OCTs Regional Risk Reduction Initiative (R3I)

Building capacity in disaster risk reduction in Caribbean OCTs
National outputs with regional integration

Open International Competition

Request for Proposals – RFP101108:
Provision of Services to Caribbean OCTs:
Lot 1: GIS and Vulnerability Assessment
Lot 2: Coastal hazard analysis

Annex III
Terms of Reference
ANNEX II: TERMS OF REFERENCE

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1. BACKGROUND INFORMATION

1.1. Beneficiary countries

The beneficiaries are the British and Dutch overseas countries and territories (OCTs), with the exception of Bermuda, 11 islands in total.

<table>
<thead>
<tr>
<th>Country</th>
<th>Population</th>
<th>Area/km²</th>
<th>GDP per capita/US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aruba (ARU)</td>
<td>105,000</td>
<td>193</td>
<td>21,800 (2007)</td>
</tr>
<tr>
<td>Bonaire (BON)</td>
<td>14,000</td>
<td>294</td>
<td>11,400 (2007)</td>
</tr>
<tr>
<td>Curacao (CUR)</td>
<td>141,766(2009)</td>
<td>444</td>
<td>20,500 (2009)</td>
</tr>
<tr>
<td>Montserrat (MNT)</td>
<td>4,785(2008)</td>
<td>102</td>
<td>9,000 (2008)</td>
</tr>
<tr>
<td>Saba (SAB)</td>
<td>1,424(2004)</td>
<td>13</td>
<td>11500</td>
</tr>
<tr>
<td>Sint Eustatius (EUS)</td>
<td>3,100</td>
<td>21</td>
<td>11400</td>
</tr>
<tr>
<td>Sint Maarten (SXM)</td>
<td>40,917</td>
<td>34</td>
<td>20600 (2007)</td>
</tr>
<tr>
<td>Virgin Islands (VI)</td>
<td>27,000</td>
<td>260</td>
<td>53,302 (2008)</td>
</tr>
</tbody>
</table>

1.2. Contracting authority

The Contracting Authority is:

**UNDP Barbados and the OECS**
UN House, Marine Gardens, Hastings
Christ Church, Barbados
1.3. Relevant country background

ANGUILLA

Anguilla has few natural resources and the economy depends on tourism, foreign banking, lobster fishing and remittances from emigrants.

Anguilla is exposed to various hazards such as hurricanes, tropical storms, tsunamis, floods, earthquake, coastal erosion, rising sea levels, sea penetrations, and landslides. This exposure increases the vulnerability of these vital economic sectors.

The hurricanes that affected the island, most recently, were: Omar in 2009, which affected infrastructure; Lenny in 1999, which generated damage in infrastructure; and Marilyn and Luis in 1995, which affected a large number of buildings and heavily impacted the economy of the island, particularly the tourism sector. Hurricane Donna in 1960 destroyed ¾ of the homes in Anguilla. An earthquake also occurred in the Caribbean Sea in November 2007.

The Department of Disaster Management (DDM) is the organisation responsible for civil protection issues. The National Emergency Operation Centre (NEOC) reports to the Deputy Governor and it is responsible for the following areas:

- community outreach
- preparedness and education
- mitigation
- strategic planning and mapping (GIS)
- emergency communications
- warning systems and web services

The Director of the Department and NEOC oversees the coordination and cooperation between various national actors. Anguilla did not have a national policy on mitigation of natural and technological hazards until April 2009 when the DDM developed the National Mitigation and Risk Reduction Strategy Plan. This legislation provides an integrated framework for the implementation of hazard mitigation measures on national, sectoral and community levels in a structured holistic and comprehensive manner.

Anguilla’s National Warning System (ANWS) was designed and implemented during 2006-2008. Alerting protocols were drafted collectively by the fire and police departments, Red Cross and other agencies. System requirements include policy and protocols for use; thresholds of risk and associated alert levels; consideration for at risk populations e.g. sight/hearing impaired, multiple languages; weekly and monthly testing; and integration into daily life.

Anguilla is an associate member of the Caribbean Community (CARICOM) and the Caribbean Disaster Emergency Management Agency (CDEMA).

ARUBA

Aruba has been an autonomous territory of the Netherland Kingdom since 1 January, 1986. Tourism is one of the main pillars of its economy and the main source of employment for the population.

Aruba does not have a high annual risk of hurricanes; however, the island was heavily affected by hurricanes Hazel in 1954, Janet in 1956, Lenny in 1999 and Ivan in 2004, causing severe damage to the infrastructure and the tourism sector. As part of their mitigation efforts, the Netherlands government has
installed one water pump in Aruba in the event of future hurricanes. Other potential hazards are aircraft accidents, major fire, tsunami, earthquakes and oil spills.

