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STATUS OF HAZARD MAPS VULNERABILITY ASSESSMENTS AND DIGITAL MAPS

MONTSERRAT REPORT

THE CARIBBEAN DISASTER EMERGENCY
RESPONSE AGENCY (CDERA)

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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; 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 Maps, Vulnerability Assessments and Digital Maps in the Caribbean: Montserrat

1.0 INTRODUCTION

1.1 Physical and Socio-economic Background

Montserrat is an active volcanic island of approximately 101 sq km. It is a rugged pear-shaped island to the southwest of Antigua and rises to an elevation of over 900m in the Soufrière Hills. The Soufrière Hills Volcano began its current phase of activity in 1995. As a consequence, the southern two-thirds of the island has been devastated. This area included the capital city of Plymouth, the main port and airport. The island is now divided into three zones a southern exclusion zone, a northern safe zone and a daytime entry zone. The daytime entry zone is a buffer between the exclusion and safe zones and is subject to complete evacuation during periods of volcanic activity.

The 2001 census estimated that the population of Montserrat was 4,482. This represented a loss of 58% of the population since the 1991 census. Almost half of the present population consists of migrants. Relatively few Montserradians have chosen to return to the island after the major eruption of 1997. The continued volcanic activity, high cost of living, inadequate housing and lack of education and economic activities have been indicated as deterrents to returning¹. Research indicates that cyclic volcanic activity may continue for another 30 years.

Over 90% of the population of Montserrat was relocated due to the eruption of 1997². Prior to the eruption, population was concentrated in the southern section of the island that is now within the exclusion zone. Population is now located in the northern third of the island and appears to be concentrating on Brades. Brades is developing into the unofficial new capital. An official site is still to be identified by the government.

The reduction in population and consequently labour force, has resulted in an economic environment in which there is a mismatch of skills and opportunities. Prior to the eruption, the economy was heavily dependent on the tertiary sector and in particular tourism and government services. The destruction of the airport and main port has severely reduced revenues. The economy is receiving a boost from the construction sector because of reconstruction activities. A new airport is under construction and should be operational in 2004. However, the economy is still dependent on British aid to fund public sector and related activities.

¹ Smith Warner International. 2003. *Integrated Vulnerability Assessment of Montserrat*.

² Department for International Development, 1999. *Evaluation of HMG's Response to the Montserrat Volcanic Emergency*.

1.2 Major Disaster Issues Confronting the Country

The major disaster issue facing Montserrat is volcanic activity. The island has been and continues to be devastated by it. However, the island is also at risk to hurricanes and earthquake activity. Wind and storm surge associated with hurricanes are of major concern. Areas in the safe zone with slopes steeper than 60 degrees would be most at risk. Little Bay, the site of the new port is prone to storm surge. Seismically, it has been determined that the eastern Caribbean is “ripe for a major earthquake”. In terms of a “multi-hazard” event the Integrated Vulnerability Assessment of Montserrat suggests that heavy rainfall associated with a hurricane or tropical storm could trigger a volcanic dome collapse and an eruption.

Montserrat is also at risk to technological hazards, which include oil spills, environmental health, and low altitude aircraft operations. Oil spillage can occur at connection points in Cades Bay. Environmental health, particularly in relation to ash falls, is of great concern. The main aquifers are located in the south of the island, therefore protection of the northern aquifers are critical to the development of Montserrat. The airport facility planned for Gerald's has no provision for fuel and landing will be by navigational aid rather than instrument.

2.0 HAZARD MAPPING INITIATIVES

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The volcanic activity that began in Montserrat in 1995 led to major volcanic hazard mapping in support of disaster planning and management. Subsequently, Her Majesty's Government (HMG) organized periodic joint assessments to review the mapping and support policy planning. HMG has also supported the development of the Montserrat Volcano Observatory (MVO). The MVO developed the volcanic hazard map and this is integrated into the Vulnerability assessment of Montserrat produced by Smith Warner International. The Smith Warner document, completed in June 2003, is the most recent initiative in hazard mapping for Montserrat.

The integrated assessment produced two types of maps:

- A multi-hazard map
- Local area Storm surge maps

The multi-hazard map covers the entire island and is produced at a 1:25,000 scale. It identifies categorized hazard zones into low, medium, and high zones for pyroclastic flows, ash falls, rock fragment falls, wind and storm surge.

Two local area storm surge maps exist at 1:2500 scales for the areas of Little Bay and Carr's Bay. The local area storm surge maps delineate the boundary of the 4m-storm surge zone. The maps are all dated 2003 and can be sourced from the Emergency Operations Centre (EOC). All the maps use the Clarke 1880 Modified datum and the Transverse Mercator British West Indian Grid projection. At present, the maps are in hard copy format but are to be delivered in digital format. The digital format will probably be ESRI ArcView shapefiles. Table 1 lists the details for each type of hazard map in Montserrat.

Table 1 – Hazard Mapping of Montserrat

Type	Purpose	Scale	Date Produced	Primary Sources	Author
Multi-hazard	To determine categorized hazard zones	1:25000	2003	EOC	Smith Warner International
Storm Surge	To identify areas at risk	1:2500	2003	EOC	Smith Warner International

2.1 Methods of Preparation and Distribution

The volcanic hazard map was produced in collaboration with the MVO. It is based on the MVO volcanic deposit map and a study of the morphology of the Soufrière Hills Volcano. Storm surge is a result of wave and wind set-up and inverse barometric pressure rise (IBR). The methodology used by Smith Warner combined wave hindcast analysis with parametric wave models. Input data was sourced from the US National Oceanic and Atmospheric Administration (NOAA) hurricane database.

