of each category, this is illustrated in Table 4.

Factors	Caribbean Terrace	Port Royal
Economic	31.1%	70.0%
Social	17.2%	26.3%
Environmental	51.7%	3.7%
Political	0.0%	0.0%

Table 4: Factors affecting settlement

In Caribbean Terrace, the most popular reason for choosing to stay in the area were the environmental factors (beach front aesthetics), followed by economic factors and finally social factors. In Port Royal on the other hand, economic factors were the most dominant reasons for settlement, followed by the different social issues. None of the respondents in Port Royal cited environmental reasons for settlement. Finally, none of the respondents in either community stated that there were any political influences on their

decision to reside in the area; however, it is important to note that several respondents stated that they were motivated by political factors, but then opted to change their answers.

5.1 Economic Factors

As mentioned before, economic factors were the most popular reason for settlement in both areas, and an in-depth analysis uncovered more similarities as respondents from both communities stated that the cost of housing was the most important economic factor to encourage settlement. The reasoning behind this however, was very different for each community. Focus group interviews revealed that in Caribbean Terrace the respondents desired ownership of comfortable, scenic beach front property, while in Port Royal, respondents simply desired an affordable place to live based on their limited incomes. This is reflected in the comparison of houses from the different communities, in terms of structure, design and cost. It was found that many of the houses in Caribbean Terrace were superior to the low cost housing in Port Royal.

While the cost of housing attracted settlement in both areas, it also represents sizeable investments made by the residents; it is this investment which acts as an incentive to stay in the area. Eighty percent (80%) of respondents in Caribbean Terrace stated that they were unwilling to relocate because of the economic losses they would suffer. It is also important to note that after such a sizeable investment, the option to relocate is often removed,

as residents may be financially unable to relocate. In a telephone conversation with the author on July 2nd, 2010, Mr. Ian Jackson a resident of Caribbean Terrace for over twenty years declared that after taking large loans towards the purchase of his home, he was unable to afford any type of permanent or temporary relocation. Mr. Jackson went on to state that, years later when he had recovered his financial footing, and could once again afford to move, he had "grown fond" of the community and did not wish to leave. This is an excellent example of how factors influencing settlement can change over time, as initially economic constraints restricted his ability to relocate, but now, well established social ties are strong influences on his decision to stay.

Issues relating to employment were the second most popular economic reason to encourage settlement in both areas. Living in close proximity to their workplace was very important to many residents, in fact 20% of respondents in Caribbean Terrace and 33.3 % in Port Royal stated that a major reason for continued settlement in their respective communities was due to that fact they either earned their living within the community or in the surrounding areas. In the same way the original inhabitants of Caribbean Terrace were mainly workers at the nearby Carib Cement Company, and many present day residents still work nearby. In Port Royal as well, many of the residents make their living from the sea as fishermen or fish mongers, a profession, in many instances, that was passed down from parents to children.

5.2 Social Factors

Social and cultural factors played a significant role in the settlement process for both communities. In Port Royal, particularly, residents showed strong ties to their community, this is attributed to a number of different aspects. Firstly, Port Royal is a comparatively old community, and many of the families have lived there for generations, allowing for interpersonal relationships and strong bonds to form between residents and the community. In fact, the data collected showed 96% of respondents who have lived in the area for over 25 years stated that they were unwilling to relocate. This bond fosters a reluctance to leave; in fact 43.3% of the 60 respondents stated that the social capacity, history and traditions of the area were an important reason for residing in the area. It is important to note that none of the respondents from the Caribbean Terrace cited ties to their community as a reason for living in the area.

Issues of safety and comfort are another social factor that can be attributed towards the increased desirability of both areas for settlement. Focus group interviews revealed that residents from both study areas, perceived their communities to be safer in terms of crime than surrounding areas in Kingston. Respondents also stated that this perceived safety encouraged permanent settlement and home ownership in the area, because they felt it was a suitable place to raise children.

In answering the questionnaire, on July 2nd 2010, Mr. Dennis Edwards, who rents a house in Caribbean Terrace, explained that having himself grown up in a low income, violent community, he felt the need to provide a better life for his children. Mr. Edwards went on to state that despite the fact that he has been affected by hazards in the past, he has no present plans to relocate and "would much rather be at risk from flooding and hurricanes than gunmen."

The conviction with which Port Royal residents believe in the safety of their community is blatantly displayed when evacuation orders are issued. Only 3.3 % of respondents stated that they evacuate to designated shelter or alternate location such as the house of a family member or friend, while 43.3% state that they remain at home because they feel it is a safer alternative than staying in shelters. During focus group interviews, the reason for this was discovered; residents complained that in shelters they felt as though their safety was compromised by having to share accommodations with individuals from violent communities.

During a focus group interview with the author on June 27th,2010, Mrs. Melanie Stanley stated that she did not relocate to shelters because of her two daughters and the fear that they would be " molested or robbed " during their time in the facility. The issue of looting also arose, as another reason for residents refusing to follow evacuation orders. In Caribbean Terrace, where there is a history of looting, 46.7 % of respondents' state that they remain at

home to protect their property when evacuation orders are issued, compared to the 36.7 % in Port Royal.

In Port Royal this perception of safety is extended to include not only safety from crime but natural hazards as well. Despite the scientific evidence, risk communication efforts and a history of hazards in the area, residents still believe that they are not at risk, this perception is founded the on the beliefs and culture of residents. Mr. John Clement gave his reasons for settling in Port Royal during an interview with the author on June 30th, 2010. Mr. Clement stated that "disasters can't strike the same place twice", believing that since the area was affected by a major hazard in the past, the earthquake of 1692, the community is now safe. Spirituality is another factor that affects the perception of residents toward risk, Mr. Clement went on to state that " the past earthquake was an act of God, cleansing the area of all evil Many of the residents also share this belief that now cleansed, the community is spiritually protected and hence safe.

5.3 Environmental Factors

Only the Community of Caribbean Terrace cited environmental reasons for settlement, in fact 50% of respondents state that this was their initial reason for settlement. The aesthetics of the area, in terms of the community being a beach front property, was the initial environmental factor which attracted residents. Secondly, the location of the community was another characteristic which influenced residents to live in the area, due to its close proximity to

economic centers, while still being away from the congestion and crowding of urban areas.

