



# **STATUS OF HAZARD MAPS VULNERABILITY ASSESSMENTS AND DIGITAL MAPS**

## **GRENADA COUNTRY REPORT**

**THE CARIBBEAN DISASTER EMERGENCY  
RESPONSE AGENCY (CDERA)**

October 2003

## Table of Contents

	Page
Preface	1
1.0 Introduction	2
1.1 Physical and socio-economic background	2
1.2 Major disaster issues confronting the country	2
2.0 Hazard mapping initiatives	3
2.1 Methods of preparation and distribution	4
2.2 Users and uses	4
2.3 Current condition and limitations	4
2.4 Critical success factors	4
2.5 Respondents	5
3.0 Vulnerability Assessment Studies	5
3.1 Methods of preparation and distribution	6
3.2 Users and uses	6
3.3 Current condition and limitations	7
3.4 Critical success factors	7
3.5 Respondents	7
4.0 Digital Maps	8
5.0 Conclusions and Remarks	8
Appendix 1	9

## Preface

From 2002 – 2005, the Caribbean Disaster Emergency Response Agency (CDERA) is implementing two major regional initiatives which are designed to reduce vulnerability to natural and technological hazards. These are the Japanese International Cooperation Agency (JICA) supported Caribbean Disaster Management (CADM) Project and the Canadian International Development Agency (CIDA) supported and Organization of American States executed Caribbean Hazard Mitigation Capacity Building Programme (CHAMP). The hazard mitigation planning component of the latter is being implemented in close collaboration with the Caribbean Development Bank's Disaster Mitigation Facility for the Caribbean. Hazard maps, vulnerability assessment studies, and digital maps are critical inputs to both initiatives.

This survey reviewed the status of these thematic activities in sixteen (16) CDERA Participating States, Haiti, Martinique, Suriname and Puerto Rico over the period August – October 2003. The objectives of the Survey were as follows:

1. To determine the status of hazard maps and vulnerability assessment studies and their use in the socio-economic planning and management of the Caribbean.
2. To determine critical success factors, gaps and best practices in the preparation and use of hazard maps and vulnerability assessment studies in the Caribbean.
3. To compile a database of hazard maps, vulnerability assessment reports, and digital maps available in the Caribbean.

Hazards considered under the survey included natural hazards such as floods, hurricanes, landslides, coastal disasters (surge, wave, and erosion), earthquakes, and volcanic eruptions as well as technological hazards. The types of vulnerability assessment considered were structural, economic, and human assessments.

This report was prepared by Jacob Opadeyi, Shahiba Ali, and Eva Chin of the Centre for Geospatial Studies, Faculty of Engineering, The University of the West Indies, St. Augustine, Trinidad and Tobago.

## **Status of Hazard Map, Vulnerability Assessments and Digital Maps in the Caribbean: GRENADA**

### **1.0 Introduction**

#### **1.1 Physical and socio-economic background**

Grenada, with its dependency of Carriacou and Petit Martinique, is a small island developing state, situated at approximately 12° 07'N, 61° 40'W in the Eastern Caribbean chain of islands. With a total area of 132.8 square miles (344km<sup>2</sup>), Grenada is the most southerly of the volcanic islands in the Lesser Antilles. The highest peak in the island is the volcanic centre of Mount St. Catherine standing at 2757ft (910m).

The island has a tropical marine type of climate, being affected by the prevailing Northeast Trade winds throughout the year. The dry season is from January to May and the wet season from June to December. Hurricanes occur mainly from June to November, during the wet season. Though Grenada lies on the edge of the hurricane belt, and is not likely to be hit by hurricanes, it was hit by a hurricane in 1955.

Most of the island is covered by forest and vegetation from dry scrub woodland on the coast to tropical rainforest in the interior, providing habitats for a wide range of flora and fauna.

The preliminary figure from the 2001 census of the population of Grenada, including Carriacou and Petite Martinique, is 102,632. 35.1% of its people are under 15 years old and the economically active population makes up 61.3% of the population. Its per capita GDP is an estimated US \$5,000 (2002), with the sectors of agriculture, industry and services contributing 7.7%, 23.9% and 68.4% (2000) respectively to the Gross Domestic Product. (Source of statistics: Central Intelligence Agency (CIA) Fact Book, 2003) found at: <http://www.cia.gov/cia/publications/factbook/geos/gi.html>.