Maps were prepared from a 1982 1:2500 base map. The datum used was Clarke 1880 Modified and the projection Transverse Mercator British West Indian Grid. The hazard maps are available in published format and are also contained within the Integrated Vulnerability Assessment report. At present, distribution is limited because this report is under review.

2.2 Users and Uses

It was indicated that the maps would be used by the following agencies:

- Development Unit
- Physical Planning Unit
- Public Works
- EOC
- MVO

The Development Unit will use the maps to support development planning. The maps will inform the building codes of the Physical Planning Unit and the infrastructure and engineering activities of Public Works. The EOC and MVO will use the maps to strengthen disaster management and support seismic monitoring. The existing volcanic hazard map is used for community disaster management in all 5 district committees.

2.3 Current Condition and Limitations

The maps are very current. The EOC indicated that the scale of the hazard maps does not allow for the identification of individual elements at risk. Additional field investigation is required to identify vulnerable elements.

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2.4 Respondents

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Two interviews were conducted in Montserrat on August 8th 2003. The interviews were with the Director of the Emergency Operations Centre (EOC) and the GIS Manager of the Physical Planning Unit. Contact information is listed below:

- a) Lt. Horatio Tuitt, Director, EOC. Telephone: 1-664-491-7166; Fax: 1-664-491-2474; email: eoc@candw.ag
- b) Iftikhar Ahmed, GIS Manager, Physical Planning Unit, Ministry of Agriculture, Land, Housing and the Environment. Telephone: 1-664-491-6795; Fax: 1-664-491-5155; email: ahmed@candw.ag

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3.0 VULNERABILITY ASSESSMENT STUDIES

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In 2002 the British Government commissioned an Integrated Vulnerability Assessment study which was implemented by Smith Warner International of Jamaica. The completed study was delivered to the Government of Montserrat in July/August of 2003. The document is currently being reviewed. The assessment is of a multi-hazard nature and examines the effect of volcanic activity, wind and storm surge on areas of Montserrat. The objectives of the assessment are:

- a. To present the history of natural and technological hazards
- b. To determine the general vulnerability of the safe zone
- c. To determine the vulnerability of development in the safe zone
- d. To determine areas in safe zone prone to multiple hazards
- e. To consider physical and social infrastructure required to meet the island's needs
- f. To make disaster mitigation recommendations

3.1 Methods of Preparation and Distribution

The integrated vulnerability study combined the hazard maps prepared and identified areas prone to the various hazards. Areas at risk to multiple hazards were identified. The study relied heavily on the input of the MVO to determine volcanic vulnerability.

The assessment is distributed in report format.

3.2 Users and Uses

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At the time of preparation of this report, the Government of Montserrat had recently received the assessment study and the document was under review. The intention is to incorporate its findings into development planning, infrastructure works and disaster management. The assessment is to be used by

the Development Unit, the Physical Planning Unit, Public Works, the EOC and the MVO.

3.3 Current Conditions and Limitations

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As previously indicated, the Assessment report is very current. Concern has been expressed by the EOC that the recommendations are too generalized for local area application. The document does not attempt to categorize the vulnerability of specific elements to the hazards studied. The EOC had hoped to develop a mitigation plan on the basis of the Integrated Assessment. Preliminary review suggests that the document is a risk assessment rather than a vulnerability assessment. Additional work will be required to complete a detailed vulnerability assessment and develop a mitigation plan.

4.0 DIGITAL MAPS

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GIS activity in Montserrat is concentrated in the Physical Planning Unit at present but the intention is to distribute it to agencies that require it such as EOC. A national GIS is being developed to integrate digital maps and government databases. The GIS unit of the Physical Planning Unit has created a number of digital map layers. Table 3 indicates the digital map layers that exist for the island. All layers are in ArcView 8.2 shapefile format and were produced from 1:2500 scale maps. The maps use the Clarke 1880 Modified datum and the Transverse Mercator British West Indian Grid projection.

Table 3 – Digital Mapping in Montserrat

<i>Data Theme</i>	<i>Scale of input map</i>	<i>Year input map was produced</i>	<i>Area covered</i>	<i>Primary Source</i>
Hazards	1:2,500	1982	Entire island	EOC
Contours	1:2,500	1982	Northern 60%	Lands and Surveys
Roads	1:2,500	1982	Entire island	Physical Planning Unit / Lands and Surveys
Rivers	1:2,500	1982	Entire island	Physical Planning Unit / Lands and Surveys
Buildings	1:2,500	NS	10% of island	Montserrat Water Authority
Electricity lines	1:2,500	2001	Populated areas	Montserrat Electricity Company
Telephone lines	1:2,500	2001	Populated areas	Montserrat Electricity Company

5.0 Conclusions and Remarks

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The major disaster issues in Montserrat are volcanic activity and hurricanes. The Soufriere Hills Volcano began a cyclic pattern of eruption in 1995. Volcanic activity has had a devastating effect on the island's population and economy. Hurricanes are considered to be a major threat, as over the last decade they have caused significant structural and economic losses.

A multi-hazard vulnerability assessment has been conducted for the island and hazard maps have been produced for volcanic activity and the effects of hurricanes. The vulnerability assessment concentrates on the vulnerability of the safe zone and developed areas. The Development Unit, the Physical Planning Unit, Public Works, the EOC and the MVO will use the hazard maps and Vulnerability Assessment. The information provided will be used to support planning and development in Montserrat.

GIS activity is presently centered in the Physical Planning Unit. This unit is seeking to create a national GIS that is integrated with government databases. The government intends to extend the use of GIS to other agencies such as the EOC. Digital mapping exists for contours, roads, rivers, buildings, electricity and telephone lines.

References

Smith Warner International, 2003. Integrated Vulnerability Assessment of Monserrat.

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