5.4 Political Factors

According to the data collected, no political motivations were found to influence the decision of residents in either of the study areas. During focus group meetings residents were reluctant to discuss political groups or organizations. This was also reflected in the questionnaire; the majority of respondents, 80% in Caribbean Terrace, and 92% in Port Royal, stated that there were no political factors which affected their decision to settle in the area, the remaining percentage of respondents declined to answer the question. Also, as mentioned before, several respondents of the questionnaire did indeed select political factors as motivation for settlement before opting to change their response.

5.5 Approaches to Risk Reduction

Aside from the four major factors identified, there are also other issues which interact with internal and external conditions affecting the level of acceptable risk. According to the residents, as uncovered during focus group meetings, these issues are taken into serious account, and for many have contributed to their decision remain in the area.

Mrs. Janet Williams stated in a focus group interview with the author on June 26th, 2010, that while she was aware of hazards affecting Caribbean Terrace she decided to remain, because “hazards only come once or twice a year.”

The fact that some hazards, hurricanes in particular occur seasonally, contributes to the perception that the level of vulnerability is not constant, but rather increases or decreases as hazard conditions change. When considered from this view point, residents see themselves only being threatened during certain periods, making it easier to accept the risks.

Mitigation is another measure which has a direct effect on the level of vulnerability. Methods of mitigation were communicated to the residents of both communities along with hazard announcements and warnings. The goal of mitigation is to directly reduce the impact of hazards in terms of damage and losses. The data collected, as seen in Table 5, showed that the majority of residents 66.7% in Caribbean Terrace and 76.7% in Port Royal believed that mitigation will successfully reduce some of the existing risks. This means that they understood, that even with mitigation, they were still subjected to some level of susceptibility to hazards.

Ms. Marie Simon, a Caribbean Terrace homemaker, stated during an interview with the author on June 26th, 2010, that, she worried less about hurricanes because she had "secured her roof and possessions" which gave her "peace of mind." Mitigation because of its ability to reduce vulnerability creates a sense of security among the inhabitants of the community. This feeling of safety enhances the capacity to residents to accept existing risks, mainly because they feel better prepared to face whatever hazard situations may arise.

Perception of Mitigation	Caribbean Terrace	Port Royal
Mitigation will remove all risks.	26.7	23.3
Mitigation will remove some risks.	66.7	76.7
Mitigation will have no effect on risks.	6.7	0.0

Table 5: Perception of Mitigation in Caribbean Terrace and Port Royal.

Economic losses are a major repercussion of hazards, aside from loss of life which can occur under extreme circumstances. Insurance is a particular method of mitigation designed specifically to offer protection to both persons and their property. Having insurance, again offers a sense of security to residents, but its successful implementation faces severe constraints .The data collected showed that none of the respondents sampled in Port Royal had any form of insurance; this contrasted the data collected in Caribbean Terrace as seen in Table 6.

Type of Insurance	Percentage
Home and Property Insurance	5.0%
Life Insurance	17.3%
Vehicle Insurance	53.3%
No Insurance	23.3 %

Table 6: Types of Insurance used in Caribbean Terrace.

When the issue of Insurance was discussed during focus group meetings in Port Royal, the residents unanimously agreed that they could not afford to pay for any type of insurance. The author made several attempts to contact insurance providers, among them national insurance agencies, but requests

for interviews were declined and the researcher was informed that information on the cost of insurance premiums could not be disclosed. Due to the differences in the income level of both communities, residents of Caribbean Terrace, were able to afford different types of insurance, as seen in Table 6, life and vehicle insurance were among the most popular.

The issues of hazard frequency and methods of mitigation, though dependant on the economic, social, environmental and political factors, still play a major role in the determining the level of vulnerability in the area. This can directly affect the severity of the risks, for when properly implemented; they can soften the blow of hazards and reduce the incidence of disasters.

Chapter 6

The Acceptable Risk Assessment Tool

Many of the concepts in Disaster Management have only just begun to be properly explored, one such concept is that of Acceptable Risk. While an understanding of the concept has been established, there is no widely accepted method by which it can be categorized and measured .The following tool attempts make a contribution to this field, and create a broader spectrum of understanding on this topic.

6.1 Applicability of the Tool

This tool was designed to have the versatility to be applied at different scales, be it at an individual, family, or community level. While the tool has potential for use at a wider national level, in order to achieve maximum efficiency it will need to be modified to incorporate a larger study area and an increased diversity of hazards and risks.

The primary use of the tool is to not only identify acceptable risk, but to categorize and differentiate between its different levels, allowing for a greater understanding for the populations' willingness to accept threats to their lives or property. It can also be used to uncover gaps in risk communication, and classify reasons for limited awareness of risk and hazards. This information can be very beneficial to disaster managers, as it allows for the identification of vulnerable populations, and can be used as a

guide to help determine the level and type of intervention required from disaster agencies.

6.2 Using the Acceptable Risk Assessment Tool

This tool is divided into 3 Phases, illustrated in figure 17; each targeting a different data set .The objective of Phase 1 is to assess risk and vulnerability, while Phases 2 and 3 are based on a point system, the totality of which will be compared on the Acceptable Risk Scale. The following is a detailed explanation of how the tool is used.

6.2.1 Phase 1: Vulnerability Analysis

This stage is designed to assess the level of vulnerability and risks to which the community is exposed to .This arm of the tool, is designed specifically to be used only as a quick or summary assessment, during data collection when in the field or when the researcher is faced with time constraints. Ideally, this phase should be conducted in collaboration with well established and widely accepted vulnerability assessment tools such as the Benchmarking Tool (B-Tool) which provide a detailed analysis and insight into hazards, vulnerability and risks.

Phase 1 is to be carried out by the Disaster Manager, and it is imperative that the data collected be accurate as it will be used as the baseline, against which the data collected from the subjects will be compared. Once the Phase 1 data is collected and existing risks specific to the area are fully uncovered, then

the next step is to continue to Phase 2. If however no risks are present, then the use of the tool ends here as there is no need for further assessment.

