

# National Rainwater Harvesting Programme for Grenada



Prepared by  
**The Caribbean Environmental Health Institute**  
P.O. Box 1111, The Morne, Castries, ST. LUCIA

Funded by  
**The United Nations Environment Programme (UNEP)**

Under the aegis of the  
**Ministry of Health, Social Security, Environment and  
Ecclesiastical Affairs, Grenada**

March 2006



# Table of Contents

List of Tables .....	iii
List of Figures .....	iii
Executive Summary .....	iv
Acronyms .....	v
Acknowledgements .....	vi
<b>1. Background and Scope .....</b>	<b>1</b>
<b>2. Introduction .....</b>	<b>3</b>
2.1 Water and developmental issues – Global to Small Island Developing State perspectives .....	3
2.2 Rainwater Harvesting – a practical water supply measure .....	4
<b>3. Situational Analysis for Grenada .....</b>	<b>7</b>
3.1 Geography .....	7
3.2 Demography .....	9
3.3 Economic Factors and Environmental Considerations .....	10
3.4 Impacts of Hurricanes Ivan and Emily .....	10
3.5 Impacts of extreme events on water resources in small islands .....	11
3.6 Water governance in Grenada .....	12
3.6.1 Water Supply and Demand .....	12
3.6.2 Water User Profiles .....	13
3.6.3 Policy and Legislation .....	13
3.6.4 Water Tariff Structure .....	14
3.7 Status of rainwater harvesting in Grenada .....	15
<b>4. Strategic Directions for a National Rainwater Harvesting Programme .....</b>	<b>17</b>
4.1 Component 1: Awareness Raising .....	17
4.1.1 Objectives .....	17
4.1.2 Key actions .....	20
4.1.3 Key indicators .....	22
4.1.4 Key results .....	22
4.1.5 Indicative costs .....	23

4.2	Component 2: Capacity building.....	24
4.2.1	Objectives .....	24
4.2.2	Key actions .....	25
4.2.3	Key indicators .....	26
4.2.4	Key results .....	27
4.2.5	Indicative costs .....	27
4.3	Component 3: Legislative and Policy Reform.....	28
4.3.1	Objectives .....	28
4.3.2	Key actions .....	34
4.3.3	Key indicators .....	35
4.3.4	Key results .....	35
4.3.5	Indicative costs .....	35
4.4	Component 4: Infrastructural Development.....	36
4.4.1	Objectives .....	36
4.4.2	Key actions .....	37
4.4.3	Key indicators .....	38
4.4.4	Key results .....	38
4.4.5	Indicative costs .....	39
4.5	Programme Administration, Monitoring and Evaluation.....	39
4.5.1	Indicative costs .....	40
<b>5.</b>	<b>Conclusion.....</b>	<b>49</b>
<b>References</b>	<b>.....</b>	<b>51</b>
<b>Annexes</b>	<b>.....</b>	<b>53</b>

## List of Tables

Table 1	Water and Sewage Tariff Structure (NAWASA Act regulation)	14
Table 2	Existing Water Rates for Carriacou (from communal cisterns)	15
Table 3	Summary of water-related legislative provisions and gaps related to incorporation of RWH augmentation	31
Table 4	Logical Framework - National Rainwater Harvesting Programme for Grenada	41

## List of Figures

Figure 1	Location map of Grenada and sister islands	7
Figure 2	Mean annual rainfall on mainland Grenada	8
Figure 3	Watershed management units on mainland Grenada and Carriacou	9
Figure 4	Grenada's water supply and distribution network	12

## Executive Summary

The Caribbean Environmental Health Institute (CEHI) is the executing agency for the Caribbean component for a United National Environment Programme (UNEP)-funded global initiative on the promotion of the practice of Rainwater Harvesting (RWH). The tri-island state of mainland Grenada and its sister islands of Carriacou and Petit Martinique were chosen as a pilot for this initiative given their recent experience with the destruction brought on by Hurricanes Ivan and Emily in 2004 and 2005 respectively. These storms caused massive damage to the housing stock and commercial sectors, and disrupted water supplies in mainland Grenada for extended periods as landslides and sedimentation from heavy rains caused problems to the distribution network, highlighting vulnerability of island communities to extreme water scarcity in a post-disaster environment. Carriacou and Petit Martinique on the other hand, although being significantly smaller and more arid than mainland Grenada, fared better in the post-disaster environment from a water availability stand-point, as the residents have a historic tradition of harvesting rainwater to meet virtually all consumptive demands. The contrast between these circumstances within the same country further contributed to the decision to select Grenada as the pilot country.

A national RWH programme was developed for Grenada, which emerged out of a national assessment of key public and private sector stakeholder institutions, and select communities, followed by national workshops held in mainland Grenada and Carriacou. The National Programme presented in this document is framed against the global vision of IWRM and a broad objective stated as “to contribute to the conservation of the water resources of Grenada through adoption of sustainable water management and conservation technologies”. More specifically, the programme seeks to develop and strengthen capacity to facilitate the implementation of rainwater harvesting for household and commercial purpose and develop support policies and incentives and mainstream them into national development strategies and policies.

Four major strategic areas constitute the programme:

- (1) Awareness-raising for the general public and policy makers;
- (2) Capacity building at both the individual and institutional levels;
- (3) Governance in terms of legislation and policy formulation;
- (4) Infrastructural development.

The programme is proposed to run over a three-year period at an estimated cost of US\$447,600. The lead national agency to promote the programme will be the Ministry of Health, Social Security, Environment and Ecclesiastical Affairs (MOH) and will partner with the National Water and Sewerage Authority (NAWASA), the agency with the legal mandate over the management of freshwater resources in the country.

## Acronyms

BSAP	Biodiversity Strategy and Action plan
CEHI	Caribbean Environmental Health Institute
CWWA	Caribbean Water and Wastewater Association
FAO	Food and Agricultural Organization
gals	Imperial gallons
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIDC	Grenada Industrial Development Corporation
GIPE	Grenada Institute of Professional Engineers
GIS	Geographical Information Systems
GoG	Government of Grenada
GWP-C	Global Water Partnership Caribbean
IICA	Inter-American Institute for Cooperation on Agriculture
IWCAM	Integrating Watershed and Coastal Areas Management (project)
IWRM	Integrated Water Resource Management
km	kilometers
kph	kilometers per hour
m <sup>3</sup> /d	cubic metres per day
mgd	million gallons per day
MOA	Ministry of Agriculture
MOH	Ministry of Health
mm	millimetres
mph	miles per hour
NADMA	National Disaster Management Agency
NAWASA	National Water and Sewerage Authority
OECS	Organization of Eastern Caribbean States
PAHO	Pan American Health Organization
PSA	Public Service Announcement
PSIP	Public Sector Investment Programme
RWH	Rain Water Harvesting
SIDS	Small Island Developing States
SOPAC	South Pacific Applied Geoscience Commission
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
US\$	US dollar (equivalent to 2.70 East Caribbean dollars)
UWI	University of the West Indies

## Acknowledgements

The Caribbean Environmental Health Institute wishes to express its sincere gratitude to all who assisted in any way in the development of this programme and recognizes the following key contributors to the project.

Gemma Bain-Thomas, Permanent Secretary in the Ministry of Health, Social Security, Environment and Ecclesiastical Affairs and staff of the Environmental Health Unit, notably Alan Edwards, Senior Environmental Health Officer and Christopher Joseph, Environmental Protection Coordinator for provision of close operational support to the project. Bernadette Lendor-Sylvester, Permanent Secretary in the Ministry of Carriacou and Petit Martinique Affairs is thanked for her enthusiastic support and for hosting the CEHI project team during their visits to Carriacou and Petit Martinique. Special thanks go to Alphonsus Daniel who served as technical advisor and co-contributor to this document.

Alan Neptune and Christopher Husbands of the National Water and Sewerage Authority are acknowledged for their useful insights into the operation and management of the rainwater harvesting systems on the islands of Carriacou and Petit Martinique. Technical contributions are also acknowledged from Fabian Purcell and Jocelyn Paul of the Ministry of Finance, Lana McPhil, Michael Mason and Anne Francis of the Ministry of Agriculture, Kelvin Dottin of the Ministry of Health and Sonia Roden of the Grenada Industrial Development Corporation.

The participants of the national workshops held in Grenada and Carriacou in February 2006 are thanked for providing their first-hand experiences on the use of RWH systems and their inputs in the conceptualization of the national RWH programme for Grenada.

The Project team finally thanks Elizabeth Khaka, Programme Officer, Division of Environmental Policy Implementation at UNEP, Nairobi, Kenya, for her support to this project.

## 1. Background and Scope

UNEP has embarked on a global initiative to promote Rainwater Harvesting (RWH) and to date has implemented projects in Asia, Africa and the Pacific Small Island Developing States (SIDS). UNEP is extending the initiative to the Caribbean using Grenada as a pilot, drawing on lessons learnt from other regions, particularly the Pacific SIDS. UNEP has also facilitated the formation of the Global Rainwater Partnership and CEHI will play a leadership role in its promotion in the Caribbean region.

The project funded by UNEP entitled “Promoting Rainwater Harvesting in Caribbean Small Island Developing States” has as a main objective ***to promote adoption of RWH practices and mainstreaming strategies that facilitate its adoption within wider water sector policies and to strengthen the institutional and human resources capacities of the Caribbean countries to use RWH.***

Grenada and its dependencies, Carriacou and Petit Martinique were selected for this pilot initiative given their recent experience with Hurricanes Ivan and Emily in 2004 and 2005 respectively. These storms wreaked great destruction on the tri-island state with the resulting negative impacts on water availability and quality, as well as on sanitation. The project has led to the articulation of a national RWH programme which intended to build some measure resilience in terms of access to water in a post-disaster scenario and augment water supply during drought conditions. Grenada is well-suited since it has all the attributes of a typical Caribbean SIDS and shares similar vulnerabilities and faces similar development challenges with respect to management and equitable access to water resources. It is anticipated that the lessons learnt from the promotion of RWH in Grenada will be applied through replication throughout the Caribbean region and contribute to global knowledge-sharing in parallel with initiatives in African and the Pacific regions.

The National RWH Programme was developed as a deliverable under the Project and is intended to serve as a guide for elaboration of a series of interventions by the Government of Grenada (GoG) in collaboration with all concerned stakeholders toward the greater adoption of RWH. The programme focuses on four major strategic areas. This was done against the backdrop of a situational analysis based on a national assessment that was carried out during November 2005 and national programme planning workshops convened in Grenada and Carriacou in February 2006. The four strategic areas are (1) Awareness Raising, (2) Capacity Building, (3) Legislative and Policy Formulation and (4) Infrastructural Development. For each strategic area the objectives and key actions are detailed, along with key indicators and indicative costs.



## **Grenada National Rainwater Harvesting Programme**

---

It is envisaged that that this Programme will be a major component within Grenada's Integrated Water Resource Management Plan when developed and articulated and should become an integral strategic element in the country's adaptive programme to climate change and climate variability.

## 2. Introduction

### 2.1. Water and developmental issues – Global to Small Island Developing State perspectives

**Water is life!** It is undisputed that water is the most vital natural resource and all of life and life support processes are dependent on this liquid medium. Many scientific theories postulated that life itself originated in an aqueous medium and even though it evolved to survive under drier conditions, the role of water as a medium and conveyance of biochemical reactions that support survival and propagation of life remains a critical one. The finiteness of available water on earth is very discernible when we consider that of the 1,400 million cubic kilometers of water on earth and circulating through the hydrological cycle, only one-hundredth of 1% of this amount is readily available for human use (FAO, 2005). It is believed that this quantity is sufficient to meet humanity's needs if it were evenly distributed; however, this available 9,000 cubic kilometer volume is very unevenly distributed across the planet. In areas where the indigenous water supplies average less than 1,000 cubic meters per person per year, these areas are categorized as water scarce (FAO, 2005).

The amount of water available to each person is falling considerably as growing human populations continue to place tremendous pressure on diminishing water resources. Water scarcity is exacerbated by pollution. According to the FAO (2005), 450 cubic kilometers of wastewater pollute the world's surface waters each year reducing utility of these waters for safe human consumption. This not only has implications for human populations but also for the natural environment, offsetting the delicate balance of ecological systems, and in severe cases unleashing irreversible consequences which may have direct adverse socio-economic consequences.

This situation is of particular concern for developing countries and Small Island Developing States (SIDS) where nearly one-third of the population has no access to safe drinking water. The Caribbean region has the least water available per capita as compared to other SIDS regions; just 13.3% of that available in the Indian Ocean SIDS and 1.7% of that available in the South Pacific SIDS on a per-capita basis. The island of Barbados for example is ranked among the ten most arid countries in the world. The geomorphology of most Caribbean islands limits the physical availability of freshwater reserves on account of relatively small landmass areas and typical mountainous terrain. The impacts of relatively frequent natural disasters (hurricanes and floods) exacerbated by human activity compromise water supply systems for extended periods, placing populations at risk under water scarce conditions. The impacts of climate change on the climatic and water regime in SIDS cannot be underestimated and constitutes an additional threat to water security.

## 2.2. Rainwater Harvesting – a practical water augmentation measure

Rainwater harvesting (RWH) has been practiced by civilization for more than 4,000 years to satisfy daily water demands. This ancient technique continues to be an important source, if not the only source of fresh water to many communities, particularly those isolated from municipal water distribution infrastructure. In the context of the increasing pressures on limited conventional reserves and consequent supply constraints, the practice has tremendous potential for application in the Caribbean, from household to commercial purpose. The Caribbean region has a sub-tropical climate with relatively abundant rainfall during half of the year where wet-season rainfall accumulations range between 1,500 mm to in excess of 3,000 mm.

The rudimentary practices of RWH have been improved with the introduction of simple technologies and most water quality standards can be met by application of basic practices. RWH is a simple and low-cost water supply technology which is generally easy to install and maintain. In spite of these considerations, the practice has been declining in the Caribbean as communities have become better serviced by central municipal systems. Many countries have not included rainwater harvesting in integrated water resources management (IWRM) plans and/or water polices, as has been done for management of ground and surface waters. As a result, there has been relatively little commitment to investment in the practice in many islands. This can be generally attributed to inadequate awareness and lack of requisite skills and knowledge among citizens and their governments.

The Thirteenth Session of the United Nations Commission on Sustainable Development (CSD 13) held between the 11<sup>th</sup> and 22<sup>nd</sup> April 2005, which focused on water policy, called for the use of rainwater harvesting to augment water demand and for the development of capacities in rainwater harvesting in accordance with the countries' needs involving all stakeholders in particular women, youth and local communities.

Rainwater harvesting continues to be a main source of water supply in many of the drier islands of the Caribbean, notably the Grenadines, the Leeward Islands, Virgin Islands, and the Bahamas. However, the emerging trend in some of these islands is to move away from traditional RWH methods in favour of alternative technologies such as desalination and deep-well abstraction based on centralized management and distribution to multiple consumers. These alternative technologies come at a higher cost and sustainability of these alternatives depends on consumers' ability and willingness to pay for these services. Where investment in expensive water supply options are not viable RWH remains an attractive option to meet shortfalls in supplies particularly during the dry months. An important consideration which warrants investment in RWH systems is enhancing water security following natural disasters, notably

hurricanes, where distribution infrastructure may be damaged and remain out of commission for extended periods. The applications of rainwater harvesting is not only limited to household and domestic purposes but also is critical to agriculture and can be used to offset demands for non-potable water in commercial sectors that also have heavy water use requirements.