#### **1.2 Major disaster issues confronting the country**

Grenada is part of a volcanically and tectonically active ridge formed along the Lesser Antillean island arc system. The island has only one potentially active volcanic centre, Mt. St. Catherine, with most of the geothermal activity being associated with it. Lava flows and domes, pyroclastic flows and falls, and crater lakes indicate past volcanic activity.

Grenada is threatened by the presence of a submarine volcano, Kick 'em Jenny, located 9km North of Grenada, at 12° 10.8' N, 61° 22.8' W. It is said to be the only 'live' submarine volcano in the Eastern Caribbean, having erupted about 12 times since 1939, when it began to be observed. The volcano is about 1300m

high, and recent research in March 2003 has put the summit at about 180m below the surface of the sea and the depth to the vent at 268m. As the vent of the volcano approaches the surface of the sea, the threat of tsunamis also increases. <http://www.uwiseismic.com>

Storm surges, floods and landslides often accompany storms and hurricanes. The storm surge produced by Hurricane Lenny in 1999 caused extensive damage to infrastructure along the west coast of the island and to Carriacou and Petit Martinique.

Coastal erosion, along its 121km of coastline, is a continuous threat to property and communication networks, along with anticipated sea level rise that make the coastal zone particularly vulnerable to beach erosion, loss of habitat for marine life, loss of fresh water aquifers, and damage to coastal infrastructure.

Volcanoes, earthquakes, tsunamis, hurricanes, storm surges, floods, landslides and coastal erosion are potential disaster issues facing the country, given the fact that the majority of the population lives mainly on the coast.

## 2.0 Hazard Mapping Initiatives

Table 1 shows the details of hazard maps in Grenada.

**Table 1 – Hazard Maps in Grenada**

<i>Type</i>	<i>Purpose</i>	<i>Coverage</i>	<i>Scale</i>	<i>Date produced</i>	<i>Primary sources</i>	<i>Author</i>
Multiple hazards	To identify areas prone to natural hazards and recommend mitigation measures	Towns of St. George's, Gouyave, Victoria Sauteurs, Grenville, Tivoli, St. Paul, St. David Parish,	1:25 000	June 1988	OAS, Physical Planning Division, Ministry of Finance and Planning	Vivian Bacarreza

## **2.1 Methods of preparation and distribution**

A report entitled *The Identification, Monitoring and Mitigation of Hazardous Risks in Towns and Villages of Grenada* contained a project report on *Natural Hazards Risk Assessment of Towns and Villages in Grenada, West Indies*, done by Vivian Bacarreza, Organization of American States (OAS) Physical Planning Consultant, June 1988.

The project report dealt with identification of hazards in six major areas (St. George's, Grenville, Victoria, Gouyave, Sauteurs, Tivoli), and two other areas (St. Paul and the St. David parish) in Grenada. It was prepared for the Integrated Development Project, a technical cooperation project between the OAS-Department of Regional Development and the Government of Grenada.

The hazards identified in the study sites were hurricanes, tropical storms, floods, erosion, landslides, rockslides, wave action, earthquakes, and volcanic eruptions. The elements of infrastructure that were at risk were transportation, communication, services, public buildings and facilities, education, energy and warehouses.

Risk assessment maps were prepared for each location, where the hazard was located as a point occurrence on a map of 1:12,500 scale, a magnified version of a 1:25,000 scale topographic base map. The maps, done manually, were based on field visits, aerial photography, reports and interviews.

This report is not widely circulated.

## **2.2 Users and uses**

No information was provided on the users and uses of this study.

## **2.3 Current condition and limitations**

No information was provided on the current condition and limitations of this study.

## **2.4 Critical success factors**

No information was provided on the critical success factors in the preparation, maintenance, and use of this study.

**2.5 Respondents**

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Respondent to the hazard map survey questionnaire was:  
 Mr. Trevor Thompson  
 Land Use Officer, Min of Agriculture, Lands, Forestry and Fisheries  
 Tel: 1-473-440- 3083/2708  
 Fax: 1-473-440-4191  
 Email: [trevort\\_lud@yahoo.com](mailto:trevort_lud@yahoo.com)

Please see Appendix 1 for a list of persons interviewed.