6.2.2 Phase 2: Awareness

Phase 2 consists of the assessment of one key element which is awareness. As mentioned before, the concept of acceptable risk cannot be applied, if the subject is unaware of existing risks, Phase 2 seeks to discern just this. As seen in Table 7, if the subject displays full or limited awareness, then scores of 1 or 0.5 will be given accordingly, and the implementation of the tool shall continue to Phase 3 .If the subject is unaware of existing risk, then a score of zero will be given, placing the subject in the section of the scale, indicating unawareness, and therefore, no acceptable risk.

Response	Meaning	Score
Fully Aware	Respondent is fully aware of all major existing risks.	1.0
Limited Awareness	Respondent is aware of some of the existing risks.	0.5
Unaware	Respondent is ignorant of risks	0.0

Table 7: Phase 2 Awareness Scores.

If a score of zero is assigned, then the implementation of the tool continues to Phase 2b, to uncover the reason for the lack of awareness. Based on the analysis of the data collected, one of three categories can be chosen, these are further explained in Table 8.

Category	Description
1	Methods of risk communication are established by the relevant agencies, and risk messages exist, residents are unaware because they ignore these risk messages. This may be due to their attitudes and perceptions.
2	While methods of risk communication are established, residents are unaware because, they are unable to properly interpret and assimilate these risk messages. This may be due to the fact that the way the information is relayed is not suited to the target population.
3	Unawareness has arisen due to the absence of risk communication efforts.

Table 8: Phase 2B Categories of Unawareness.

These categories encompass the main reasons for little to no awareness on the individual or population. While it is established that unawareness eliminates the possibility of Acceptable Risk, the assessment does not end here .The category selected will guide to risk managers to where intervention is needed. For example, if Category 2 best describes the situation, then the next step would be to, tailor risk messages to the needs of the community, so that they are easily understood.

Responsible organizations must then ensure that steps are taken to increase the level of awareness in the area. Once achieved, the area can be reassessed using the Acceptable Risk tool. If efforts to increase awareness were successful, then at Phase 2 the scores will allow for the researcher to advance to Phase 3.

6.2.3 Phase 3: Level of Acceptable Risk

Phase 3, the final stage, focuses on determining the level and intensity of Acceptable Risk. For the purposes of this study, the author has divided the concept of Acceptable Risk into two categories a, Forced and Voluntary. Forced Acceptable Risk refers to the situation where the option to leave is removed or reduced due to constraints such as economic, social, environmental or political factors. Voluntary Acceptable Risk, is essentially the opposite, it refers to the situation where the ties to the area are weaker, making relocation a feasible alternative, yet still, residents choose to remain despite existing risks.

Phase 3 asks respondents a series of questions, prompting either Yes or No responses, which will be appropriately scored. The sum of the scores in Phases 2 and 3 will then be ranked on the Acceptable Risk scale. The tool also records GPS readings, to be used in Phase 3, for the generation of maps showing the differing intensities of Acceptable Risk within an area.

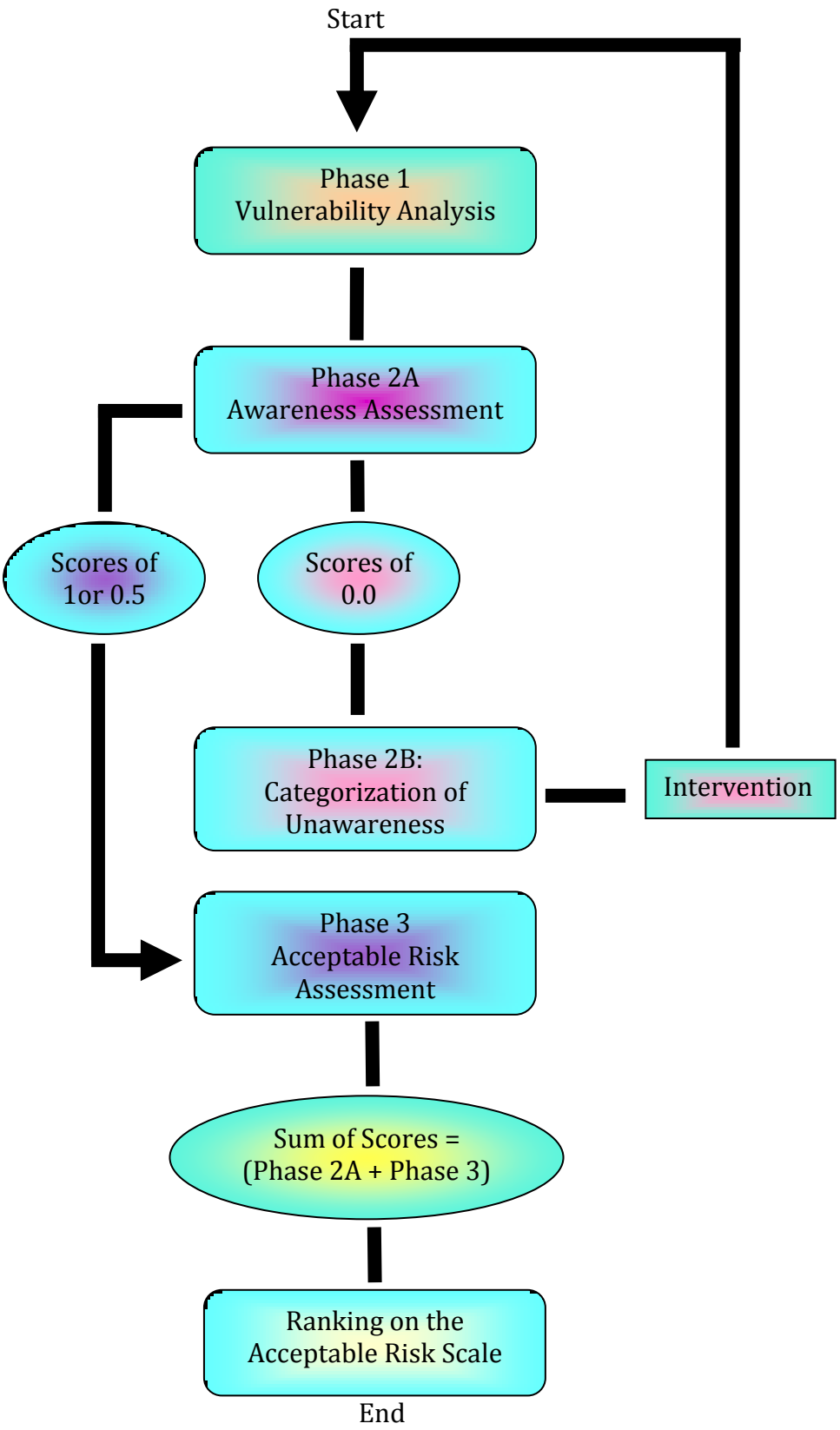

Figure 17: Flowchart outline of the Acceptable Risk Tool procedure.