According to UNEP Guidelines, investment in RWH should be framed against the following considerations:

- Is there a real need for an improved water supply in term of reliability and quality?
- Are present water supplies either distant and not easily accessible or contaminated, or both?
- Are suitable roofs and/or other catchment surfaces available for capture of rainwater?
- Does the average annual rainfall exceed 400 mm? (this consideration is a benchmark applied in arid countries and is not applicable in the Caribbean)
- Does an improved water supply feature prominently in the community's list of development priorities? (UNEP, 1996)

If the answers to the above questions are 'yes', it is a clear indication that rainwater harvesting might be a feasible water supply augmentation measure.

As with all technologies and processes there are advantages and inherent disadvantages. UNEP's Source Book of Alternative Technologies for Freshwater Augmentation in Latin America and the Caribbean (1996) lists the advantages and disadvantages typically associated with implementing RWH systems.

These include:

### **Advantages:**

- ◆ Rainwater harvesting provides a source of water at the point where it is needed. It is owner-operated and managed.
- ◆ It provides an essential reserve in times of emergency and/or breakdown of public water supply systems, particularly during natural disasters.
- ◆ The construction of a rooftop rainwater catchment system is simple, and local people can easily be trained to build one, minimizing its cost.
- ◆ The technology is flexible. The systems can be built to meet almost any requirements. Poor households can start with a single small tank and add more when they can afford them.

- ◆ It can improve the engineering of building foundations when cisterns are built as part of the substructure of the buildings, as in the case of mandatory cisterns.
- ◆ The physical and chemical properties of rainwater may be superior to those of groundwater or surface waters that may have been subjected to pollution, sometimes from unknown sources.
- ◆ Running costs are low.
- ◆ Construction, operation, and maintenance are not labour-intensive.

### **Disadvantages:**

- ◆ The success of rainfall harvesting depends upon the frequency and amount of rainfall; therefore, it is not a dependable water source in times of dry weather or prolonged drought.
- ◆ Low storage capacities will limit rainwater harvesting so that the system may not be able to provide water in a low rainfall period. Increased storage capacities add to construction and operating costs and may make the technology economically unfeasible, unless it is subsidized by government.
- ◆ Leakage from cisterns can cause the deterioration of load bearing slopes.
- ◆ Cisterns and storage tanks can be unsafe for small children if proper access protection is not provided.
- ◆ Possible contamination of water may result from animal wastes and vegetable matter.
- ◆ Where treatment of the water prior to potable use is infrequent, due to a lack of adequate resources or knowledge, health risks may result; further, cisterns can be a breeding ground for mosquitoes.
- ◆ Rainfall harvesting systems increase construction costs and may have an adverse effect on home ownership. Systems may add 30% to 40% to the cost of a building.
- ◆ Rainfall harvesting systems may reduce revenues to public utilities.
- ◆ Rainwater is mineral-free:
  - Flat taste
  - May cause nutrition deficiencies to people who are already on mineral-deficient diets

### 3. Situational Analysis for Grenada

#### 3.1. Geography

Grenada, the most southern of the Windward Islands group is located between Trinidad to the south and St. Vincent to the north. The tri-island State is of volcanic origin and consists of Grenada, Carriacou and Petit Martinique, which together have an area of 344 km<sup>2</sup> (133 sq miles) and a population of approximately 102,632 (OECS, 2005). The mainland Grenada is 34 km (21 miles) long and 19 km (12 miles) wide and is situated at 11° 58' north latitude and 61° 20' west longitude (GEF, 2001). **Figure 1** is a location map of Grenada, Carriacou and Petit Martinique.

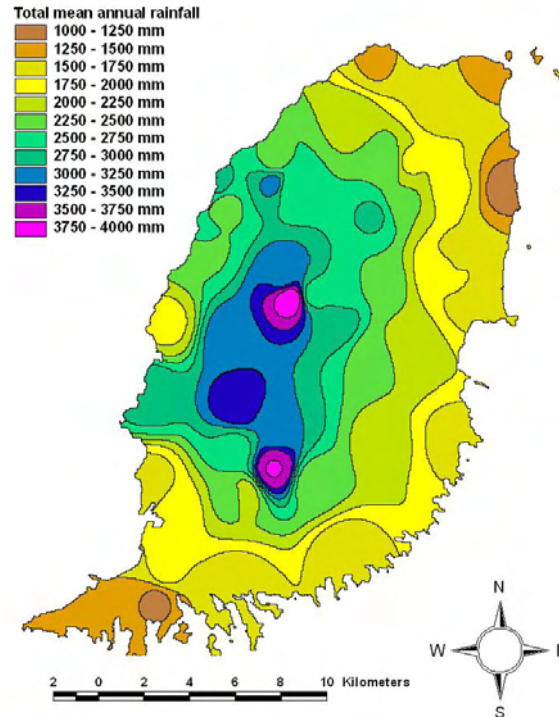
Grenada is predominantly of volcanic origin, although some sedimentary rocks of the Tertiary and Quaternary periods are present. The island was built up of volcanic eruptions during the tertiary and early Pleistocene times. The soils of Grenada are dominated by clay loams (84.5%) with clays (11.6%) and sandy loams (2.9%). The islands of Carriacou and Petit Martinique are also of volcanic origin and represent the exposed summits of peaks on a single narrow bank of submerged volcanic mountains. About 1/3 of these islands are of fossiliferous limestone which is mainly of the Miocene age (GEF, 2000).



**Figure 1** Location map of Grenada and sister islands

Grenada lies in the humid tropical zone within the Atlantic northeast trade wind belt, and the seasonal shift in these winds give rise to a wet season (June to December) and a dry season (January to May). The average annual rainfall for

mainland Grenada (**Figure 2**) ranges between 1,000 mm and 1,500 mm along the coastal zone, to approximately 4,000 mm in the interior, and supports surface stream flow and recharge of sub-surface aquifers. Due to the orographic effect contributed by the interior mountain ranges there is a marked spatial distribution in rainfall across the island which gives rise to the arid conditions experienced in the northern and southern extremes of the island (see Annex 1).



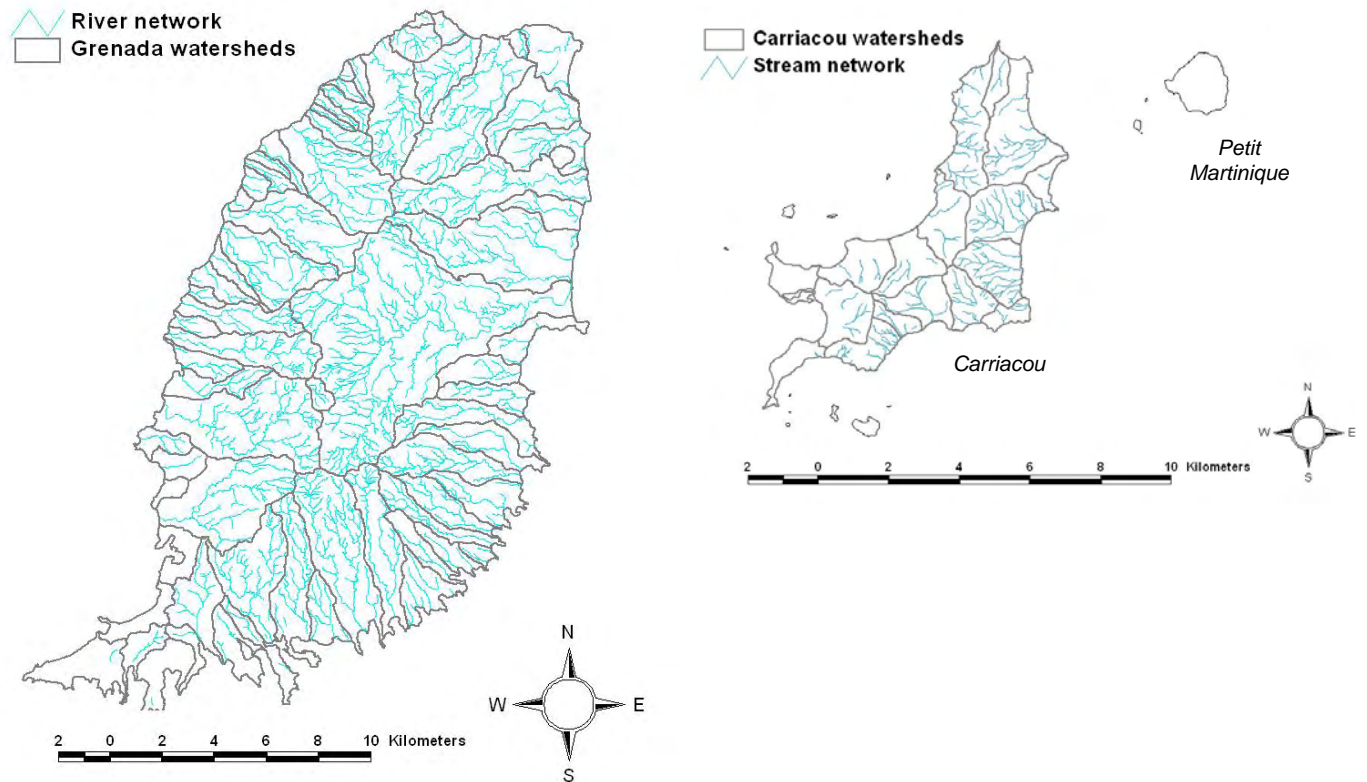
**Figure 2** Mean annual rainfall on mainland Grenada (source: interpolated map developed from rainfall station data; Land Use Division, Ministry of Agriculture).

Due to their small size and relatively low elevations, Carriacou and Petit Martinique are significantly drier than the mainland where the average annual rainfall is about 1,000 mm. In all the islands extended dry periods and extreme drought conditions during the dry season are not uncommon.

Temperatures at sea level are generally high with little seasonal, diurnal or spatial variation due to the dampening or stabilizing effect of the adjacent ocean. Annual average sea surface temperatures range between 28.3°C and 33.3°C, however, temperatures in the mountainous interior can dip to the low 20s Celsius during the winter months (GEF, 2000).

Grenada is segregated into 71 watershed areas, while Carriacou is disaggregated into 20 watershed units (**Figure 3**). No such differentiation exists

for Petit Martinique on account of its small size. On Grenada the watersheds are characterized by a relatively dense network of permanent rivers, while the sister islands are dominated by intermittent streams.



**Figure 3 Watershed management units on mainland Grenada and Carriacou** (source: Land Use Division, Ministry of Agriculture)

### 3.2. Demography

Owing to the mountainous topography, the majority of the population is confined to settlements within the coastal areas. The population of 102,632 (OECS, 2005) is inclusive of an estimated 5,000 on Carriacou and 800 on Petit Martinique. The main settlements are St. George's and Grenville on mainland Grenada, and Hillsborough in Carriacou; they account for almost 60% of the total population.



### 3.3. Economic Factors and Environmental Considerations

The per capita Gross Domestic Product (GDP) in 2001 was approximately US\$4,300. The economy has achieved an annual growth rate of over 5% for the period 1997 to 1999. The unemployment rate was estimated at 14% in 1999, and tourism exceeded agriculture as the main foreign exchange earner (BSAP, 2000).

The Medium-term Economic Strategy (GoG, 1999) guides the overall economic development of Grenada and includes the following environmental considerations:

- ◆ The Government's main objective is to promote the sustainable economic and social development of Grenada;
- ◆ The Government will institute environmental protection programmes, to ensure that economic and social development is physically and institutionally sustainable;
- ◆ The Medium-term Economic Strategy emphasizes greater attention to environmental issues;
- ◆ Over the medium-term the Government will continue to place emphasis on policies and actions designed to safeguard the environment;
- ◆ The Government will put measures in place to ensure preservation of coral reefs and marine life, coastal forests and wetlands.

In 2004 and 2005 Grenada was severely affected by the passage of two hurricanes within a 10-month period. The outfall from the devastation was felt across all sectors, notably in the hospitality, agricultural, manufacturing and housing sectors. The impacts are discussed in the next section.

### 3.4. Impacts of Hurricanes Ivan and Emily on Grenada

Hurricane Ivan, packing winds of up to 194 kph (120 mph) (Category 3 on the Saffir-Simpson scale) struck Grenada on September 7<sup>th</sup> 2004, causing the deaths of 37 people and damages in excess of US\$333 million, approximating 200% of the country's gross domestic product (GDP). Some 90% of the housing stock was destroyed, along with the loss of essential services, leaving the majority of the country's population in a highly vulnerable state. According to a damage assessment conducted by the OECS and the UN Economic Commission for Latin America and the Caribbean (UN-ECLAC), approximately 10,000 houses needed to be completely rebuilt and another 22,000 repaired. By

the end of 2005 several thousand still remained in temporary shelters or otherwise living in deplorable conditions, dependent on public assistance (UNDP, 2005).

During the early hours of July 15<sup>th</sup> 2005, Hurricane Emily (Category 1) passed through the tri-island state with winds of up to 140 kph (86 mph) and rainfall accumulations of up to 254 mm (12 inches) in some areas. The 7 hours of devastation inflicted on Grenada was estimated at US\$107.5 Million (NADMA, July 2005) or equivalent to 13% of the current value of GDP (OECS, 2005), with approximately 2,600 homes partially or completely destroyed, and roughly 4,590 persons displaced. One death was reported. Major damage was also sustained to infrastructure with disruption to the essential utilities including power and water supplies.

### **3.5. Impacts of extreme events on water resources in small islands**

The passage of two hurricanes and their cumulative destructive effects on Grenada, Carriacou and Petit Martinique elucidated the heightened need for reducing human-induced influences in terms of vulnerability to natural disasters. Greater emphasis needs to be placed on coordinated and integrated land use planning, regularization of unplanned settlements, watershed resource conservation and rehabilitation and integration of hurricane safety provisions in the rebuilding process.

The impacts of destructive cyclones on watershed systems of small islands are particularly evident in circumstances where the watersheds are highly degraded on account of unsustainable land management practices attributable to agriculture, housing or other infrastructural development. The associated high rainfall accumulations tend to cause massive erosion in steep upland areas where the soils are rendered exposed, with consequent siltation of river channels and deposition of sediment loads in offshore marine ecosystems. In many Caribbean islands a large percentage of the potable water supply is sourced from rivers and streams typically in upland areas that may be already compromised by human activity in the watershed. Silt and debris-laden high storm flows frequently choke the water intake infrastructure, while landslides often cause breakages in the distribution lines, forcing supply interruptions to many communities for weeks, and in some cases, months. Water supply deficiencies over extended periods can have potentially serious adverse public health and sanitary implications. Hence the need to secure adequate potable water supplies to assist with the post-disaster restoration and recovery efforts cannot be understated.