**3.0 Vulnerability Assessment Studies**

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Table 2 shows the details of vulnerability assessment study undertaken in the country.

**Table 2 – Vulnerability Assessment Studies for Grenada**

<i>Type</i>	<i>Purpose</i>	<i>Coverage</i>	<i>Date produced</i>	<i>Primary source</i>	<i>Author</i>
Sea level rise	To identify coastal resources most likely to be affected by sea level rise	Northeast Grenada, Southwest Grenada, and Carriacou	2001	CPACC	<u>Leon Charles Charles &amp; Associates Inc.</u>
Storm	To understand the distribution, magnitude, and frequency of storm hazard	Island wide	Yet to be determined	<a href="http://www.oas.org/en/cdmp/document/reglstrm/grenada.ppt">http://www.oas.org/en/cdmp/document/reglstrm/grenada.ppt</a>	<u>OFDA/USAID/OAS</u>
Seismic and wind hazards	Vulnerability Assessment of Buildings Designated as Shelters	Island wide	1998	<a href="http://www.oas.org/en/cdmp/schools/schlrscsc.htm">http://www.oas.org/en/cdmp/schools/schlrscsc.htm</a>	

Seismic	Seismic Hazard Maps: Windward Islands	Island wide	Yet to be determined	<a href="http://www.oas.org/en/cdmp/document/seismap/index.htm">http://www.oas.org/en/cdmp/document/seismap/index.htm</a>	OFDA/ USAID/ OAS
Human and structural	Hurricane-resistant Home Improvement Program	Island wide	Yet to be determined	<a href="http://www.oas.org/en/cdmp/bulletin/home.htm">http://www.oas.org/en/cdmp/bulletin/home.htm</a>	

The relevant documents can be found at <http://www.oas.org/en/cdmp/publist.htm>  
Persons interviewed did not mention these projects.

### 3.1 Methods of preparation and distribution

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The United Nations Environmental Programme (UNEP) methodology was used for the coastal vulnerability and risk assessment due to sea level rise. It allowed use of limited data and proceeded in a series of stages:

- Stage One - Identification of problems and scope of analysis.
- Stage Two - Scenarios for Coastal Vulnerability Assessment.
- Stage Three - Impact Assessment.
- Stage Four - Autonomous and Planned Adaptation.

Pilot sites were Northeast Grenada, Southwest Grenada and the island of Carriacou. The sites were selected based on the presence of at-risk sectors of the economy and/or activities, such as tourism, fishing, settlements, ports, infrastructure, recreation and historic sites. The scenarios used in the analysis were for sea level rise of 0.2m rise for 2020, 0.5m rise for 2050 and 1m rise for 2100. For the 100-year storm surge level, five scenarios were run. No vertical movement was assumed in the analysis. The economic cost of the loss due to sea level rise on infrastructural elements was calculated.

There has been no distribution of this study. It is still a draft document and is awaiting approval from Caribbean Planning for Adaptation to Climate Change (CPACC) Project.

### 3.2 Users and uses

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The Coastal Vulnerability and Risk Assessment for Sea Level Rise study has informed the:

- a. National Emergency Relief Organization (NERO) for developing evacuation plans for at-risk areas



- b. Physical Planning Division, Ministry of Finance for the approval process for physical development.
- c. Ministry of Agriculture, Lands, Forestry and Fisheries.
- d. Ministry of Works for damage assessment.

### 3.3 Current condition and limitations

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Unavailability of baseline data for the study was the main limitation. It was overcome to some extent by using field surveys and interviews.

### 3.4 Critical success factors

The success factor in the preparation of this study was that it was part of the CPACC project, with a time constraint posed for the completion of the study, and as such resources were assigned to meet the deadline.

### 3.5 Respondent

Respondent to the vulnerability assessment section of the questionnaire was:

Mr. Michael Mason  
Land Use Officer, Ministry of Agriculture, Lands, Forestry and Fisheries  
Tel: 1-473-440- 3083/2708  
Fax: 1-473-440-4191  
Email: [elvmason.lud@caribsurf.com](mailto:elvmason.lud@caribsurf.com)

#### 4.0 Digital Maps

Table 3 shows details of digital data themes available in the country.