The Acceptable Risk Tool

Phase 1			
Name of Community :			
Location :			Date:
Name:		Contact number:	
Address:			
Size of household:	Age:	Gender: Male □ Female □	
Environmental/ Physical			
a.	Determine which hazards are prevalent in the area.		
b.	Rank the severity of hazards on a scale of 1 – 5 1. Residents are mostly unaffected. 2. Mild inconvenience, causing no disruption in the daily activities of residents. 3. Moderate damage to property, and disruption in the daily activities of residents taking short periods of time to get back into schedule. 4. Damage to property, infrastructure and lives of residents. 5. Severe damage to property and loss of life. Serious disruption in services and functions of the community.		
c.	Determine the frequency of prevalent hazards.		
d.	Is there a possibility of secondary hazards occurring? If so, which?		
e.	What is the main construction materials used for buildings in the area?		
f.	Do major structures in the area receive regular maintenance? E.g. Bridges, major drains, electricity and telephone lines etc.		
	Demographic		
g.	What is the size of the population at risk?		
h.	Are there individuals within the population facing heightened risk? e.g. elderly, disabled, infants etc		

	If so, how many?
	Economic
i.	What is the overall income level or status of the community? e.g. Low income, Middle class, Upper residential
j.	Are there any economic centers located in the area? If so, are any residents employed in this sector?
	Social
k.	Are they any social/cultural groups in the area? If so what is the level of involvement of the community?
l.	Have community members received any special education and training? e.g. First Aid, Community Based Disaster Management Planning (CBDM)
m.	What methods of risk communication are utilized in the area?
	Political
n.	Are there any groups, Organizations (e.g. NGO's) operating? If so how large is their influence on the area?
	Vulnerability
o.	Is mitigation practiced in the area? If so which methods?
p.	Rank the level of vulnerability to hazards : Type of Vulnerability low ----------High 1 2 3 4 5 Technological Vulnerability ☐ ☐ ☐ ☐ ☐ Social Vulnerability ☐ ☐ ☐ ☐ ☐ Economic Vulnerability ☐ ☐ ☐ ☐ ☐ Political Vulnerability ☐ ☐ ☐ ☐ ☐ Physical Vulnerability ☐ ☐ ☐ ☐ ☐
Phase 2A		**Score**
	Are you aware of any hazards affecting the area? If so which?	
Phase 2B		
a.	Have you ever been exposed to risk messages of any kind such as	

	television, radio, community announcements?	
b.	If so, did you fully understand these messages?	
	Category Assigned : 1 ☐ 2 ☐ 3 ☐	
	Phase 3	**Score**
	Yes=1 No=2	
a.	Do you work /make your living in the area?	
b.	Do you own Property in the area?	
c.	Have you lived in the area over 25 years?	
d.	Is this your permanent residence?	
e.	Do you have family or close friends in the area?	
f..	Are you involved in any social/cultural community groups?	
g.	Are you involved in any religious groups in the community?	
h.	Are you strongly affiliated with any political groups or organizations in the area?	
i.	Do you enjoy of the environmental aesthetics of the community?	
j.	Does living here offer convenience in your daily activities? E.g. social and public services, close proximity to schools etc.	
k.	Do you feel safe in this community?	
l.	Will you evacuate if orders to do so are issued?	
m.	Do you practice mitigation?	
n.	Do you suffer from limited mobility due to a disability or medical condition?	
o.	Is this your only living arrangement? E.g. another house or apartment?	
p.	Does your financial situation prevent you from being able to relocate?	
	Total	

Figure 18: The Acceptable Risk Assessment Tool.

6.3 The Acceptable Risk Scale

The Acceptable Risk Scale has ten levels, each representing a different intensity of acceptable risk moving from forced to voluntary, with level ten being the highest, and level one the lowest. The scale also, shows a level below zero representing the various categories of unawareness. The sum of the scores obtained in Phase 2 and 3 of the tool are used to rank the level of risk. From the 17 questions designed to measure acceptable risk, a minimum score of 16.5 represented a perfectly forced assessment, whilst a maximum score of 33 represented a perfect voluntary measurement.

Using these values a gradational point system was developed and correlated with the acceptable risk scale. Therefore the minima (16.5) and maxima (33) represented a level 1 and 10 on the acceptable risk scale respectively. As such the 1-10 levels on the Acceptable Risk scale represented a net score range of 16.5 (max voluntary - max forced = 33-16.5=16.5) attained from the tool, whereby a single level (1) increase in the acceptable risk scale was equivalent to 1.8333 score increment. This was calculated by dividing the maximum forced values (16.5) by the number of remaining levels (9). With each increment added, the ranking will move up a level to increase the intensity of acceptable risk, this is illustrated in Table 9. The Risk Table is therefore necessary in order to rank the scores obtained on the scale appropriately.