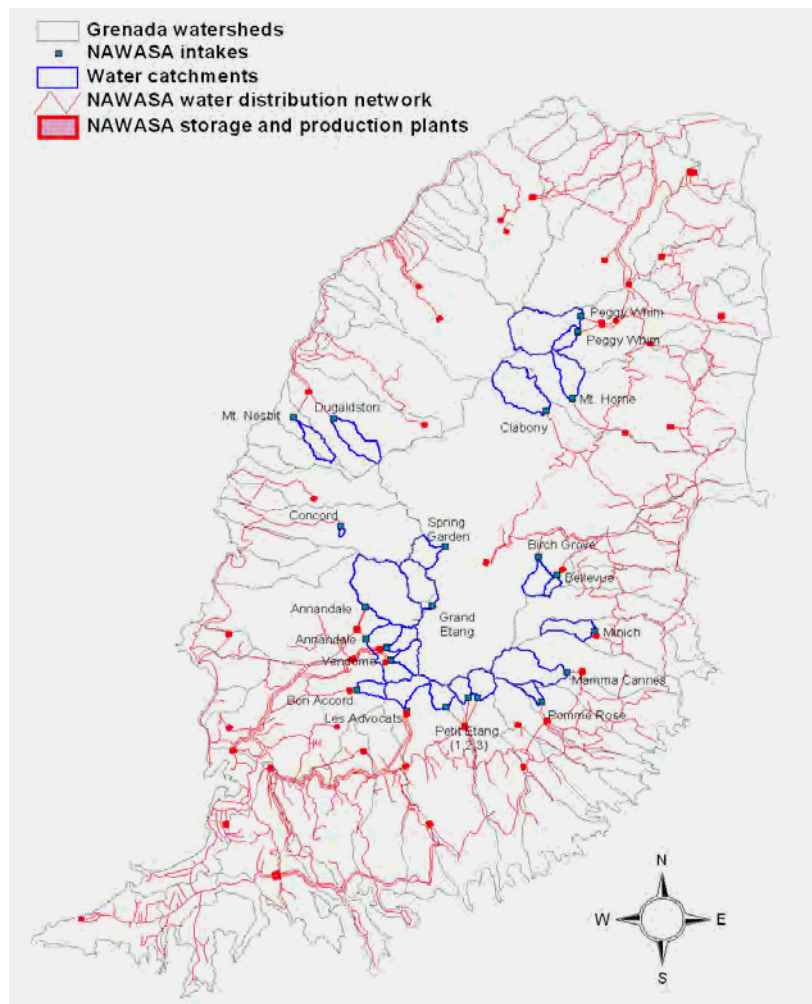
Following both hurricanes, the availability of potable water to Carriacou residents as compared to those on mainland Grenada was not seriously compromised due to the dominance of RWH systems on that island. Whereas blockage of intake

dams and damages to the distribution network disrupted the water supply on mainland Grenada for extended periods, the individual household and communal cisterns of Carriacou and Petit Martinique permitted a ready potable water supply during the immediate recovery period.

### 3.6. Water governance in Grenada

#### 3.6.1. Water Supply and Demand

There are 23 surface and 6 ground water potable supply sources (**Figure 4**) on mainland Grenada, which yield some 54,600 m<sup>3</sup>/day (12 mgd) in the rainy season and a maximum of 31,800 m<sup>3</sup>/day (7 mgd) in the dry season. The water demand in the rainy season is 45,500 m<sup>3</sup>/day (10 mgd) and in the dry season, 54,600 m<sup>3</sup>/day (12 mgd) (GEF, 2000). The higher water demand in the dry season is largely due to increased demand from the hospitality sector (peak visitor arrivals occur during this period) and irrigation (landscaping and agricultural) requirements.



**Figure 4** Grenada’s water supply and distribution network  
(source: NAWASA and Land Use Division, Ministry of Agriculture)

There are 33 community catchment and cisterns in Carriacou and Petit Martinique. Communal cisterns have also been installed in public buildings, schools hospitals, medical clinics and churches (Peters, 2002), totaling some 78 public storage systems.

### 3.6.2. Water User Profiles

Water users, in accordance to the NAWASA Act of 1990, are categorized as domestic and non-domestic users for purposes of tariff-setting. The domestic users can be re-classified into the following sub-categories:

- ◆ Household (in excess of 86% of the population are serviced by the potable water distribution network NAWASA pers. comm., 2006)
- ◆ Agricultural (crop and livestock production).

The non-domestic user category is inclusive of:

- ◆ Commercial enterprises (restaurants, businesses);
- ◆ Industrial enterprises (light manufacturing);
- ◆ Hospitality sector (hotels);
- ◆ Public institutions (hospitals, prisons, government buildings);
- ◆ Schools;
- ◆ Ships

### 3.6.3. Policy and Legislation

The National Water and Sewerage Authority (NAWASA) Act, 1990 was passed to establish the Authority to execute the mandate of the Government of Grenada in:

- a) the provision of water supplies and the conservation, augmentation, distribution and proper use of water resources including preservation and protection of catchment areas;
- b) sewerage and the treatment and disposal of sewage and other effluents.

According to this Act, the Authority shall have full power over all waters whether surface or underground in the State of Grenada, and shall collate and publish information from which assessment can be made of the actual and prospective water resources in the State. Additionally, the Authority shall, unless unavoidable, be responsible for the provision of a satisfactory supply of potable water for domestic purposes and an otherwise satisfactory supply of water for

agricultural, industrial and commercial purposes and for such other purposes as may be prescribed by the Minister.

Essentially, the Act covers all areas such as the institutional arrangements of the Authority and the administration of the powers vested in this body, the powers of entry and acquisition for water and sewerage works, financial provisions, rates and charges, acquisition of property and wells and boreholes. Catchment areas are given emphasis and measures for the protection and conservation are outlined along with the collaborative arrangement with the Ministry of Agriculture's Forestry Division for the management of these areas.

### **3.6.4. Water Tariff Structure**

Under the provisions of the NAWASA Act (1990), water and sewerage charges are incorporated into a monthly customer bill for the metered, and a quarterly bill for the un-metered consumers. The tariff structure is presented in Table 1 (source: GoG, 1999).

**Table 1 Water and Sewage Tariff Structure (NAWASA Act regulation)**

<b>(A) Metered Domestic Customers</b>
<p><b>Category 1 - Consumption less than 10 m<sup>3</sup> (2,200 gals):</b> US\$2.22 per 5 m<sup>3</sup> (1000 gals) per month</p> <p><b>Category 2 - Consumption between 10 m<sup>3</sup> (2,200) and 25 m<sup>3</sup> (5,500 gals):</b> US\$3.70 per 5 m<sup>3</sup> (1,000 gals) per month</p> <p><b>Category 3 - Consumption above 25 m<sup>3</sup> (5,500 gals):</b> US\$5.56 per 5 m<sup>3</sup> (1,000 gals) per month</p> <p><b>Fixed charge of US\$2.96 per connection.</b></p>
<b>(B) Un-metered Domestic Consumers</b>
<p>0.25% of the market value of the property for the first US\$37,037 per year 0.15% of the market value of the property for the next US\$74,074 per year 0.05% of the market value of the property above US\$222,222 per year</p> <p>A minimum charge of US\$35.60 per year (if property value is US\$14,074 or less)</p>
<b>(C) Metered Commercial and Industrial Consumers</b>
<p>Proportional Part - US\$5.86 per 5 m<sup>3</sup> (1,000 gals) per month</p> <p>Fixed Part – 40 % of un-metered rates for these premises.</p>
<b>(D) Un-metered Commercial and Industrial Consumers and Government Buildings</b>
<p>0.35% of the Market Value of the property for the first US\$185,185 per year 0.30% of the Market Value of the property for the next US\$185,185 per year 0.25% of the Market Value of the property above US\$370,370 per year</p> <p>Minimum charge of US\$35.55 per year</p>
<b>(E) Ships - US\$25 per 5 m<sup>3</sup> (1,000) gallons</b>
<b>(F) Private trucks/tankers - US\$5.56 per 5 m<sup>3</sup> (1,000) gallons</b>

The existing rates for water supplied from the communal cisterns of Carriacou are outlined in Table 2.

**Table 2 Existing Water Rates for Carriacou (from communal cisterns)**

Cost	Quantity
US\$0.24 for 3 months	14 litres (1 pan) per day
US\$0.12 for 2 months	14 litres every other day
US\$0.06 for 1 month	14 litres every other day
US\$0.36 for 450 litres of water	

According to an OECS study (1986), there were no records available to quantify the revenue derived from the distribution of water from communal systems in Carriacou. It suggested that administrative costs such as issuing receipts and maintaining accounts exceeded the benefits of revenue collection. For sustainable operation and maintenance of the RWH systems in Carriacou, a viable system of revenue collection for cost recovery needs to be instituted.

### **3.7. Status of rainwater harvesting in Grenada**

Rainwater harvesting is practised throughout the tri-island state. The level of sophistication varies from simple containers storing roof runoff to relatively sophisticated catchment design, conveyance, filtration, storage and distribution systems. Some measure of protection and treatment of the rainwater harvested is employed but that is dependent on whether the water is used for consumption purposes. Maintenance of cisterns is seasonal and although in Carriacou and Petit Martinique there is distaste for treatment of the water by chlorination, there is widespread use of biological control to prevent the breeding of mosquito vectors. Rainwater also finds uses in other sectors such as agriculture, construction and tourism.

In a CEHI assessment of RWH practice in Grenada, Carriacou and Petit Martinique (November 2005), it was revealed that some 66% of households on mainland Grenada, and 100% of households on Carriacou and Petit Martinique utilize rainwater. Individual household RWH systems are most common in Carriacou and Petit Martinique and have developed in sophistication with increasing affluence. This has however resulted in reduced reliance on the traditional communal rainwater catchments and cisterns. The survey results showed that there is a preference for consumption of rainwater and there is a perception that many benefits are to be derived from rainwater harvesting. Most respondents indicated that there is need to develop rainwater harvesting and provide incentives for the initiatives. Some 83% of the respondents on the

mainland indicated a willingness to practise rainwater harvesting while all surveyed in Carriacou and Petit Martinique were willing to continue using rainwater as the primary source of freshwater.

A national rainwater harvesting programme has been recognized as a critical need from the assessment survey and stakeholder dialogues. It was noted however that for mainland Grenada, emphasis should be placed on promotion of the practice, the development of a supportive policy for rainwater harvesting and the appropriate of incentives for householders and economic sectors. For Carriacou and Petit Martinique, the emphasis should be placed on water treatment and the protection of storage systems from contamination. The Carriacou and Petit Martinique stakeholders identified the need for assistance in rehabilitation of communal RWH systems that serve economically disadvantaged households in particular.

## 4. Strategic Directions for a National RWH Programme

At the overall objective level the proposed programme for Grenada attempts to ***Contribute to the conservation of the water resources of Grenada through adoption of sustainable water management and conservation technologies.*** The specific objective the programme attempts to achieve and to contribute to the overall objective is defined as: ***Capacity to facilitate the implementation of rainwater harvesting for household and commercial purposes strengthened and support policies and incentives developed and mainstreamed into national development strategies and policies.***

The strategic areas (components) forming the basis of the programme are as follows; (1) Awareness raising, (2) Capacity building, (3) Legislative and policy formulation and (4) Infrastructural development. A fifth element is Programme administration, Monitoring and Evaluation. This additional element, which is costed, is being built into the Programme given the present human and financial constraints in the proposed lead agencies which are envisaged to carry out the Monitoring and Evaluation of the Programme. A series of interventions within each component have been identified that will lead to the creation of an enabling environment that fosters greater investment in RWH as a viable water supply augmentation measure. The extent to which society re-adopts what is an old traditional practice will depend greatly on how much support is provided at the institutional level. In this regard the Government of Grenada through the Ministry of Health and Environment, with support from the National Water and Sewerage Authority are proposed as the lead agencies to advance the process.

For each component the objectives are defined, along with the key actions, verifiable indicators that need to be monitored, and the anticipated result. Indicative costs for each activity are provided. A logical framework analysis for the programme is included.

### 4.1. Component 1: Awareness Raising

#### 4.1.1. Objectives

**To enhance positive public awareness on the practice of RWH** – RWH was at one time universally practised before the introduction of a potable supply distribution network on mainland Grenada. Traditional RWH systems were rudimentary when households had no internal plumbing. As communities became more affluent and houses were built with internal plumbing, the perceived need for RWH declined and generally fell out of favour. Based on the



national assessment conducted by CEHI in November 2005, the majority of households on mainland Grenada do not practise water supply augmentation using rainwater, although many households are equipped with back-up storage for potable water. Up-scale housing developments on the southern coast are all outfitted with RWH systems largely due to the unreliability of the potable supply in those areas.

The Programme therefore focuses on crafting a new image for RWH on the premise of building resilience in an environment where there is increasing pressure on scarce water resources. This will be framed against the backdrop of ensuring some measure of security of supply in a post-disaster circumstance and during prolonged drought conditions when demand surpasses supply. The recent experience with Hurricanes Ivan and Emily will no doubt help galvanize favorable public perception. The threats of climate change and changes to the rainfall regime in the Caribbean region are of concern and will be an issue that will need to be confronted over the coming decades. Adaptive strategies have water resource security at their core such as the National Communication on Climate Change and the programme proposed here will build on adaptive measures proposed by the country.

**To increase investment in RWH** – Investing in RWH systems has been constrained to some degree by the cost associated with construction of storage systems within households, in some cases adding anywhere between 10 and 20% to the cost of construction. For most potential homeowners this added cost is typically not factored in new homes, and existing home owners are typically unwilling to invest in retro-fitting their homes with appropriate measures to capture rainwater on account of cost. The public education strategy must focus on weighing the long-term advantages of RWH. While the initial investment cost may be relatively high, particularly for lower-income households, the cost of foregoing investment can actually outweigh the investment.

The Programme will focus also on the hospitality and other commercial sectors which consume large volumes of water for a variety of purposes. In many instances they utilize the potable supply for non-drinking purpose; in other words, using relatively expensive water for ‘low-end’ uses. These low-end uses can be serviced by rainwater to some extent, whereby operators can realize significant cost savings while contributing to water conservation particularly when the supply is under stress at peak demand during the dry season. Investment in RWH not only translates into direct cost saving but contributes to continued service provision which is of direct economic interest of service providers.

**To promote RWH as a viable augmentation measure for conventional potable networks in water-stressed areas, and promote water conservation** – In parts of Grenada, notably the southwestern and northern areas, there is significant water stress particularly during the dry season when NAWASA resorts to water rationing in order to service communities with water for at least part of

the day. The situation is worse for communities that are situated at the most distal ends of the water distribution network. Residents and business operators in these areas know first-hand the difficulties associated with water shortages and are readily accepting of implementing RWH systems.

The Programme will use these areas as prime examples drawing on the fact that some of the areas lie within key tourist development zones, a sector that is becoming increasingly important as a source of foreign exchange and investment to the country. Emphasis will be placed on water conservation in general as part of on-going education with all partners in the water sector.