**Table 3 – Digital Maps Available in Grenada**

<i>Theme*</i>	<i>Input scale</i>	<i>Year produced</i>	<i>Coverage</i>	<i>Primary source</i>
Hazard				
Contours	1:25 000	1985	Entire island of Grenada	Land Use Division, Ministry of Agriculture
Land use	1:25 000	2000		
Vegetation	1:25 000	2000		
Soils	1:25 000	1959		
Geology	1:25 000	unknown		
Roads	1:25 000	1985		
Rivers	1:25 000	1985		
Rainfall	1:25 000	1920-2003		
Water lines	1:25 000	2000		
Social facilities	1:25 000	2000		
Economic facilities	1:25 000	2000		
Buildings	1:25 000	1985	Southwest Grenada	

\* The data themes have the following datum, projection and file format:

Datum: GS8 Astro 1953  
 Projection: Transverse Mercator  
 Data format: ArcView shapefile (.shp) format

#### 5.0 Conclusions and Remarks

Grenada does not possess any hazard maps other than the ones produced in 1988 on hazards risk assessment of towns and villages in Grenada, which only pinpointed locations of hazard occurrence.

The Coastal Vulnerability and Risk Assessment for Sea Level Rise (Component 6) report on vulnerability of coastal resources to sea level rise is being used by agencies such as NERO and the Ministries of Finance, Agriculture, Works and Communications for developing evacuation plans, damage assessment, and for the physical development approval process.

No vulnerability assessments or hazard maps were prepared for technological hazards in the country.

Grenada is moving towards being better prepared to deal with hazards with its initiation of discussion among major stakeholders interested in vulnerability assessments. This was done at the First Caribbean Development Bank (CDB)

Vulnerability Assessment Forum held on 4th-6th December 2002. Panel discussions were held on:

- a. National Vulnerability Assessment Methodologies
- b. Sub-national and Community Vulnerability Assessment Methodologies
- c. Community Vulnerability Assessment Methodologies
- d. Structural Vulnerability Assessment Methodologies

(Personal Communications with Fabien Purcell, Planning Technologist/GIS Operator, Physical Planning Unit, Min. of Finance).

### References

Charles, Leon. 2001, **Coastal Vulnerability and Risk Assessment for Sea Level Rise (Component 6)**, Caribbean Planning for Adaptation to Climate Change Project (CPACC) project report, Charles & Associates (CAA) Inc., Grenada.

CIA FactBook, 2003. <http://www.cia.gov/cia/publications/factbook/geos/gj.html>

<http://www.uwiseismic.com/> (for information on Kick 'em Jenny submarine volcano)

<http://www.oas.org/en/cdmp/publist.htm>

### Appendix 1: Persons interviewed on 15 August 2003, Grenada

<b>Contact</b>	<b>Position</b>	<b>Agency</b>	<b>Tel. No./Fax. No</b>	<b>Email</b>
Mr. Slyvan McIntyre	National Disaster Coordinator	NERO	Tel: 1-473-440-0838 1-473-440-0890 Fax: 1-473-440-6674	<a href="mailto:nero@caribsurf.com">nero@caribsurf.com</a>
Mr. Michael Mason	GIS Technician	Land Use Division, Min. Agric.	Tel: 1-473-440-2708	<a href="mailto:elvmason@yahoo.com">elvmason@yahoo.com</a>
Mr. Fabien Purcell	Planning Technologist/ GIS Operator	Physical Planning Unit	Tel: 1-473-440- 2214 440-2471-440-9701	<a href="mailto:ppu@caribsurf.com">ppu@caribsurf.com</a>
Mr. J.C. St. Louis	Head, Project Implementation Management Unit	Min of Works, Comm, Pub. Utilites	Tel: 1-473-440-0123 Fax: 1-473-440-4122	<a href="mailto:jcstloius@hotmail.com">jcstloius@hotmail.com</a>
Mr. Trevor Thompson	Land Use Officer	Land Use Division, Min. Agric.	Tel: 1-473-440-2708	<a href="mailto:trevort_lud@yahoo.com">trevort_lud@yahoo.com</a>
Mr. Rickie Morain	Economist – Project Officer	Dep't of Economic Affairs, Min of Finance	Tel: 1-473-440-2731 Fax: 1-473-440-4115	<a href="mailto:rickiem@hotmail.com">rickiem@hotmail.com</a>