Ranking	Type	Score	Description		Range	
10	Voluntary	33.00	Optimum Voluntary		31.18	33.00
9	↑	31.17	↑		29.34	31.17
8		29.33			27.51	29.33
7		27.50			25.68	27.50
6		25.67	Lowest	Voluntary	23.84	25.67
5		23.83	Lowest	Forced	22.01	23.83
4		22.00			20.18	22.00
3		20.17			18.34	20.17
2	↓	18.33	↓		16.51	18.33
1	Forced	16.50	Optimum Forced		16.50	

Table 9: Simplified Risk Table

Table 9, is a simplified Risk Table, showing the range and values of the 10 point on the scale at intervals of 1, however, if the researcher wanted a more accurate reading, and wished to extend the scale to include intervals of 0.1 then another Risk Table could be calculated using the same method (Appendix 2).By extending the risk table, the scores can be ranked using more precise values. Essentially, by applying the same method of calculation , Risk Tables can be manipulated based on the needs of the researcher in terms of the depth of the analysis and precision. For the purposes of this study however, Table 9, will be used when testing the tool.

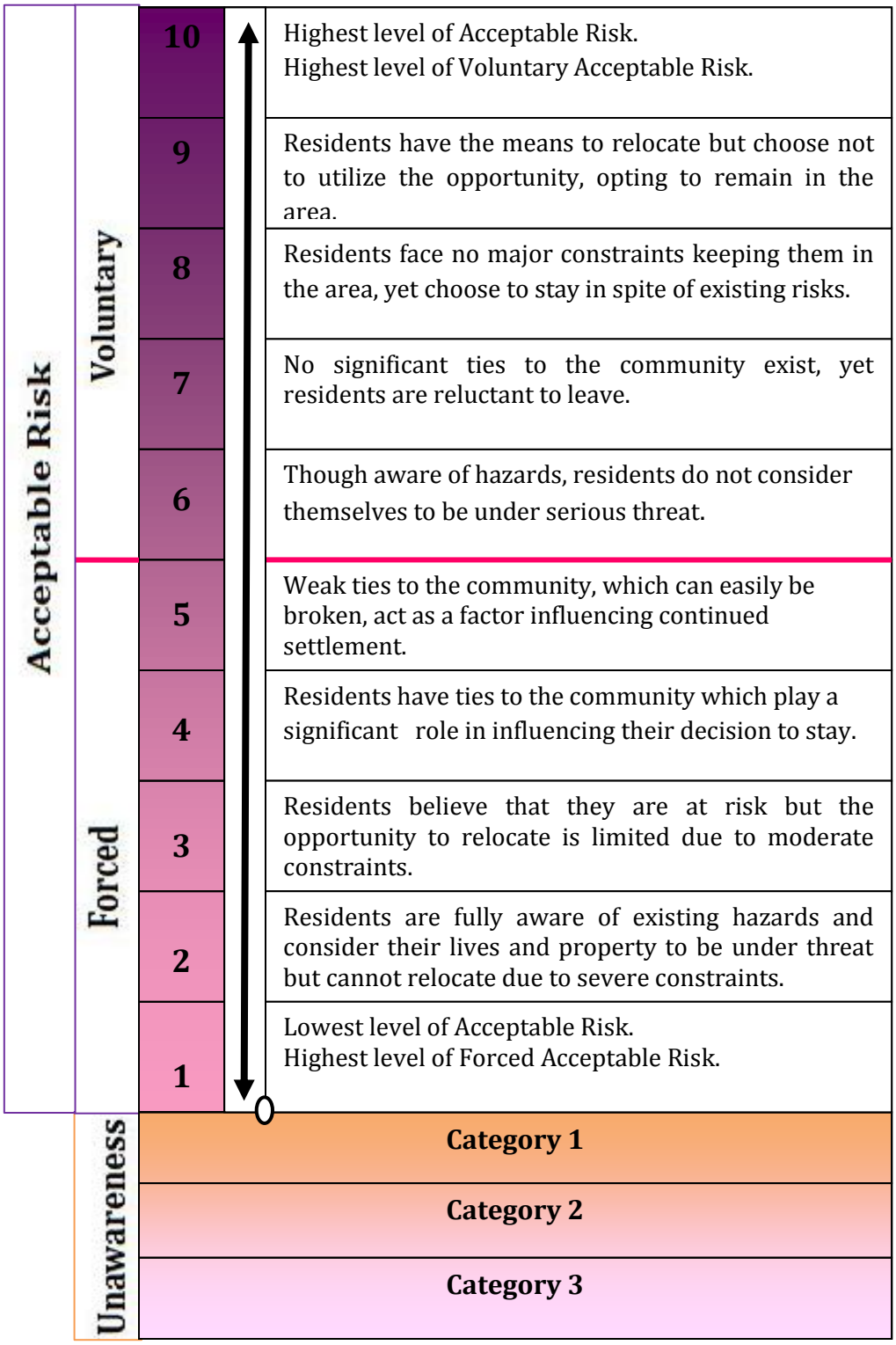

Figure 19: The Acceptable Risk Scale

6.4 Testing the Acceptable Risk Tool

In order to ensure functionality, the tool was tested on randomly selected individuals from both the Caribbean Terrace and Port Royal Community. The following are the results of both tests. Upon the request of the respondents, the names, addresses and contact information have been omitted, but all other responses have been kept.

Test 1

Name of Community : Caribbean Terrace			
Location : 17◦56'54.4''N 76◦42'46.78''W			**Date:** 26/7/10
Name: Mr. John Doe		**Contact number:**	
Address:			
Size of household: 5	**Age:** 46	**Gender:** Male ☑ Female ☐	
Phase 1			
Vulnerability Assessment conducted using NOAA CVAT			
	Phase 2A		**Score**
	Are you aware of any hazards affecting the area?		1
Phase 2B			
a.	Have you ever been exposed to risk messages of any kind such as television, radio, community announcements?		
b.	If so, did you fully understand these messages?		
	Category Assigned : 1 ☐ 2 ☐ 3 ☐		
	Phase 3		**Score**
	Yes=1 No=2		
a.	Do you work /make your living in the area?		1
b.	Do you own Property in the area?		1
c.	Have you lived in the area over 25 years?		1

d.	Is this your permanent residence?	1
e.	Do you have family or close friends in the area?	1
f.	Are you involved in any social/cultural community groups?	2
g.	Are you involved in any religious groups in the community?	1
h.	Are you strongly affiliated with any political groups or organizations in the area?	2
i.	Do you enjoy of the environmental aesthetics of the community?	1
j.	Does living here offer convenience in your daily activities? E.g. social and public services, close proximity to schools etc.	1
k.	Do you feel safe in this community?	1
l.	Will you evacuate if orders to do so are issued?	1
m.	Do you practice mitigation?	1
n.	Do you suffer from limited mobility due to a disability or medical condition?	2
o.	Is this your only living arrangement? E.g. another house or apartment.	1
p.	Does your financial situation prevent you from being able to relocate	1
	Total	20

Table 10: Test 1 results

Based on the responses seen in Table 10, a total score of 20 was obtained, when compared to the Acceptable Risk Scale; a ranking of level 3 was assigned. This indicated that the respondent displayed Forced Acceptable Risk, as he wished to move but due to issues such as financial constraints he could not, leaving no other option but to stay in the area.