**To improve practices in existing RWH with respect to water quality and sanitation** – The residents of Carriacou and Petit Martinique have traditionally relied almost exclusively on rainwater to meet daily water requirements. The communities of Bogles, Cherry Hill and L’Esterre on Carriacou and Petit Martinique utilize communal catchment systems that service some households. Traditionally, these systems have not had proper maintenance regimens and water quality is known to be compromised. Security fencing intended to exclude livestock and persons from polluting the catchment surfaces are in a state of disrepair and in the case of the Cherry Hill system the cistern no longer holds water to capacity. Persons also obtain water directly from the cisterns via bucket increasing the risk of introducing contaminants into the water supply. From the assessment survey carried out, residents were open about their dislike for carrying out chemical treatment such as chlorination to their cistern water given the perception that it alters the water’s flavor and it is not healthy. Although not quantified through clinical observations, it is assumed that there are possible health risks from consumption of un-treated water from cisterns that are not properly maintained. The Environmental Health Unit of the Ministry of Health and NAWASA has made deliberate efforts in the past to encourage the practice of disinfection of water to guard against possible risk of infection.

The issue of sanitation needs to be addressed in two areas; (1) proper management of community RWH systems through a regulated regime and (2) encouragement of good practices at the individual household level. With regard to the first area, there is a lack of a coordinated framework for administration of community catchment systems. It is the common perception that the systems are the responsibility of the State and that the State should take full responsibility for their operations and maintenance. However the NAWASA Act, the statute that essentially governs management of all water resources in Grenada, is silent on the precise operating mechanisms for community rainwater harvesting systems and consequently NAWASA tends to place limited emphasis on the operations of these systems.

The awareness strategy will therefore need to address this issue and will need to be based on creating clear understanding on the roles of the various

stakeholders in provision of quality water from communal systems. Policy makers will need to be sensitized so as to recognize the social and economic dimensions associated with management of common-property resources as is the case with operation and management of communal systems.

As a complementary initiative, community members on Carriacou and Petit Martinique will need to be sensitized on the value of treatment of water supplies and the safe operations and maintenance of communal systems. Persons who own private systems will also need to be sensitized in the same manner with respect to proper care of household systems and treatment of stored water to guard against contamination potential.

**To facilitate the creation of an appropriate incentive environment for RWH based on informed policy making** – The adoption of RWH systems in households and commercial operations requires some level of investment. The scale of investment will vary depending on the size of the household and the numbers of persons reliant on the system, or in the case of commercial operations, on the water requirements that can be readily catered for by RWH. Careful considerations must be made to ensure that the systems are adequately designed so that cost-effective results can be delivered. In the national assessment conducted in November 2005, many respondents noted that access to support measures by way of special incentives would be desirable to offset the cost of investment in RWH.

To this end, appropriate policy must be crafted to effect meaningful incentive measures. Incentives must be developed around the central theme of water conservation and should include the range of possibilities that encourages optimal utilization of water resources, rewards good practitioners and penalizes abusers. The NAWASA tariff is designed to impose higher payments for greater water consumption (commercial users) as a regulatory mechanism; universal meterization is being implemented in tandem in an effort to encourage water conservation. An incentive regime in the water sector will help to lend support to private householders, farmers and firms to implement good practices in water management, particularly where value-added investments are to be made.

Policy makers and resource users should be targeted in an awareness programme that facilitates the development of the policy framework and incentives for water resource management that includes RWH. This should form an integral facet of integrated water resource management plans (IWRMs). Grenada's IWRM Plan is yet to be elaborated; dialogue on RWH can in fact lend considerable support to the process of advocacy in the water management sector in development of the IWRM Plan.

### 4.1.2. Key actions

- ◆ **Public and policy-makers workshops and seminars** – A series of workshops and seminars targeting community members, the private and commercial sectors and policy makers will assist in promotion of the programme and create the environment necessary to foster investment in the practice. These seminars and workshops will need to be tailored to ensure maximum receptivity depending on the audience. It is anticipated that educational materials developed under the CEHI/UNEP project will form core resources for facilitators.
- ◆ **Media productions** – Public service announcements (PSAs), TV documentaries, features, radio/TV panel discussions and print articles in newspapers and magazines should be used to promote the message of water conservation and RWH. These should be designed to coincide with significant commemoration days (World Water Day, March 22<sup>nd</sup>, World Environment Day, June 5<sup>th</sup>, World Food Day October 16<sup>th</sup> and World Day to Combat Desertification, June 17<sup>th</sup>) and should be featured in advance of the annual dry season when the public is most aware of impending water scarcity. Under the CEHI/UNEP RWH project, radio PSAs and a 15-minutes video documentary which were be produced could be used not only in Grenada, but across the Caribbean region.
- ◆ **Dissemination of technical material** – In addition to the media productions, a reserve of technical material should be made available to the general public for consultation where specific information on the design and construction of RWH systems is being sought. A Handbook and technical brochures are being developed under the CEHI/UNEP RWH project which will furnish users appropriate information for all types of applications. The Handbook should be regarded as a work in progress; as new lessons are learnt and new technologies introduced, it will be updated. The Handbook and brochures will be made available in limited copies but will be available in Adobe pdf format on CEHI's website at no cost.
- ◆ **School competitions** – Competitive essay and art competitions to promote the message of water conservation to include RWH as a significant means of practising water conservation should be organized. These programmes can be tied into significant commemorative events such as World Water Day (March 22<sup>nd</sup>), World Environment Day (June 5<sup>th</sup>), World Food Day (October 16<sup>th</sup>) and World Day to Combat Desertification (June 17<sup>th</sup>).
- ◆ **Creation of a RWH website** – A national water resources website with resource material that should include RWH material should be developed. The MOH and NAWASA could be the primary institutional hosts. This site

should be linked to CEHI's (and UNEP's) websites that features the RWH project, the Caribbean Water and Waste Water Association (CWWA) and the Global Water Partnership Caribbean (GWP-C) websites. Other good Caribbean websites include the CARICOM Caribbean Climate Change Centre (CCCCC) and the Caribbean Agricultural Research and Development Institute (CARDI).

- ◆ **Public / stakeholder assessments on level of awareness pre- and post-programme** – Essential to any public outreach campaign is the systematic assessment of impact. Society should be polled periodically to determine their receptivity to water conservation and extent to which they may have adopted practices as a result of the public education programmes. The Ministry of Health and NAWASA could partner in this regard.

### 4.1.3. Key indicators

- ◆ Percentage participation (in relation to number invited) in awareness seminars;
- ◆ Number of development applications to the Planning Ministry (households, commercial enterprises) that include RWH systems;
- ◆ Number of times video, radio PSAs are broadcast via local media;
- ◆ Number of handbooks and brochures disseminated; both in print and downloads electronic versions;
- ◆ Number of schools and students participating in RWH (water conservation) awareness programmes;
- ◆ Existence of dedicated water resources website. Number of hits on the web-site; number question and answer submissions; traffic on discussion board;
- ◆ Survey results compiled and analyzed.

### 4.1.4. Key result

***Public and policy makers awareness raised on RWH concepts, practices, water quality and sanitation issues***

#### 4.1.5. Indicative costs

<b>Activity expenditure items</b>	<b>Estimated cost US\$</b>
Workshops and seminars for public and policy makers. At least 8 workshops/seminars.	14,800
Radio productions. At least 4 radio PSAs.	3,000
Video features. At least 2 feature programmes.	7,400
Printed material (brochures). At least 2 brochures.	1,100
Website development	5,600
School awareness programme (primary and tertiary levels)	3,000
Public and commercial house surveys. 4 surveys (annually and at end of programme)	14,800
<b>Total</b>	<b>49,700</b>

## 4.2. Component 2: Capacity Building

### 4.2.1. Objectives

**To develop and improve national competency in developing (design and construction) and operating RWH systems** – The national assessment on RWH practice in Grenada, Carriacou and Petit Martinique revealed that there are significant capacity gaps for installation and operation of RWH systems. Building contractors in Carriacou and Petit Martinique are familiar with cistern construction given the long history of RWH. On Grenada however, the knowledge on specific design criteria for cisterns and the use of the stored water for non-potable purposes is generally lacking among building contractors. Examples are known where poor cistern design prohibits maintenance, and in extreme cases the integrity of building foundations are compromised (A. Daniel pers. comm., 2006).

Capacity will also need to be developed in application of RWH technologies for non-household uses, particularly in the commercial and agricultural sectors, with a clear focus on enhancing efficiencies in water utilization. RWH application can also be extended to municipal use in the case of firefighting where paved roads, parking lot surfaces, and roofs of large buildings can be used to harvest rainwater for storage at strategic locations as water reserves. This is of value particularly in elevated clustered housing developments where access to water is often a problem.

NAWASA has some resident capacity in operation of RWH systems given the nature of NAWASA's water infrastructure operations. They, in partnership with the Ministry of Health provide technical support in Carriacou and Petit Martinique in operation and maintenance of community RWH systems and provide advice to home owners in management of RWH systems.

This Programme proposes to train a cadre of specialists in the area of design and planning of RWH systems within the private sector, drawn from the pool of private contractors, engineers and architects. Training will be necessary for public service professionals in the Planning Section of the Ministry of Finance, the Ministry of Health and the Ministry of Agriculture to equip them with the necessary advisory and technical support tools for transfer to clients. It is anticipated that the Grenada Institute of Professional Engineers (GIPE) will be a key partner in support of coordinated capacity development.

**To train communities in Carriacou and Petit Martinique in operation and management of community RWH systems** – The management and operation of the communal RWH systems in Carriacou and Petit Martinique is of serious concern. Although NAWASA has played a key role in the management and upkeep of these systems in collaboration with the Ministry of Health, the residents of communities these systems serve do not play an integral role in assisting with management. Vivid examples that include permitting livestock on

the catchment surfaces, allowing vegetation to grow on the catchment surfaces causing serious damage and facilitating the accumulation of detritus on the surface, are the result of a lack of collective responsibility on the part of the beneficiaries. The community members in fact do not pay for the water obtained from these systems, which further exemplifies an attitude of non-committal to any responsibility.

The Programme calls for awareness-building as noted in 4.1 above, but will be strengthened by developing capacity among the community so that members can play a collaborative role along with support agencies in management and maintenance of their communal water supply. During the national assessment and the follow-up workshop in February 2006 on Carriacou, participants expressed the strong desire to rehabilitate the communal catchment that serves the Bogles and Cherry Hill communities and acknowledged that capacity of the community needs to be raised so that rehabilitative measures would be sustained through a well managed community-based maintenance programme.

**To train professionals in water governance** – This is a recurring need in all facets of water resource management including RWH and must always be kept in the forefront of development planning for water. Training professionals in water governance lends significant value to the crafting of appropriate policy and incentives and creating the enabling environment to facilitate investment in water management and conservation programmes by the private sector and civil society.

The Programme will call for a series of technical exchanges between local public and private sector professionals with other professionals and consultants from the Caribbean and wider afield. Some of these exchanges may take the form of in-country technical seminars and workshops while others may involve travel to neighbouring Caribbean countries, and where necessary, outside the region, to gain first-hand insights on best practices that are relevant to Grenada's needs. Given the cost involved in this undertaking donor assistance will need to be sought through partners such as the Food and Agricultural Organization (FAO), the Caribbean Water and Waste Water Association (CWWA), the Global Water Partnership (GWP). The Integrating Watershed and Coastal Areas Management project (IWCAM) which is a Caribbean-wide initiative executed by CEHI could contribute resources to facilitate some of the envisaged activities.

### 4.2.2. Key actions

- ◆ **Technical seminars** – Special seminar series for home owners, contractors, hotel plant managers, industry, agricultural extension officers, farmers, irrigation service providers and senior policy makers should be organized to sensitize them on practical issues related to implementation (operation, maintenance and quality testing/monitoring) of RWH. These seminars can be organized and tailored depending on the target sector. A



training-of-trainers programme should be considered. The Grenada Institute of Professional Engineers should play a key role particularly in reaching out to the private sector. The Ministry of Health could be the key institution in reaching out to householders. The Rainwater Harvesting Handbook developed under the CEHI/UNEP project should be used as a key tool in this effort.

- ◆ **Training workshops for communities in Carriacou and Petit Martinique on best practices for communal systems** – Training workshops for targeted community members should be conducted in the areas of cistern and distribution network maintenance, water quality testing and treatment. It is proposed that this be carried out under technical supervision of the Ministry of Health with administrative support from the Ministry of Carriacou and Petit Martinique Affairs. The technical Handbook developed by the CEHI/UNEP project will be used as a major reference.
- ◆ **Technical exchange programme** – A series of exchanges should be organized to send professionals to Grenada and have reciprocal visits to regional and extra-regional countries to exchange experiences in rainwater harvesting applications. In several Caribbean countries, the water sectors have been, or are in the process of being reformed to meet the challenges imposed by rising water scarcity, the ever increasing complexity of water user allocations and requirements from the agri-food, tourism and health sectors which have direct trade implications. RWH, where it serves multiple users in the commercial and hospitality sectors, finds itself within the same arena as conventional supply sources and lessons learnt by Caribbean neighbours in water sector reform can be translated to the Grenadian circumstance. Other water-scarce SIDS, notably those in the South Pacific have made tremendous strides in RWH in all areas from technical advancements to policy and governance. These countries have similar geography and face similar development challenges making them ideal for partnering in exchange programmes.

### 4.2.3. Key indicators

- ◆ Number of technical seminar sessions organized and attendance level;
- ◆ Number of downloads of RWH Handbook from source websites; number of hard copies disseminated by various agencies;
- ◆ Number of technical professional exchanges undertaken.

#### **4.2.4. Key result**

***Capacity strengthened amongst professionals (technical, advisory services), stakeholders, for the implementation, management of RWH systems***

#### **4.2.5. Indicative costs**

<b>Activity expenditure items</b>	<b>Estimated cost US\$</b>
Technical training seminars. At least 10 organized for various sectors and home owners	10,000
Training workshops on operation and maintenance of RWH systems - Carriacou and Petit Martinique. At least 3 workshops	3,600
Technical exchange. At least 3 overseas exchanges organized for 5 persons	30,000
<b>Total</b>	<b>43,600</b>

## 4.3. Component 3: Legislative and Policy Formulation

### 4.3.1. Objectives

**To promote integration of RWH within national IWRM plans through policy and legislative reform** – Success in sustained implementation of a national RWH programme is contingent on existence of an IWRM Plan. Few countries in the Caribbean region have developed IWRM Plans which is at the core of the reason why management of water resources has been a fragmented, poorly coordinated process. RWH falls within the realm of water conservation and is recognized as a key strategy for enhancing water security in an environment where water is becoming a scarce resource, and alternative options such as desalination and deep well abstraction remain comparatively more expensive. In Grenada, the prevailing policy environment favours continued investment in surface water exploitation through infrastructure upgrades (output capacity increase) and seeking out new potential sources. The GoG invested heavily in desalination plants on Carriacou, Petit Martinique and mainland Grenada. To date, all these plants remain largely inoperable on account of the high operating cost. During recent discussions with NAWASA, the organization is exploring the possibilities of abstracting water from deep wells to augment surface sources. As with desalinization, this option is a relative costly one and the questions must be raised regarding whether customers are able to pay for such “high-cost” water. For these reasons, promotion of RWH by the Government and NAWASA is not officially featured highly on the agenda.