Test 2

Name of Community : Port Royal			
Location : 17◦56'16.8"N 76◦50'26.43"W			**Date:** 26/7/10
Name: Mrs. Jane Doe		**Contact number:**	
Address:			
Size of household: 8	**Age:** 36	**Gender:** Male ☐ Female ☑	
Phase 1			
Vulnerability Assessment conducted using NOAA CVAT			
	Phase 2A		**Score**
	Are you aware of any hazards affecting the area?		1
	Phase 2B		
a.	Have you ever been exposed to risk messages of any kind such as television, radio, community announcements?		
b.	If so, did you fully understand these messages?		
	Category Assigned : 1 ☐ 2 ☐ 3 ☐		
	Phase 3		**Score**
	Yes=1 No=2		
a.	Do you work /make your living in the area?		2
b.	Do you own Property in the area?		2
c.	Have you lived in the area over 25 years?		1
d.	Is this your permanent residence?		1
e.	Do you have family or close friends in the area?		1
f.	Are you involved in any social/cultural community groups?		2
g.	Are you involved in any religious groups in the community?		2
h.	Are you strongly affiliated with any political groups or organizations in the area?		2
i.	Do you enjoy of the environmental aesthetics of the community?		2
j.	Does living here offer convenience in your daily activities?		2

	E.g. social and public services, close proximity to schools etc.	
k.	Do you feel safe in this community?	1
l.	Will you evacuate if orders to do so are issued?	2
m.	Do you practice mitigation?	2
n.	Do you suffer from limited mobility due to a disability or medical condition?	2
o.	Is this your only living arrangement? E.g. another house or apartment.	1
p.	Does your financial situation prevent you from being able to relocate?	2
	Total	28

Table11: Test 2 results

In Test 2, the responses came to a total score of 28 as seen in Table 11, when compared to the Acceptable Risk Scale; a ranking of level 8 was assigned. This places the respondent in the Voluntary Acceptable Risk category, as respondent faced no major ties or constraints to the community, but still opted to reside in the area.

6.5 Limitations

One of the limitations of this tool is that due to the time constraints and scope of this project, the design does not allow for a more detailed analysis of the specific factors responsible for Acceptable risk. This can be rectified by expanding the tool to examine a wider variety of issues, for example aside from asking more questions, the tool can also be modified to allow for a

wider range of answers, be it opened ended or with a greater choice of fixed responses.

While the Acceptable Risk Tool can be applied at different levels, be it individual or community, its capacity to assess Acceptable Risk at a wider national level is somewhat limited. This is due to the size of the study area, the diversity of hazards and secondary hazards, as well as varying types and levels vulnerability throughout the country. This can also be rectified though the expansion and modification of the tool.

Due to the diversity of communities and the nature of the tool, representation of a large area with differing perceptions may be difficult .In order to increase efficiency, a national database of communities in high risk areas can be maintained, and the tool regularly applied, to monitor changes in acceptable risk and gauge the success of methods implemented to increase awareness of risk while decreasing vulnerability. The data collected can be used in the generation of risk maps showing changes in intensity of risk acceptance, and can be used by disaster managers to target key areas for intervention.

Chapter 7

Conclusion and Recommendations

Hazards have devastating effects on both the population and socioeconomic conditions of a country. Many attempts have been made to reduce the effects of hazards, and prevent their escalation to disasters, and while some success has been achieved, at present it is unrealistic to completely eradicate disaster losses. Also as the environment changes, through natural process or anthropogenic intervention, vulnerability and risks can change, leading to degradation which may cause areas that were once safe, to become more susceptible to the effects of hazards. With increasing rural to urban migration in developing countries like Jamaica, the need for housing is steadily growing, and more marginal lands are being used for settlements. This means that communities built on high risk areas is an inevitable consequence of development, highlighting the importance of understanding risk in all its forms.

In order to assist populations at risk, it is necessary to understand not only the type and level of risk the community is experiencing, but also the level of risk they are willing to accept. Before this can be done however, perceptions of risk must be assessed and if necessary altered. The way in which risks are perceived are influenced by a number of different factors, and it was found in this study, that perceptions of risk are often shared by a community. For example, in Port Royal, residents believe that they are not susceptible to earthquakes, despite past events and scientific evidence .It can therefore be

said, that perception of risk is influenced not only by exposure to risk and communication methods, such as the media, but also by the importance society places on its effects.

This study has proven that risk acceptance is a conscious decision, made based on a variety of different factors, namely benefits or constraints. The most significant relationship uncovered is that as the benefits obtained from settlement increase, so too does the level of voluntary acceptable risk, the same can be said with forced acceptable risk, increasing along with constraints which prevent relocation. This however, is not meant to indicate that acceptable risk and its underlying factors are uniform throughout, in fact, acceptable risk, like vulnerability is site specific.

In this study, two communities affected by similar hazards, were assessed, and results indicated that the level of acceptable risk and the specific factors responsible displayed several prominent differences. Caribbean Terrace displayed many cases of forced acceptable risk, while the majority of the respondents assessed in Port Royal displayed a more voluntary disposition of risk acceptance.