Under the current policy and regulatory regime, NAWASA has legal jurisdiction for all water resources in Grenada which conflicts with the principle of separation of the regulator functions from the user; presently NAWASA acts in both roles. In some Caribbean countries, notably Jamaica, Trinidad and Tobago and more recently St. Lucia, legislative reform has achieved this separation where a national regulatory body has the mandate for establishing policy and regulating users including water distribution companies to ensure equitable, sustainable resource use. In this arrangement, the water companies are users.

Legislative and policy reform should realize a process of harmonization of water resources management across sectors within the context of an IWRM. The IWRM Plan should speak to all elements of management instruments in terms of optimizing supply and managing demand, creating the enabling environment and institutional frameworks (GWP, 2001; USAID, 2005). The national IWRM Plan development process must be championed and the Ministry of Health and the Environment appear to be best placed to undertake this challenge within the broader environmental management policy. NAWASA must remain a key partner in an advocacy and technical role given its mandate. As noted previously, the IWCAM Project could provide technical support to the process not only in Grenada but across the Caribbean region.

**To create an enabling environment to foster investment in RWH** – The most significant legislative instruments (outside catchment protection) related to water resources management in Grenada are the NAWASA Act, the Public Health Act, Town and Country Planning Act and the Grenada Bureau of Standards Act (Table 3).

The NAWASA Act gives management jurisdiction for all water resources, including wastewater in Grenada to NAWASA, although there are no specific provisions for management of RWH systems<sup>1</sup>. The Act does not make specific provisions for the granting of incentives or concessions for investments in RWH.

The Public Health Act gives management authority to the Ministry of Health in the area of environmental health and sanitation and therefore has direct relevance to water quality in the context of human consumption and wastewater management. Under the vector control regulations of the Act, provisions are made for management of risk associated with harmful vectors notably mosquitoes that are linked to standing waters such as is the case in RWH storage systems.

The Physical Planning and Development Control Act makes regulatory provisions for residential and commercial developments, however mandatory requirements for water augmentation (against specific criteria) are not currently supported in the Act. Only with larger-scale developments (commercial/industrial, housing sub-divisions and hotels) where there are potential water supply issues, the development applications are sent to NAWASA for review and make recommendations. In some cases, these applications may be subject to an Environmental Impact Assessment (EIA) process where water availability and supply issues may be further addressed. New regulations are being drafted and water supply and management provisions will likely feature in these regulations (F. Purcell, pers. comm. 2006).

The Grenada Bureau of Standards Act makes provisions for setting quality standards for traded commodities either consumed directly or used to make other products. Bottled water, regardless of the source, is of particular concern under the Act.

The policy and legislative environment must be crafted so that it favours observance of best practices in water conservation. Measures such as rebates and tax concessions are commonly used instruments to encourage investment. In Grenada, concessions may be applied for under two fiscal instruments (S. Roden, pers. comm. 2006); (1) the Hotel Aid Act of 1960 and (2) the Fiscal Incentives Act of 1974. The former offers concessions to developers in the

---

<sup>1</sup> The communal RWH systems in Carriacou and Petit Martinique can be considered to fall within the definition of "catchment areas" as defined by the Act and therefore may be regarded in the same management context as natural river system catchment areas.

hospitality sector while the latter applies to the manufacturing and processing sectors. Under both regimes, investors are eligible for 100% waiver of general consumption tax and import duties; only the 5% customs service charge applies. The Grenada Industrial Development Corporation (GIDC) administers the incentive instruments and makes recommendations on behalf of applicants for approval by the Cabinet of Ministers. This is done on a case-by-case basis. A national investment policy and new Investment Act are being developed that would integrate and harmonize the various incentive regimes.

In the agricultural sector, the General Tariff, a statutory regulatory instrument (SRO) provides duty waivers to farmers in procurement of equipment, supplies and materials (L. McPhil, pers. comm. 2006) that can include items required for RWH.

Table 3 provides a summary of the key legislative instruments that are of importance in water governance. The data compiled was gathered from a Stakeholder Workshop held in Grenada in February 2006.

**Table 3. Summary of water-related legislative provisions and gaps related to incorporation of RWH augmentation.**

<i>Name of instrument</i>	<b>NAWASA Act (1990)</b>	<b>Public Health Act (1958, 1990 revised law of Grenada Chapt. 263)</b>	<b>Physical Planning and Development Control Act (2002)</b>	<b>Grenada Bureau of Standards Act (No. 6 of 1989)</b>
<i>Responsible agency for execution/oversight</i>	National Water and Sewerage Authority (NAWASA)	Ministry of Health (MOH)	Physical Planning Unit (PPU) of Ministry of Finance; Planning and Development Control Authority under the aegis of the Ministry of Finance	Grenada Bureau of Standards
<i>Key stakeholder agencies (list)</i>	<ul style="list-style-type: none"> <li>Ministry of Health - Responsible for regulation and enforcement of water quality.</li> <li>Ministry of Agriculture, (specifically the Forestry Dept) and Public Utilities - Responsible for protection of watersheds and catchment areas</li> <li>Ministry of Works</li> <li>All other agencies represented on NAWASA's Board</li> </ul>	<ul style="list-style-type: none"> <li>Grenada National Solid Waste Agency</li> <li>NAWASA</li> <li>Ministry of Works</li> </ul>	<ul style="list-style-type: none"> <li>Grenada Institute of Professional Engineers (GIPE)</li> <li>NAWASA</li> <li>Ministry of Health</li> <li>Ministry of Agriculture</li> <li>Grenada Bureau of Standards</li> <li>Grenada Industrial Development Corporation (GIDC)</li> </ul>	<ul style="list-style-type: none"> <li>Ministry of Health</li> <li>NAWASA</li> <li>Produce Chemist Laboratory (PCL-MOA)</li> </ul>
<i>Relevant policy/Act section(s) in context of RWH (quote number)*</i>	All areas applicable	Nuisance Regulations related to vector control	<ul style="list-style-type: none"> <li>No specific areas in legislation related to water supply augmentation. However the Authority has the power to request that EIAs be carried out for large developments</li> </ul>	<ul style="list-style-type: none"> <li>SRO 71 of 2003 - Specifications for Water packaging</li> <li>SRO72 of 2003 - Good Hygienic practices</li> </ul>

<b>Name of instrument</b>	<b>NAWASA Act (1990)</b>	<b>Public Health Act (1958, 1990 revised law of Grenada Chapt. 263)</b>	<b>Physical Planning and Development Control Act (2002)</b>	<b>Grenada Bureau of Standards Act (No. 6 of 1989)</b>
			<p>(typically with large water requirements). In these cases NAWASA is a referral agency for deriving appropriate development recommendations.</p> <ul style="list-style-type: none"> <li>Regulations are in the process of being prepared that will better define requirements related to water.</li> </ul>	
<p><i>Describe how may RWH practice be supported through incorporation into policy/legal instrument under review; propose modification to existing text or new inclusions if required (focus should be on gaps where policy and legal instruments under review are inadequate)*</i></p>	<ul style="list-style-type: none"> <li>Provisions need to be made for setting appropriate tariffs to offset operating and maintenance costs of communal cisterns. Community catchments on Carriacou and Petit Martinique are not legally vested in NAWASA; presents a “grey” area for management in the context of the legislation.</li> <li>The possibility of operation of community cisterns and delivery infrastructure by private concerns may need to be considered under regulations. This may apply also to commercial</li> </ul>	<ul style="list-style-type: none"> <li>Act does not give enforcement authority to Vector Control Inspectors; hence they have no power to rapidly effect change in response to emergency situations. This power is held by other officers and can result in bureaucratic delays. Vector control officers are mainly responsible for data collection.</li> <li>Act and policies should strengthen/mandate collaborative linkages between associate agencies. Collaboration tends to be weak/ad-hoc since there are generally</li> </ul>	<ul style="list-style-type: none"> <li>Enhancement of the legislation to foster obligatory/mandatory investment in RWH in formally designated zones such as “end-of-network” and high water deficit areas (currently mandated only for large developments under the EIA process; small private developments not considered)</li> <li>Enhancement of legislation to foster implementation of special conservation measures for commercial operations.</li> <li>Development of regulations under the Act</li> </ul>	<p>Legislation needs to make provision for sale of rain harvested water (and ice) to yachts. This is being done on Petit Martinique. The regulation currently specifies bottled water only.</p>

<b>Name of instrument</b>	<b>NAWASA Act (1990)</b>	<b>Public Health Act (1958, 1990 revised law of Grenada Chapt. 263)</b>	<b>Physical Planning and Development Control Act (2002)</b>	<b>Grenada Bureau of Standards Act (No. 6 of 1989)</b>
	suppliers of harvested water.	no formal arrangements and MOUs between agencies. <ul style="list-style-type: none"> <li>Legislation should be reviewed to mandate the MOH to do spot checks and conduct quality assurance activities. This should be established as a tool for decision making.</li> </ul>	providing guidance for design and construction codes for cisterns and catchments.	
<i>Other related policies and or legal instruments. Describe briefly the relationship to the instrument under review.</i>	Water quality Act 2005 specifically related to Carriacou and Petit Martinique to adhere to EU Standards related to fish export (use of safe water for icing during transport)  Other guiding policy instruments include the National water Policy, the Forestry Policy and the National Environmental Policy & Strategy	NAWASA Act - NAWASA's Board consists of Members from a number of agencies such as the Ministry of Health, Ministry of Agriculture, Physical Planning Unit, Ministry of Finance	Planning and development Control Authority Board is a multi-stakeholder body that includes representation from both public and private sector including NAWASA.  Other guiding policy instruments include the Forestry Policy, System of National Parks & Protected Areas and the National Environmental Policy & Strategy	Public Health Act NAWASA Act



### 4.3.2. Key actions

**Review existing legal and policy instruments to propose an effective legal (regulatory) and policy framework for promotion of RWH** – A comprehensive review of the existing legislative and policy frameworks will need to be undertaken to determine the extent to which existing legal and regulatory instruments meet the requirements for promotion of RWH within a structured programme. As is typically the case, many of the instruments exist. However, amendments will be required to ensure proper synergistic relationships are established to facilitate promotion of RWH. This must be framed against the backdrop of significant national policies such as the National Environmental Policy and commitments under international conventions, notably the Climate Change Convention in the context of where adaptation strategies in the water sector needs to be implemented.

**Design appropriate incentive regime to augment existing water conservation measures** – An appropriate suite of incentive measures need to be developed to encourage water conservation from the individual household level to the large-scale commercial development level. While concessions may be available to developers under the Hotel Aid Act (1960) and the Fiscal Incentives Act (1974), these are not specifically targeted in the context of water management and conservation. The incentive regime, if it is to reside within separate sector-specific policy/regulatory instruments, should be harmonized both in terms of intended effect and administration. In a harmonized incentive regime, investors should be able to obtain concession for supplies and materials that are used specifically to harvest and conserve water (guttering, tanks, pumps), however creative ways may need to be sought to include generic (general-purpose) material. Investors should be rewarded for implementing water conservation measures through rebate or tax reduction/refund mechanisms. This will have to be done in conjunction with the Ministry of Finance, the lead agency charged with the preparation of the new Grenada Investment Policy and Investment Act.

**Consultation/workshops with stakeholders** – In support of the above, a series of stakeholder consultations will be necessary. The November 2005 National Assessment and follow-up Workshops in February 2006 under the CEHI/UNEP Project marked the beginning of national consultations. This needs to be followed on under the aegis of the national environmental policy and strategy, national climate change adaptation strategy and national water policy under the leadership of the Ministry of Health and the Environment.

### 4.3.3. Key indicators

- ◆ Legislation revised/amended and passed by Parliament into law;
- ◆ Number of consultations / stakeholder workshops held and record of attendance;
- ◆ Harmonized incentive regime developed and effected.

### 4.3.4. Key result

***Existing legal and policy instruments reviewed to propose an effective legal (regulatory) and policy framework for promotion of RWH***

### 4.3.5. Indicative costs

<b>Activity expenditure items</b>	<b>Estimated cost US\$</b>
Legislative and policy review	20,000
Design incentive regime for RWH	20,000
Stakeholder workshops At least 6 workshops in support above activities	7,200
<b>Total</b>	<b>47,200</b>

## 4.4. Component 4: Infrastructural Development

### 4.4.1. Objectives

**To optimize RWH systems to increase the quantity and improve quality of water** – The poll conducted in November 2005 on mainland Grenada revealed that approximately 20% of respondents practised RWH and that there is a general willingness to invest in RWH by all respondents. The entire population of Carriacou and Petit Martinique are dependent on RWH. Given the rapid expansion in urban development and the hospitality sector in particular, the demands placed on NAWASA's distribution system during the dry months in some cases far outstrips supply. Many new households and properties in the water-stressed parts of mainland Grenada are configured for sole reliance or rely heavily on rainwater during the dry months. Unless there are significant upgrades in NAWASA's existing infrastructure to meet supply shortfalls, investments in RWH for new developments will likely increase. Annex 1 illustrates the water deficit zones on Grenada that should be targeted for investment in RWH.

In Carriacou and Petit Martinique, the communal RWH systems serving Bogles, Cherry Hill and L'Esterre are in a serious state of disrepair as a result of a poor maintenance programme. The quality of water from these systems is of concern and there is an urgent need to rehabilitate and possibly upgrade these systems.

The Programme therefore calls for support to homeowners, investors in various sectors and the public sector (schools, hospitals and other public buildings) to make investments in RWH. In the case of the private sector, this will likely be dependent on the effectiveness of the emerging incentive regime to support investment, with emphasis in areas of the country that are frequently impacted by poor water supply. In the case of State properties investment, RWH should be mandatory in water-stressed areas. However, it is recommended that policy dictates that all new government properties be designed to harvest rainwater.

For the communal systems on Carriacou and Petit Martinique, urgent investment must be made and proposals must be developed for submission to financing agencies to procure funding. A full technical study should be carried out to determine the scope of works to be carried out and required costing. A lead role should be assumed by the Ministry of Carriacou and Petit Martinique Affairs in conjunction with the affected communities.

**To enhance capacity to manage and maintain communal RWH systems** – The management of RWH systems depends on the technical and financial capacity within the households, organizations and communities they are intended to service. In the case of the communal systems in Carriacou and Petit

Martinique, lack of a coordinated approach to operation and management between NAWASA, the MOH and the community has resulted in the poor state of management of the systems. Residents of these communities presently do not pay for water from the communal systems, which has compounded the situation since no revenue goes into offsetting the cost of upkeep. An agreed rate was established for water obtained from the system but the institutional arrangement for the collection of revenue was not established. Responsibility for upkeep of the systems has been left entirely to NAWASA as community members were not empowered to manage the existing systems.

The Programme therefore proposes to address the situation with respect to management of the communal RWH systems on Carriacou and Petit Martinique by building capacity amongst key members in the community actively who will contribute to management in collaboration with the other institutional stakeholders (refer to Section 4.2.2 for details). Emphasis will also be paid to the formulation of adequate cost recovery mechanisms and their management.