While many of the underlying factors responsible for the acceptance of risk operated in both communities, marked differences were observed in their dominance. In Caribbean Terrace environmental factors took precedence, with residents attracted to the beauty and status of a beach front property while in Port Royal economic factors such as the availability of cheap housing

and the prospect of self employment as a fisherman or vendor, held the most influence. One of the most significant findings of this study however, is the fact that factors influencing the acceptance of risk in an area are not constant but rather change over time as existing conditions or constraints alter. Shifts from forced acceptance to voluntary were observed, as the factors conditioning perceptions shifted as well.

This information on the perceptions and underlying factors were incorporated in the design and production of the Acceptable Risk Assessment Tool, along with the Acceptable Risk Scale and the generated Risk Tables, the purpose of which were to reflect the distinction between forced and voluntary acceptable risk as well as categorize unawareness. Each stage of the tool was designed to capture a specific type of data, namely, vulnerability, awareness and acceptable risk, as the linkages between these three categories were significant and at times interdependent .The tool analyzes the factors influencing the behavior and perception of residents to create a score which when correlated with risk table values and ranked on the scale assigns the level of acceptable risk.

Despite success of this study there is still much room for improvement with the prospect of future research. This study could be extended to further examine the factors of acceptable risk in greater detail and possibly uncover new indicators. Alternate dimensions can also be added to the study, such as incorporating the concept of time and analyzing its effect on risk acceptance.

While the primary focus of this study has been risk acceptance, understanding the cutoff point between risks that are tolerable, and those that society deems unacceptable, will lend considerable merit to the study. In the same way, by building further on the outcomes of this research, a more extensive categorization of the level of unawareness can be developed.

It is the hope of the author that this research will be incorporated to existing risk assessment techniques and disaster management planning, with emphasis on community based initiatives, as the simple design of the tool allows for execution by community members. This provides benefits by not only reducing the cost of data collection efforts, but increasing the accuracy of responses .This research has laid the framework for the advancement of risk evaluation, providing valuable insight into the human aspects risk and the resilience of communities to tolerate disaster threats.

Addressing the issues of risk acceptance requires another dimension of complexity as it calls for the combination of concepts in both the physical and social sciences, in order to highlight how constraints and perceptions can influence behavior. The Acceptable Risk Assessment Tool has proven to be an effective approach to assessing vulnerable populations occupying high risk areas, which is a growing need not only in Jamaica but in developing countries around the world.

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Appendix 1

Questionnaire

Administration of this interview and questionnaire in partial fulfillment of:

RESEARCH PAPER for Master of Science DEGREE in

DISASTER MANAGEMENT.

CENTRE FOR ENIRONMENTAL MANAGEMENT

UNIVERSITY OF THE WEST INDIES, MONA.

RESEARCH TOPIC: ACCEPTABLE RISK IN CARIBBEAN TERRACE AND PORT ROYAL, JAMAICA.

Good day,

My name is Rishma Maharaj and I am post graduate student collecting data for a research project in order to complete my course of study at the University of the West Indies, Mona. I am asking for your assistance in the completion of this questionnaire, to obtain information regarding risk and I assure you that this information will be used for the betterment of all residents in the area.

Questionnaire # _____

Location: □ Caribbean Terrace □ Port Royal

Baseline data

1. Gender

   1.□ Male 2. □ Female

2. Age

   1. □ Under 20 2. □ 20-35 3. □ 36-50 4. □ 51-65 5. □ Over 65

3. Status

   1. □ Married 2. □ Single

4. Do you have children?

   1. □ Yes 2. □ No

5. Are there elderly people in your household?

   1. □ Yes 2. □ No

6. Do you or anyone in your household suffer from a disability?

   2. □ Yes 2. □ No

7. Size of household :

   1. □ One person 2. □ 2- 5 people 3. □ 6-10 people 4. □ Over 10 people

8. What Is your average monthly Income :

   1. □ Under $40000.00
   2. □ $40000.00- $80000.00
   3. □ $80001.00- $120000.00
   4. □ Over $120000.00
   5. □ I have no regular Income

9. Is this your permanent residence?

   1. □ Yes 2. □ No

10. Are you renting or do you own the property?

1. □ Renting 2. □ Own

11. What is your current level of education?
    1. □ Primary
    2. □ Secondary
    3. □ Tertiary
    4. □ I have no formal education

12. How long have you lived here?
    1. □ Less than 1 year
    2. □ 1-5 years
    3. □ 6-10 years
    4. □ 11-15 years
    5. □ 16-20 years
    6. □ Over 20 years

13. What are your main reasons for settling here?
    1.□ I have always lived here
    2.□ Property was affordable
    3. □ To support a particular group/party/organization
    4. □ I like the environment /location
    5.□ I have family and friends here

Awareness

14. Did you know of any hazards /risk in the area before you moved?
    1. □ Yes 2. □ No 3. □ I have always lived here

15. Are there threats/risks to yourself, your family or your property?
    1□. Yes 2. □ No

16. Which hazards affect the area?
    1. □ Hurricanes 2. □ Flooding

3. □ Strom surge
4. □ Earthquakes
5. □ Tsunamis
6. □ Technological hazards
7. □ Landslides
8. □ No hazards affect this area

17. How are you informed of risks?
    1. □ Media(TV, Radio etc)
    2. □ Community group
    3. □ Word of mouth
    4. □ Literature/pamphlets/flyers
    5. □ Seminars and Workshops
    6. □ I am not informed of risks

18. What do you do when an evacuation order is issued?
    1. □ I evacuate to designated shelters or to friends and family
    2. □ I remain at my home to protect my property
    3. □ I remain at home because I do not feel threatened by hazards
    4. □ I remain at home because I feel it is a better alternative than a shelter

Economic factors, Insurance & Mitigation

19. What are the economic reasons for staying in this area?
    1. □ I work/ make my living in this area
    2. □ Housing is more affordable here
    3. □ It is cheaper to commute to my workplace from this area
    4. □ There are no economic reasons for me settling in this area

20. Do you own a Vehicle?
    1. □ Yes 2. □ No

21. If you could/ can afford to move would you?
    1. □ Yes , I am only staying here because it is the best I can afford

2. □ No , I choose to stay here for reasons besides my financial situation

22. Who should be responsible for mitigation in the Area?
    1. □ The government
    2. □ Myself
    3. □ Community groups
    4. □ Government and Community Groups
    5. □ Myself , the government and community groups
    6. □ There is no mitigation needed in the area