### 4.4.2. Key actions

- ◆ **Conduct stakeholder discussions** – Dialogue must be pursued to determine precise needs and identify concepts for project elaboration. In the case of public sector investments, broad-based consultations may be required although this will depend on the application.
- ◆ **Technical and feasibility studies for RWH applications** – RWH has traditionally been associated with water supply augmentation for household use. However, the range of application can extend well beyond that. In the hospitality and agricultural sectors, use of rainwater can be a viable substitute for potable supplies for non-drinking purpose, which is particularly important during the dry season. Use of rainwater allows for investments to be made in geographic areas that are not serviced by the national water distribution network, or where supplies are limited. Technical studies should be considered in order to match appropriate RWH technology to suit demand requirements depending on application. Attention must be paid to the integration of RWH systems and the municipal supply system to ensure that there is no opportunity for cross-contamination, where the harvested rainwater enters the pipe-borne supply. This may occur due to improper plumbing design. Standard code of practice must be developed to ensure appropriate procedures are adopted by contractors, plumbers and other service providers to minimize problems associated with interconnection.

Technical institutes such as the South Pacific Applied Geoscience Commission (SOPAC), the FAO, UWI, University of Trinidad and Tobago (UTT), College of Science, Technology and Applied Arts of Trinidad and Tobago (COSTAATT) should be solicited to provide resources through

either provision of personnel, financing, technical materials, or a combination thereof through working relationships and partnerships.

- ◆ **Project development and funding procurement** – Following development of project concepts, full project proposals should be developed. In the case of communal systems such as those on Carriacou and Petit Martinique, the Ministry of Carriacou and Petit Martinique Affairs should take lead responsibility in development of the project proposal in conjunction with the affected communities. The Ministry of Health and Environment can play a major support role in technical back-stopping. For mainland Grenada, public sector intervention may be in support of municipal applications such as storage for potable and non-potable uses for institutions such as schools, hospitals and other government buildings and possibly for fire-fighting.
- ◆ **Technical / training workshops in operation and management of new investments** – Once investments are made there must be requisite capacity built for O&M. Component 2 details some of the key requirements and the general approach to be pursued with respect to capacity development.

### 4.4.3. Key indicators

- ◆ Number of study/feasibility reports commissioned and completed;
- ◆ Number of developed proposals with committed funding;
- ◆ Number of executed projects.
- ◆ Number of persons trained in management of systems

### 4.4.4. Key result

***Effective and efficient RWH systems established***

#### 4.4.5. Indicative costs

Activity expenditure items	Estimated cost US\$
Stakeholder consultations. At least 8 consultations conducted	9,600
Technical studies. At least 8 studies commissioned	80,000
Project development & funding procurement	30,000
Training workshops - O&M for new investments At least 8 workshops	8,000
<b>Total</b>	<b>127,600</b>

#### 4.5. Programme Administration, Monitoring and Evaluation

It is proposed that programme administration capacity be built into the lead agency responsible for execution of the Programme. This is considered necessary given the human and financial resource constraints within the agencies targeted for driving the process. It is proposed that a Programme Management Unit be staffed by two personnel; one at a senior level with public education/outreach and project management skills, and the other at an administrative assistant level with skill in financial management. The basic terms of reference for the Unit should include all services and supplies procurements, general administration of the programme to include reporting, financial management and monitoring. A provision is being made for technical backstopping from a regional coordination level. It is proposed that CEHI continue to assist the Government of Grenada in support of the execution of the Programme.

It is proposed that independent evaluations of the programme be conducted periodically to assess success of the Project and contribute to recommendations in an adaptive learning process. A pre-programme evaluation should establish the baseline (in conjunction with the assessment conducted under the CEHI/UNEP RWH project) to be followed by a mid-term and post-programme evaluation. The evaluation process should be done by an independent source.

#### 4.5.1. Indicative costs

<b>Activity expenditure items</b>	<b>Estimated cost US\$</b>
Staff salaries	
Programme manager	80,000
Administrative assistant	
Staff allowances (traveling)	
Programme manager	13,400
Officer equipment and supplies	8,100
Communications and utilities	8,000
Technical backstopping	45,000
Programme evaluation	25,000
<b>Total</b>	<b>179,500</b>

Table 4. Logical Framework - National Rainwater Harvesting Programme for Grenada

	<b>Intervention logic</b>	<b>Objectively verifiable indicators of achievement</b>	<b>Sources and means of verification</b>	<b>Assumptions</b>
<b>Overall objectives</b>	<i>Overall broader objective to which the action will contribute</i>	<i>Key indicators related to the overall objectives</i>	<i>Sources of information for these indicators</i>	
	Contribute to the conservation of the water resources of Grenada through adoption of sustainable water management and conservation technologies and practices	Decline in occurrence / frequency of water non-availability, reduction in incidence of water-related illness due to poor sanitation	Water production data – NAWASA; Enteric diseases data - Epidemiology Unit of MOH and Community Health Facilities	
<b>Specific objective</b>	<i>Specific objective the action intended to achieve to contribute to the overall objective</i>	<i>Indicators which show that the objective of the action has been achieved</i>	<i>Sources of information that exist. Methods required to get this information</i>	<i>Factors and conditions outside the Beneficiary's responsibility that are necessary to achieve that objective (external conditions) Risks to be taken into consideration.</i>
	Capacity to facilitate the implementation of rainwater harvesting for household and commercial purposes strengthened and support policies and incentives developed and mainstreamed into national development strategies and policies	Adoption and implementation of a national rainwater harvesting programme within a ratified Integrated Water Resources Management Plan.	Published country-specific policy documents.  Country report on status of rainwater harvesting in the context of an IWRM Plan	Economic growth is not seriously undermined by political instability, catastrophic climatic events, hyper-inflation.
<b>Expected results</b>	<i>Results (outputs) envisaged to achieve the specific objective.</i>	<i>Indicators to measure whether and to what extent the action achieves the expected results</i>	<i>Sources of information for these indicators</i>	<i>External conditions that must be met to obtain the expected results on schedule</i>



<p><b>RESULT AREA 1</b></p>	<p><b>Public and policy makers awareness raised on RWH concepts, practices, water quality, sanitation issues</b></p>	<p><b>1.1</b> Increase in awareness on RWH and positive change in behavior in sanitation practices (specific reference to communal system users in Carriacou and P. Martinique) assessed via survey findings</p> <p><b>1.2</b> Increase in number of new development applications incorporating RWH systems, number of retro-fits to existing infrastructure</p> <p><b>1.3</b> Increase in sales of equipment and supplies for use in establishing RWH systems</p> <p><b>1.4</b> Reduced incidence of water-related illness on account of poor water quality and quantity from RWH systems (communal systems on Carriacou and P. Martinique)</p> <p><b>1.5</b> Existence and use of a web-based resource to access RWH material; assessed by download frequency</p>	<p><b>1.a</b> CEHI(UNEP) national assessment; interim and post programme assessment reports</p> <p><b>1.b</b> Ministry of Planning development approvals</p> <p><b>1.c</b> Ministry of Commerce / Business Chamber reports on sales of RWH material and supplies</p> <p><b>1.d</b> Print and electronic media reports on initiatives</p>	<ul style="list-style-type: none"> <li>• Stable investment climate</li> <li>• Policy commitment</li> <li>• Stakeholder commitment</li> <li>• Investment Act incorporation of water-related investment</li> <li>• IWRM Plan development process inclusive of RWH promotion</li> </ul>
-----------------------------	--	---	--	--

<p><b>RESULT AREA 2</b></p>	<p><b>Capacity strengthened amongst professionals (technical, advisory services), stakeholders, for the implementation and management of RWH systems.</b></p>	<p><b>2.1</b> Number of technical workshops and seminars conducted; number of participants from various sectors</p> <p><b>2.2</b> Development and implementation of a Code of Practice for RWH design and construction (see Component 4)</p> <p><b>2.3</b> Number of professionals participating in exchange programme</p> <p><b>2.4</b> Number of handbooks, technical resource material/tools developed distributed</p>	<p><b>2.a</b> Published papers, technical briefs by MOH, NAWASA, GIPE</p> <p><b>2.b</b> Consultancy studies/reports</p> <p><b>2.c</b> Workshop / training reports</p> <p><b>2.d</b> Print and electronic media reports</p>	
<p><b>RESULT AREA 3</b></p>	<p><b>Policy/ regulatory frameworks and incentive regimes to support RWH strengthened and harmonized with increased investment in RWH.</b></p>	<p><b>3.1</b> Formally ratified IWRM plan that includes RWH programme</p> <p><b>3.2</b> Harmonized incentive regime for RWH developed and effected</p> <p><b>3.3</b> Increase in number of new development applications incorporating RWH systems; increase in retro-fits to existing infrastructure</p> <p><b>3.4</b> Number of stakeholder consultations</p>	<p><b>3.a</b> Cabinet decision / Parliamentary decrees; published legislation</p> <p><b>3.b</b> Published RWH incentive regime (in context of new Incentives Act)</p> <p><b>3.c</b> Ministry of Planning development approvals (incorporating RWH)</p> <p><b>3.d</b> Ministry of Commerce / Business Chamber reports (sales of RWH-related supplies and material)</p>	

<b>RESULT AREA 4</b>	<b>Effective and efficient RWH systems established</b>	<p><b>4.1</b> Number of technical studies conducted on RWH applications</p> <p><b>4.2</b> Development and implementation of a Code of Practice for RWH design and construction (see Component 2)</p> <p><b>4.3</b> Number of developed proposals with committed funding</p> <p><b>4.4</b> Number executed projects</p>	<p><b>4a.</b> Consultant reports (design studies)</p> <p><b>4b.</b> Code of Practice document</p> <p><b>4c.</b> Community/stakeholder consultation reports</p> <p><b>4d.</b> Project proposal documents (funding commitments; contractor procurements)</p> <p><b>4e.</b> Public Sector Investment programme (medium-term investments in RWH)</p> <p><b>4f.</b> NAWASA, GIPE technical reports</p>	
<b>Activities</b>	<i>Key activities to be carried out</i>	<i>Means required to implement these activities.</i>	<i>Sources of information about action progress</i>  <i>Activity Costs</i>	<i>Pre-conditions required before the action starts</i>
<b>ACTIVITIES IN SUPPORT OF RESULT AREA 1</b>	<b>1.1</b> Convene at least 8 island-wide awareness seminars on RWH	<b>1.1</b> MOH / NAWASA personnel time; supplies; venue rental and catering services	<ul style="list-style-type: none"> <li>• Programme/agency (MOH and NAWASA) reports</li> <li>• Reports of proceedings</li> <li>• Media reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$ 14,800</i></p>	<ul style="list-style-type: none"> <li>• Installation of programme administration support</li> <li>• Signature of MOUs between lead agency and funding</li> </ul>

## Grenada National Rainwater Harvesting Programme

	<b>1.2</b> Produce a suite of media products; 2 videos, 4 radio PSAs, 2 brochures.	<b>1.2</b> Professional media services; CEHI-UNEP project assistance & backstopping; assistance of Gov't Info Service; broadcast by media houses	<ul style="list-style-type: none"> <li>• Programme/agency reports</li> <li>• Media broadcasts</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost:</i>  <i>Radio PSAs: US\$ 3,000</i>  <i>Video: US\$7,400</i>  <i>Brochures: \$1,100</i></p>	agencies (non-gov't contributors)
	<b>1.3</b> Development of a website source for RWH material	<b>1.3</b> Professional website design services; MOH, NAWASA staff trained in updating site; CEHI technical backstopping	<ul style="list-style-type: none"> <li>• Programme/agency reports</li> <li>• Website hit-counter record</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$5,600</i></p>	
	<b>1.4</b> Conduct school awareness programme via poster, essay, special project competition (coincide with environmental commemorative events)	<b>1.4</b> MOH, Min Education, NAWASA personnel time; Business Chamber/Hotel Association collaboration for prize awards	<ul style="list-style-type: none"> <li>• Programme/agency (MOH and NAWASA) reports</li> <li>• Media reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$3,000</i></p>	
	<b>1.5</b> Conduct 4 public surveys (annual – assess public awareness and programme effectiveness)	<b>1.5</b> Surveys Department assistance in survey design; MOH personnel time in survey execution; Business Chamber/Hotel Association collaboration for acquisition of data	<ul style="list-style-type: none"> <li>• Programme/agency (MOH and NAWASA) reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$3,000</i></p>	
<b>ACTIVITIES IN SUPPORT OF RESULT AREA 2</b>	<b>2.1</b> Convene at least 10 technical seminars for building contractors, architects, farmers, Ministry of Health, Planning officers, NAWASA personnel, other service providers	<b>2.1</b> Consultancy services; personnel time of MOH, NAWASA staff; workshops and seminar costs	<ul style="list-style-type: none"> <li>• Programme/agency (MOH and NAWASA) reports</li> <li>• Reports of proceedings</li> <li>• Media reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$ 10,000</i></p>	

## Grenada National Rainwater Harvesting Programme

	<p><b>2.2</b> Conduct at least 3 technical workshops on communal cistern operation and management for community members - Carriacou and Petit Martinique</p>	<p><b>2.2</b> Consultancy services; personnel time of MOH, NAWASA staff; workshops and seminar costs</p>	<ul style="list-style-type: none"> <li>• Programme/agency (MOH and NAWASA) reports</li> <li>• Reports of proceedings</li> <li>• Media reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$ 3,600</i></p>
	<p><b>2.3</b> Conduct at least 3 technical exchanges of professionals and RWH system users (across various sectors) to observe best-practices</p>	<p><b>2.3</b> Personnel time of MOH, NAWASA staff; input by GIPE members; CEHI, FAO and regional agency technical backstopping and funding procurement (cover airfare, accommodation and logistics)</p>	<ul style="list-style-type: none"> <li>• Programme/agency (MOH and NAWASA) reports</li> <li>• Reports of proceedings</li> <li>• Media reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$ 30,000</i></p>
<p><b>ACTIVITIES IN SUPPORT OF RESULT AREA 3</b></p>	<p><b>3.1</b> Conduct comprehensive legislative and policy review, amend existing legislation</p>	<p><b>3.1</b> Consultancy fees, Personnel time of MOH, NAWASA staff; input by GIPE members, legal fraternity, Ministry of Finance, Grenada Industrial Development Corporation (GIDC)</p>	<ul style="list-style-type: none"> <li>• Programme/agency (MOH and NAWASA) reports</li> <li>• Consultant reports</li> <li>• Cabinet conclusion(s)</li> <li>• Gazette publication</li> <li>• Media reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$ 20,000</i></p>
	<p><b>3.2</b> Design appropriate incentive regime in support of RWH (incorporate into new Incentive Act)</p>	<p><b>3.2</b> Consultancy fees, Personnel time of MOH, NAWASA staff; input by GIPE members, Ministry of Finance (also Physical Planning Unit), Grenada Industrial Development Corporation</p>	<ul style="list-style-type: none"> <li>• Programme/agency (MOH and NAWASA) reports</li> <li>• Consultant reports</li> <li>• Incentive Act</li> <li>• Media reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$ 20,000</i></p>

	<b>3.3</b> Convene at least 6 community consultations (feedback into legislation and policy design)	<b>3.3</b> Consultancy fees, Personnel time of MOH, NAWASA staff; input by GIPE members, Ministry of Finance (also Physical Planning Unit), Grenada Industrial Development Corporation; workshop venue costs & catering	<ul style="list-style-type: none"> <li>• Programme/agency (MOH and NAWASA) reports</li> <li>• Reports of proceedings</li> <li>• Media reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$ 7,000</i></p>
<b>ACTIVITIES IN SUPPORT OF RESULT AREA 4</b>	<b>4.1</b> Convene at least 8 stakeholder consultations (feedback into infrastructure development projects)	<b>4.1</b> Consultancy fees, Personnel time of MOH, NAWASA staff; input by GIPE members, Ministry of Finance (also Physical Planning Unit), Grenada Industrial Development Corporation, various private sector interests; Cost of meeting venue and catering.	<ul style="list-style-type: none"> <li>• Programme/agency (MOH and NAWASA) reports</li> <li>• Reports of proceedings</li> <li>• Media reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$ 9,600</i></p>
	<b>4.2</b> Carry out at least 8 technical studies (feasibility/assessments) on viability and design of infrastructure (across various sectors)	<b>4.2</b> Consultancy fees, Personnel time of MOH, NAWASA staff; input by GIPE members, Ministry of Finance (also Physical Planning Unit), Grenada Industrial Development Corporation, various private sector interests	<ul style="list-style-type: none"> <li>• Consultant reports (studies)</li> <li>• PSIP documentation (Min Finance)</li> <li>• Programme/agency (MOH and NAWASA) reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$ 80,000</i></p>
	<b>4.3</b> Prepare project dossiers for financing and procurement of capital	<b>4.3</b> Consultancy fees, Personnel time of NAWASA staff; input by GIPE members, Ministry of Finance (also Physical Planning Unit)	<ul style="list-style-type: none"> <li>• Government estimates of expenditure</li> <li>• Public Sector Investment Programme (PSIP) documentation (Min Finance)</li> <li>• Consultant reports</li> <li>• Programme/agency reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$ 30,000</i></p>

## Grenada National Rainwater Harvesting Programme

	4.4 Carry out at least 8 training workshops on operation and maintenance of new RWH infrastructure investments	4.4 Consultancy fees, Personnel time of NAWASA staff; input by GIPE members; workshop hosting costs	<ul style="list-style-type: none"> <li>• Workshop reports</li> <li>• Programme/agency reports</li> <li>• Programme quarterly reports</li> </ul> <p><i>Estimated Cost: US\$ 8,000</i></p>	
<b>ACTIVITIES IN SUPPORT OF PROG ADMIN, M&amp;E</b>	Establish and operate Programme support desk/unit within lead agency	<ul style="list-style-type: none"> <li>• Salaries – Programme manager, Support assistant</li> <li>• Office equipment and supplies</li> <li>• Technical support - CEHI</li> <li>• Communication</li> </ul>	Financial statements Programme quarterly reports  <p><i>Estimated Cost: US\$ 179,500</i></p>	
	Programme Evaluation	Consultancy fees	Evaluation reports  <p><i>Estimated Cost: US\$ 25,000</i></p>	
			<b>TOTAL: US\$447,600</b>	

## 5. Conclusion

A national programme for the promotion of RWH for the tri-island state of Grenada is proposed. The programme emerged out of a national assessment carried out by the Caribbean Environmental Health Institute in November 2005, on mainland Grenada, Carriacou and Petit Martinique, followed by national workshops on mainland Grenada and Carriacou in February 2006. The effort is part of a global initiative led by the United Nations Environment programme in the promotion of RWH as a viable water supply augmentation measure. The selection of Grenada as a pilot country in the Caribbean was made in the context of securing water supply in a post-disaster environment given the nation's recent experiences with Hurricanes Ivan and Emily in 2004 and 2005 respectively. Water supply problems associated with heavy demand that peaks in the dry months is typical to many of the Caribbean islands, and with the impending impacts of climate change on rainfall patterns, many countries including Grenada need to consider appropriate options in securing water supply.

The general receptivity towards the implementation of a RWH programme in Grenada is favourable. The broad objective of the proposed programme is to contribute to the conservation of the water resources of Grenada through adoption of sustainable water management and conservation technologies. More specifically, the programme seeks to develop and strengthen capacity to facilitate the implementation of rainwater harvesting for household and commercial purpose and develop support policies and incentives and mainstream them into national development strategies and policies. The various consultations under the UNEP/CEHI project have pointed to four major strategic areas within the programme:

- (1) Public and policy makers awareness building;
- (2) Capacity building at both the individual and institutional levels;
- (3) Governance in terms of legislation and policy formulation;
- (4) Infrastructure development.

The four key outcomes or result areas are as follows:

- (1) Public and policy maker awareness raised on RWH concepts, practices, water quality, sanitation issues;
- (2) Capacity strengthened amongst professionals (technical, advisory services), stakeholders, regulatory institutions for the implementation, management of RWH systems;



- (3) Policy/regulatory frameworks and incentive regimes to support RWH introduced, strengthened and harmonized in context of IWRM with increased investment in RWH;
- (4) Effective and efficient RWH systems established.

The programme is proposed to run over a three-year period although this may need to be modified depending on rate of implementation and procurement of financing for core elements such as the public awareness and governance components. The programme costs proposed are indicative and intended to serve as a guide to procurement of financing for the various elements of the programme. The overall cost of the programme is estimated at US\$447,600.

The main agency to be charged with the responsibility for execution for the programme should be the Ministry of Health and Environment. NAWASA must be a key support agency given the present mandate as prescribed within the NAWASA Act which gives the Authority a legal mandate to manage all freshwater in Grenada. The range of applications for RWH is potentially very broad and as such continued discussions with all stakeholders in the public and private sectors needs to be pursued.

RWH must be promoted along the theme that it is a supply augmentation measure and that it is **not intended to replace reliance on the potable supplies**. It is envisaged that by the end of the programme significant investments will be made in RWH in new housing developments, commercial and public sector investments. An evaluation of the programme during and after the programme must be undertaken against some of the proposed indicators.

The national programme is expected to be replicated across the Caribbean, although under a more generic programme of national actions along with actions that will need to be pursued at a regional level primarily in the areas of production of educational products, information exchange, coordination, and research and development. The regional programme is expected to fall within the administrative aegis of a Caribbean Rainwater Harvesting Partnership which falls within the global network being championed by UNEP.

## References

- Allen, R.G., Pereira, L.S., Raes, D. & Smith, M. 1998. **Crop evapotranspiration: Guidelines for computing crop water requirements**. FAO Drainage and Irrigation Paper 56. UN-FAO, Rome, Italy, 300 p.
- BSAP, 2000. Grenada Biodiversity Strategy and Action Plan.
- FAO, 1995. **Dimensions of Need. An Atlas of Food and Agriculture. Water – A Finite Resource**. Corporate Document Repository. Available on-line at [http://www.fao.org/documents/show\\_cdr.asp?url\\_file=/docrep/U8480E/U8480E0c.htm](http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/U8480E/U8480E0c.htm)
- GEF, 2001 **National Report - Integrated Watersheds and Coastal Areas Management**. Global Environment Facility.
- GoG. 1958, 1990. **Public Health Act**. Government of Grenada.
- GoG, 1989. **Grenada Standards Act**. Government of Grenada.
- GoG, 1990 **Grenada National Water and Sewerage Authority Act**. Government of Grenada.
- GoG, 1999. **Medium-Term Economic Strategy**. Government of Grenada.
- GoG, 1999. **NAWASA Water Tariff Regulations**. Government of Grenada.
- GoG, 2000 **National Report – Integrating Management of Watersheds and Coastal Areas – Grenada**. Government of Grenada
- GoG, 2000 **Grenada’s Initial Communication to the UNFCCC**. Government of Grenada
- GoG. 2002. **Physical Planning and Development Control Act**. Government of Grenada.
- GoG, 2005. **National Environmental Policy and Management Strategy for Grenada**. Government of Grenada.
- GoG, Undated. **Grenada’s Initial Communication to the UNFCCC**. Government of Grenada.
- GoG/FAO, 2005. **Grenada Land Information System**. Land Use Division, Ministry of Agriculture.

GWP (2001). **Supporting Countries in the Sustainable Management of their Water Resources**. Available Online at [http://www.emwis.org/documents/presentations/Madrid\\_2001-11\\_GWP\\_en.pdf](http://www.emwis.org/documents/presentations/Madrid_2001-11_GWP_en.pdf)

OECS, 2005. **Grenada: Macro-Socio-Economic Assessment of the Damage Caused by Hurricane Emily July 14, 2005**. Organisation of Eastern Caribbean States.

Peters, E. 2003: Sizing of Rainwater Cisterns for Domestic Water Supply in the Grenadines. Available Online at: <http://www.uwichill.edu.bb/bnccde/svg/conference/papers/peters.html>

UNDP, 2004: **Impacts of Hurricane Ivan on Grenada**. Available Online at: <http://www.un.org/pubs/chronicle/2005issue3/0305p07.html>

UNDP, 2005: **Impacts of Hurricane Ivan On Grenada**. Available Online at <http://www.un.org/Pubs/chronicle/2005/issue3/0305p07.html>

UNEP 1996. **Source Book of Alternative Technologies for Freshwater Augmentation in Latin America and the Caribbean**, United Nations Environment Programme.

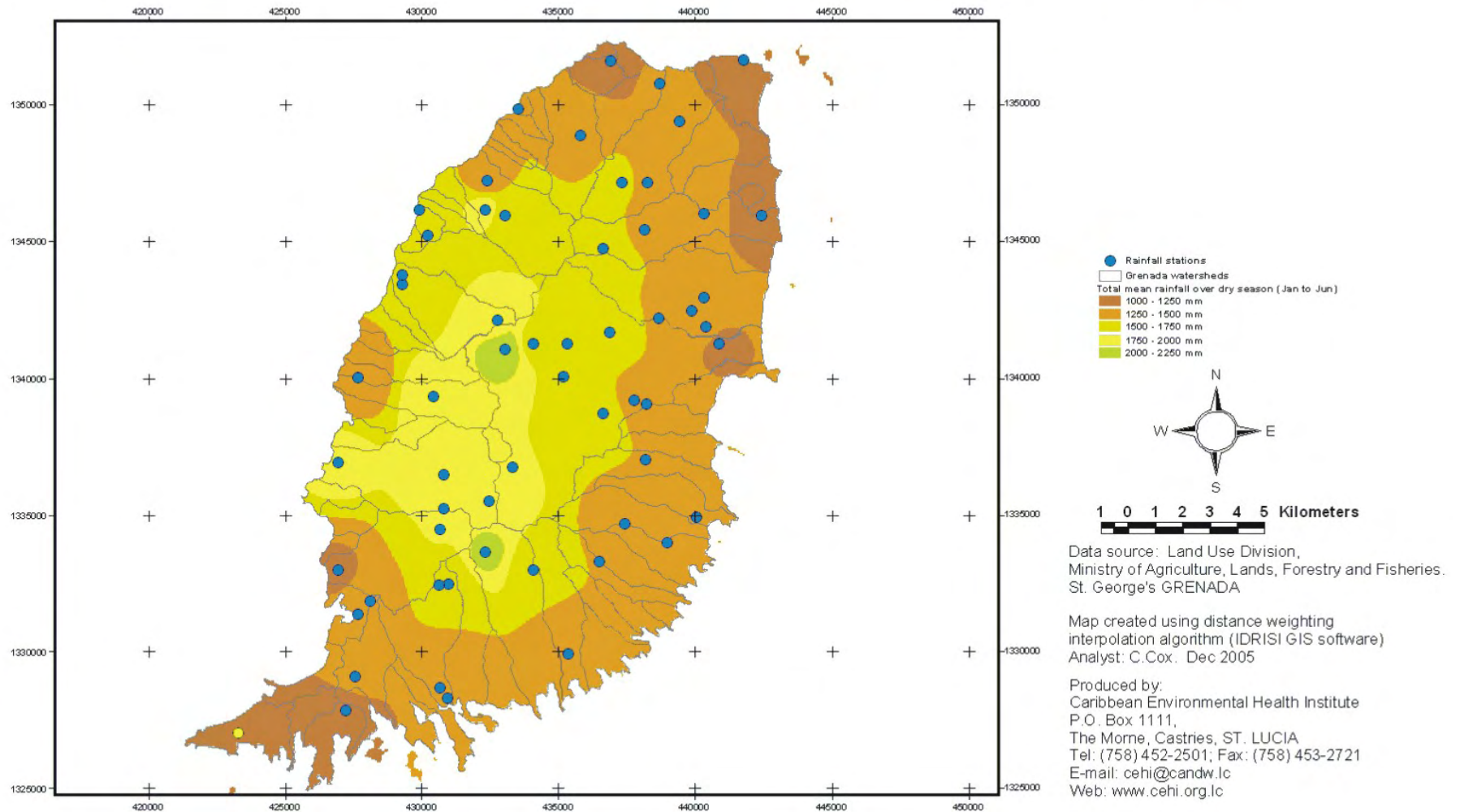
USAID, 2005. **What is Integrated Water Resources Management?** Available Online at [http://www.usaid.gov/our\\_work/environment/water/what\\_is\\_iwrm.html](http://www.usaid.gov/our_work/environment/water/what_is_iwrm.html)

## Annexes

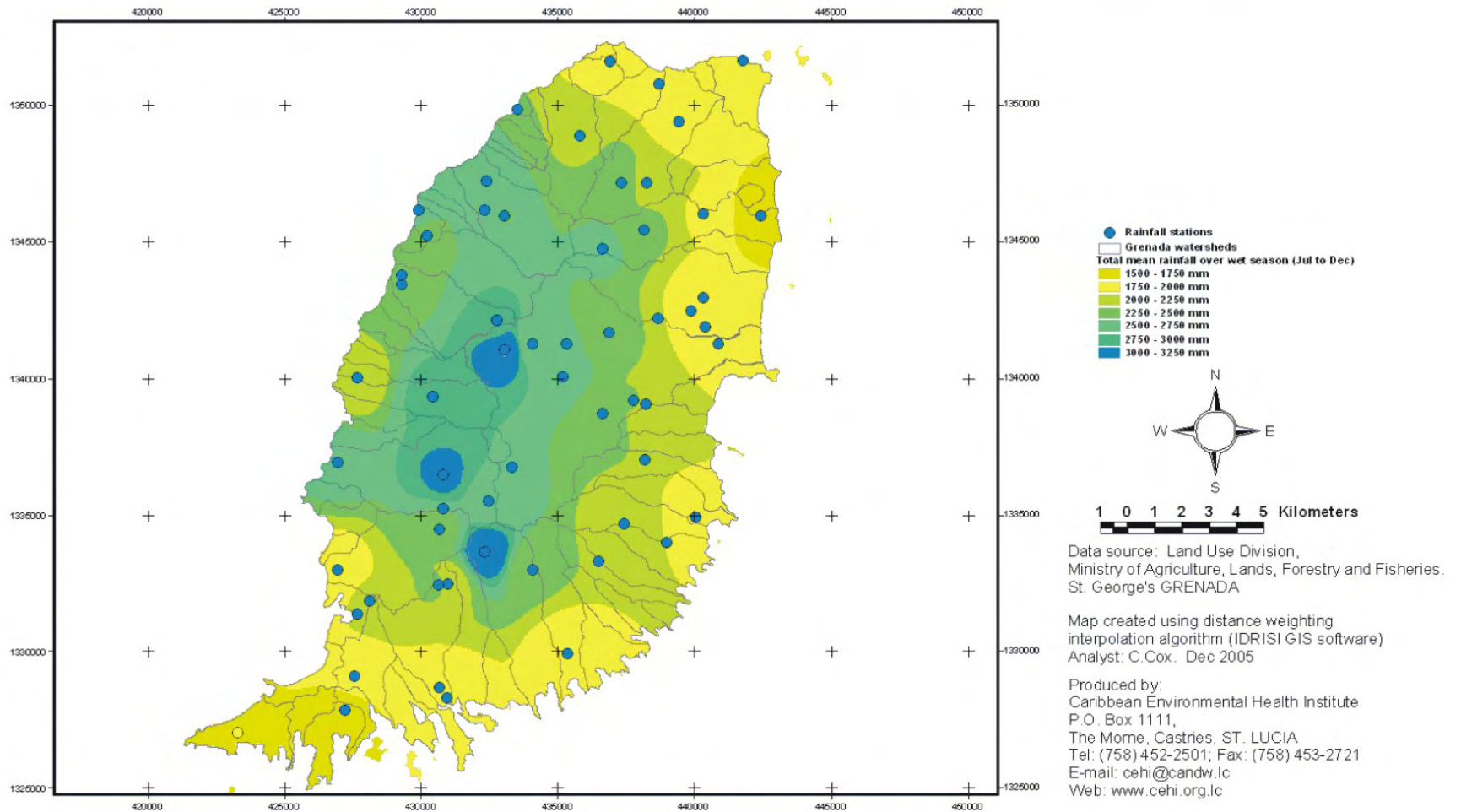
**ANNEX 1 Grenada water availability estimation (Using GIS spatial analytical tools) - Determination of relative water scarcity based on the difference between mean rainfall and estimated mean evapotranspiration (ET) (using the FAO Penman-Monteith method. (See Allen et al., 1989).**

Locations where ET exceeds rainfall in a given month suggest water scarcity at that location. Consequently it is assumed that recharge to NAWASA water catchment areas, agricultural lands will be minimal, particularly during the dry months. The mean dry **(A)** and wet season **(B)** maps below were generated using GIS-based interpolation analyses from rainfall station observations.