23. How do you feel mitigation will impact risk?
    1. □ Mitigation will remove all of the risks I am exposed to
    2. □ Mitigation will reduce some of the risks I am exposed to
    3. □ I do not think mitigation will affect risk

24. Do you believe insurance will reduce the impacts of hazards and reduce risk?
    1. □ I believe insurance will completely reduce the impacts of hazards and risk
    2. □ I believe insurance will partially reduce the impacts of hazards and risk
    3. □ I do not believe that insurance can reduce the impacts of hazards and risk

25. What type of insurance do you have?
    1. □ Home and Property Insurance
    2. □ Life Insurance
    3. □ Vehicle Insurance
    4. □ I do not have Insurance

26. Have you ever received financial assistance with regard to risk and hazards?
    1. □ Yes 2. □ No

Social, Cultural, Environmental and Political Factors

27. What are the environmental reasons for staying in this area?
    1. □ I find the environment very beautiful
    2. □ I believe that this environment is better for my health and well being
    3. □ This environment reduces the impact of many risks(crime ,hazards etc)
    4. □ This location is convenient for me
    5. □ There are no environmental reasons for me settling in this area

28. What are the social and/or cultural reasons for staying stay in this area?
    1. □ I feel strong ties to this area(Strong social capacity , history , traditions etc)
    2. □ I have Family and / or friends in this area □
    3. □ I share similar cultural/ religious beliefs with people in this area □
    4. □ I feel safer /comfortable in this area rather than anywhere else (e.g. crime etc)
    5. □There are no Social/ Cultural reasons for me settling in this area

29. What are the political reasons for staying in this area?
    1. □ To lend support to certain parties/groups, organizations.

2. □ I wish to live in an area governed by the beliefs of certain parties/groups/organizations.
3. □ There are no Political reasons for me settling in this area.

30. What is your main reason for living here?

Rank in order of significance. 4= Highest 1 = Lowest

	1	2	3	4
Economic				
Social/Cultural				
Political				
Environment/Location				

Thank you for your assistance!

Appendix 2

Risk Tables

Acceptable Risk table at 0.1 intervals.

Acceptable Risk	Perception	Points
1	Forced	16.50
1.1		16.68
1.2		16.87
1.3		17.05
1.4		17.23
1.5		17.42
1.6		17.60
1.7		17.78
1.8		17.97
1.9		18.15
2		18.33
2.1		18.52
2.2		18.70
2.3		18.88
2.4		19.07
2.5		19.25
2.6		19.43
2.7		19.62
2.8		19.80
2.9		19.98

3	20.17
3.1	20.35
3.2	20.53
3.3	20.72
3.4	20.90
3.5	21.08
3.6	21.27
3.7	21.45
3.8	21.63
3.9	21.82
4	22.00
4.1	22.18
4.2	22.37
4.3	22.55
4.4	22.73
4.5	22.92
4.6	23.10
4.7	23.28
4.8	23.47
4.9	23.65
5	23.83
5.1	24.02
5.2	24.20
5.3	24.38
5.4	24.57
5.5	24.75

5.6	24.93
5.7	25.12
5.8	25.30
5.9	25.48
6	25.67
6.1	25.85
6.2	26.03
6.3	26.22
6.4	26.40
6.5	26.58
6.6	26.77
6.7	26.95
6.8	27.13
6.9	27.32
7	27.50
7.1	27.68
7.2	27.87
7.3	28.05
7.4	28.23
7.5	28.42
7.6	28.60
7.7	28.78
7.8	28.97
7.9	29.15
8	29.33
8.1	29.52

8.2		29.70
8.3		29.88
8.4		30.07
8.5		30.25
8.6		30.43
8.7		30.62
8.8		30.80
8.9		30.98
9		31.17
9.1		31.35
9.2		31.53
9.3		31.72
9.4		31.90
9.5		32.08
9.6		32.27
9.7		32.45
9.8		32.63
9.9		32.82
10	Voluntary	33.00

Acceptable Risk Table at 0.5 Score intervals.

Acceptable Risk	Perception	Score
1.00	Forced	16.50
1.27		17.00
1.55		17.50
1.82		18.00
2.09		18.50
2.36		19.00
2.64		19.50
2.91		20.00
3.18		20.50
3.45		21.00
3.73		21.50
4.00		22.00
4.27		22.50
4.55		23.00
4.82		23.50
5.09		24.00
5.36		24.50
5.64		25.00
5.91		25.50
6.18		26.00
6.45		26.50
6.73		27.00
7.00		27.50
7.27		28.00

7.55		28.50
7.82		29.00
8.09		29.50
8.36		30.00
8.64		30.50
8.91		31.00
9.18		31.50
9.45		32.00
9.73		32.50
10.00	Voluntary	33.00

Appendix 3

DEFINITION OF KEY TERMINOLOGIES

Risk –The expected number of lives lost, persons injured, property damage and economic activity disrupted due to particular natural phenomenon. Risk is therefore the product of specific risk and elements at risk (United Nations 1991).

Vulnerability – the degree of loss to a given element at risk, or set of such elements, resulting from the occurrence of natural phenomenon of a given magnitude and express on a scale of from 0(no damage) to 1(total loss). In lay terms, it means the degree to which an individual, family, community, class or region is at risk from suffering a sudden and serious misfortune following an extreme natural event (United Nations 1991).

Natural Hazard- The probability of occurrence, within a specific period of time in a given area, of a potentially damaging natural phenomenon (United Nations 1991 Manual for Policy Makers and Planners).

Mitigation – All measures taken to reduce loss of life, livelihood and property caused by either reducing vulnerability or by modifying, where possible, the hazard (United Nations 1991).

Disaster-risk reduction- The conceptual framework of elements aimed at minimizing the vulnerabilities and disaster risks throughout a society, avoiding (prevention) or limiting (mitigation and preparedness) the adverse

impacts of hazards, within the broad context of sustainable development (IRIN 2005, 34).

Early warning- The provision of timely and effective information through identified institutions that allows individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for an effective response (IRIN 2005).