# Grenada Mean Dry Season Rainfall



# Grenada Mean Wet Season Rainfall

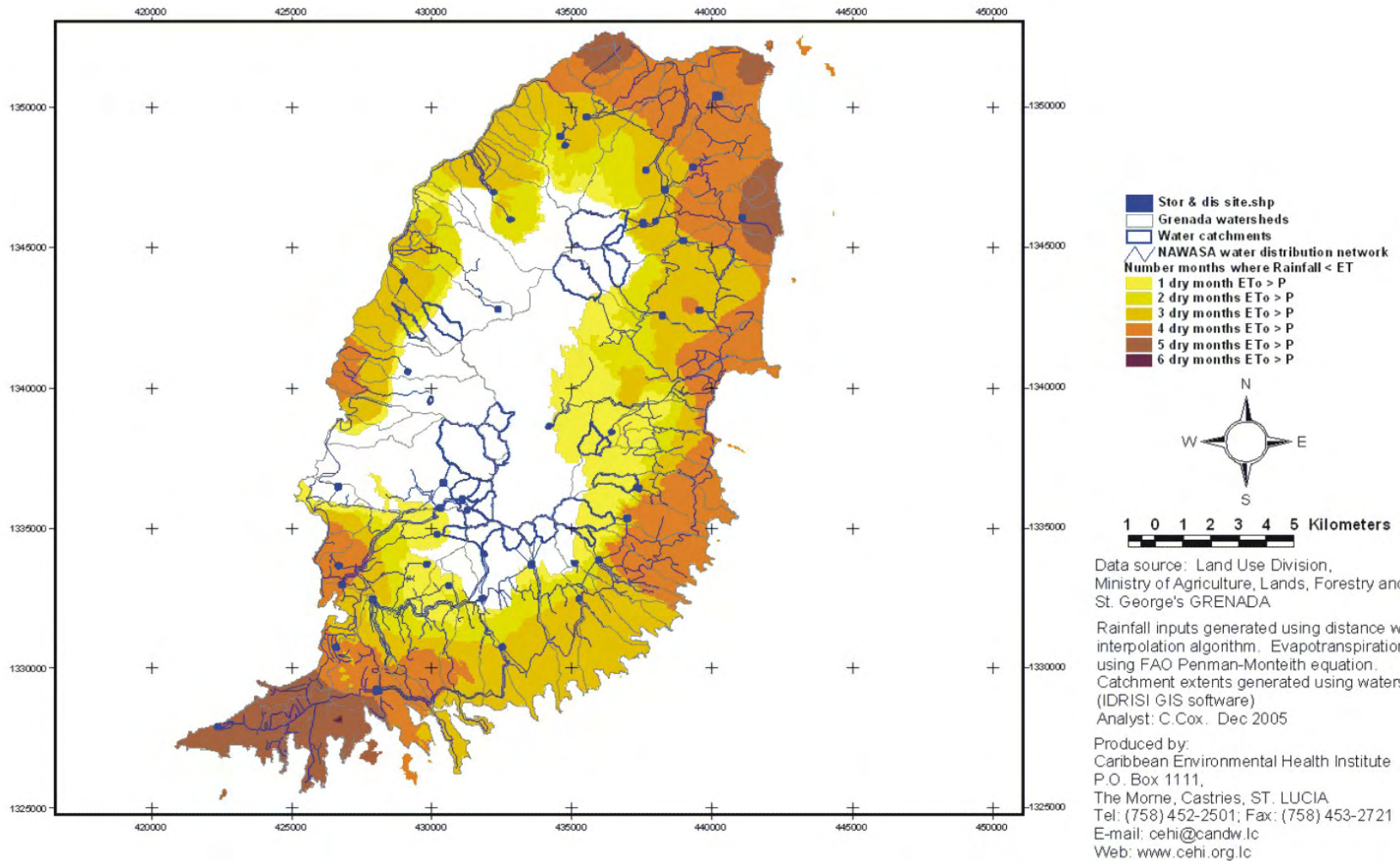


The water deficit map illustrates the number of consecutive months where ET exceeds rainfall. The NAWASA surface catchment areas used for potable water supply (blue outline) lie mainly at high elevations where there is limited water deficit. Those catchments at lower elevations (nearer the coast) suffer from some degree of water stress and by extension those communities that rely on water supplied from these catchment areas (see next page).

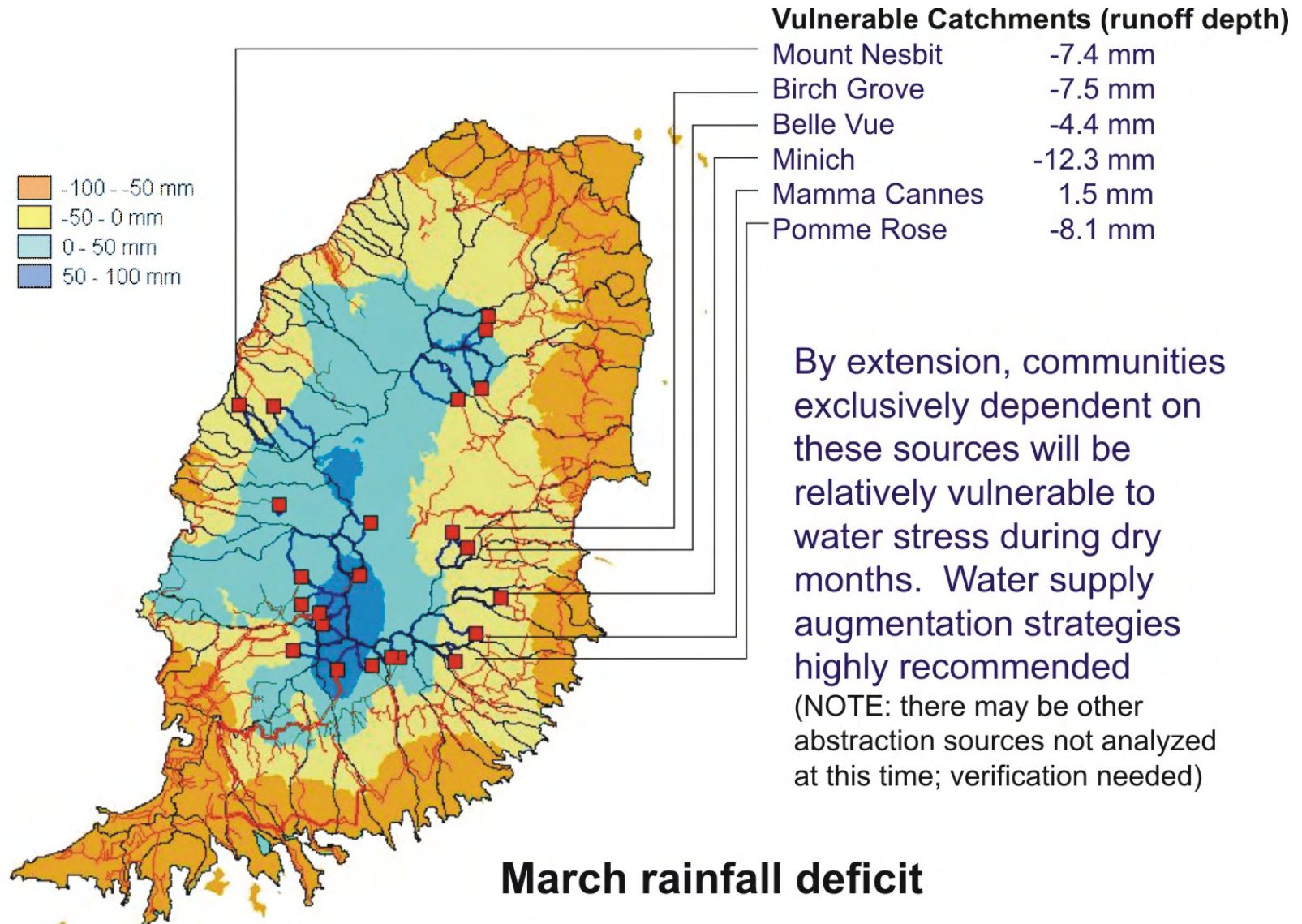
Rain-fed agriculture is similarly constrained in areas with longer water stress duration, notable along the east and extreme south west.

This map is intended as a guide based on mean data. Variability in rainfall from year to year will present different spatial patterns in terms of water availability.

# Grenada Water Deficit

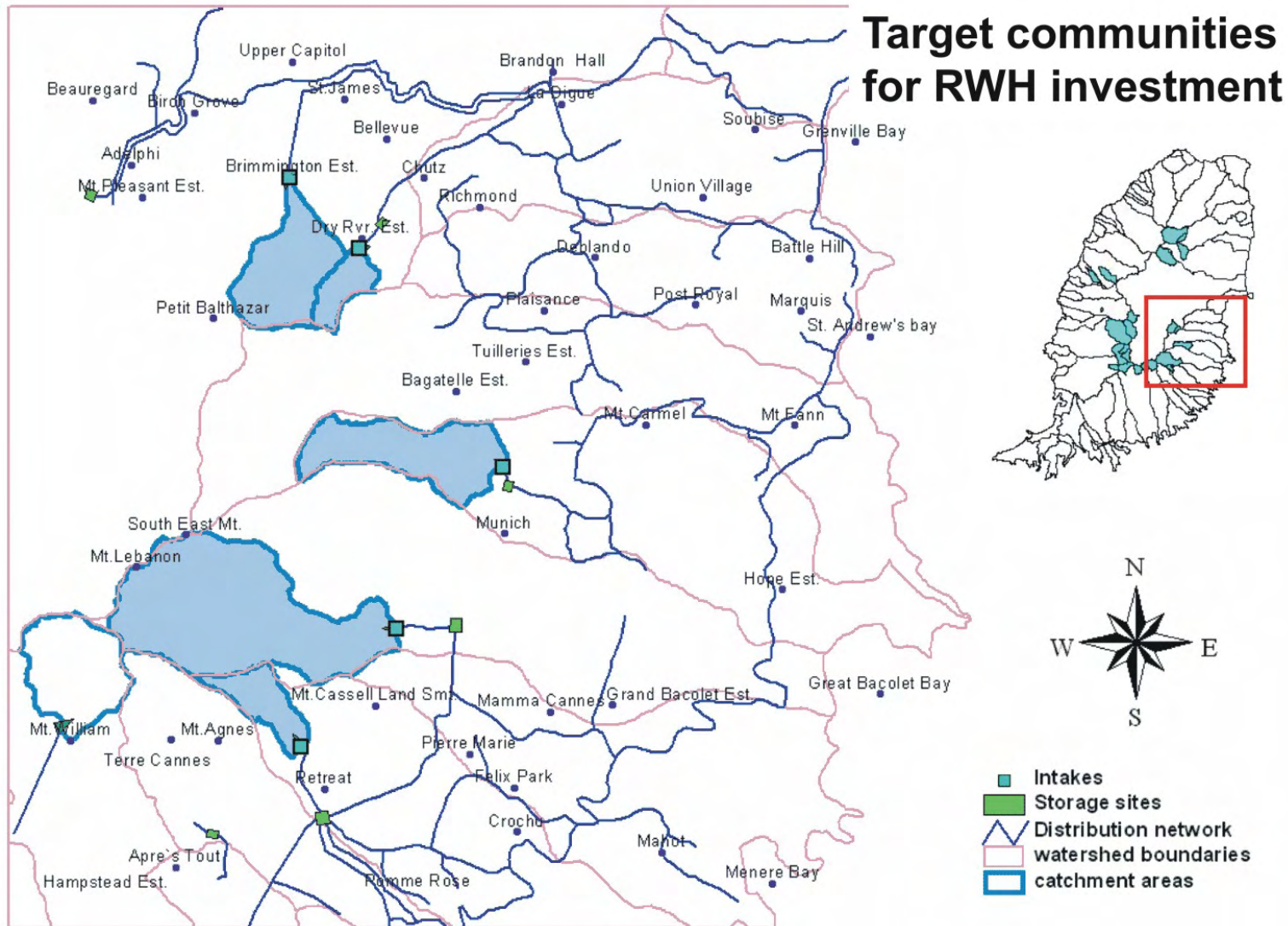






By extension, communities exclusively dependent on these sources will be relatively vulnerable to water stress during dry months. Water supply augmentation strategies highly recommended (NOTE: there may be other abstraction sources not analyzed at this time; verification needed)

The map above identifies those NAWASA catchment areas that lie with the water deficit zone; that is where ET exceeds rainfall during March, statistically the driest month.



The map above is an expanded view of the eastern region of Grenada showing the potentially affected communities in the context of potable water supply. It must be noted that supplies to these communities may be augmented from other sources due to inter-connectivity with the rest of the distribution network.

**Annex 2. Examples of rainwater harvesting applications in Grenada**



Household rooftop rainwater catchment systems in Carriacou.



Concrete rainwater catchment surface in Petit Martinique.



Typical household rooftop rainwater harvesting in southern Grenada (Woburn).