In 2003 Aruba established a Crisis Management Office which reports directly to the Prime Minister. This office is the coordination point for the organisation and preparation for all disasters and is independent from the Fire Department. Its organisational structure consists of a director, an administrative and information technology division, and four discipline areas (Prevention and Mitigation; Training, Practice and Public Relations; Planning and Preparedness; Legal Affairs). However, it presently has only three permanent staff.

The incident response structure includes the Command, Operative Management, the Commander and the On-site Units. The key organisations are the fire, police, and health departments which have contingency plans for hurricanes, aviation and marine incidents. Every two years they conduct drills for a possible airplane accident to test operational procedures, protocols, responsibilities and coordination mechanisms. The Military Command of the Antilles islands meets twice every year with the Fire Department, which has 167 employees in addition to volunteers.

The Netherlands Dutch Red Cross provides funding to Red Cross Aruba for prevention programmes. They have 3 permanent staff and approximately 100 volunteers (about half of them are presently active), an ambulance, and limited equipment and supplies. They provide support, emergency shelter, medical care, training and simulations. They maintain a good relationship with the Crisis Management Office but they develop their own activities and dynamics.

CAYMAN ISLANDS

The Cayman Islands consists of three islands: Grand Cayman, Little Cayman, and Cayman Brac. With a total population of approximately 69,000 people (2008), it has one of the strongest economies in the Caribbean. It is the fifth largest international finance centre and the GDP per capita (2004) is the 12th highest in the world. Tourism is also an important source of income and it is attractive to high-income travelers from the United States.

History has shown that the Cayman Islands are at risk of being affected by hurricanes, tropical storms and earthquakes. In 2008, they were severely affected by Hurricane Paloma, which damaged several houses and some tourist resorts. In 2004, Hurricane Ivan caused two deaths and severely damaged infrastructure. Other hurricanes that have also affected the islands include Michelle (2001), Gilbert (1988), and Katrina (1981). In December 2004, there was a 6.7 Richter scale earthquake, but it did not cause considerable damage.

The organisation responsible for hurricane preparedness and alert is the National Hurricane Committee. The committee is composed of senior government officials and members of the community. Hazard Management Cayman Islands (HMCI) is responsible for the coordination between relevant agencies in the event of an incident.

After Hurricane Ivan, a software package called WebEOC was adopted. It is a commercial incident management software package marketed to facilitate the collection, review and dissemination of data for an informed decision making process. HMCI has offered training services in WebEOC to other OCTs and CDEMA.

HMCI has developed maps for storm surge, wind and wave hazards based on hurricane track scenarios, bathymetric surveys and experiences from Hurricane Ivan. This allows the approximate prediction of impact in vulnerable areas and a better planning for response and mitigation. There are cadastral maps of
the islands, with data that include the number and location of houses and buildings, their value, and population. These data contribute to the efficiency of rapid impact assessments, which are subsequently validated with a detailed assessment. There is also a National Weather Service and a Fire Department.

Many disaster reduction and preparedness activities and actions have been developed and include:

- regular revision and development of legislation related to risk reduction
- modernisation of the construction code
- evaluation of building and construction safety
- development of public awareness programmes
- building of storm-resistant emergency shelters equipped with emergency electrical power and water
- implementation of an early warning system for hurricanes
- installation of a seismic surveillance network

The Cayman Islands are an associate member of CARICOM, but not of CDEMA.

**MONTserrat**

Due to the effects of Hurricane Hugo (1989) and the eruption of the Soufriere Hills Volcano (1995, 1997), the economy of Montserrat has practically halted. Economic activities are reduced to selling and shipping of aggregate for construction. The life in the country depends on external assistance and imports of goods for sale on the island.

In July 1995, Montserrat suffered a violent volcanic eruption, which required the establishment of a safety zone (north) and an exclusion zone (south), the latter covering over half the 102km² island. Since Plymouth, the former capital, was destroyed in the eruption and is within the exclusion zone, a provisional capital was set up in Brades. The total population of Montserrat stands at 4,785 inhabitants. Before the volcanic eruption, it stood at 10,400, but about 8,000 people fled the island after the disaster (only 2,700 inhabitants in 1997).

The volcanic eruption has put a serious damper on Montserrat’s small open economy. Per capita GNP stands at US$4,814 (2005). Montserrat continues to suffer from the consequences of the volcanic eruptions, as more than half of the island remains uninhabitable. Montserrat also has a significant budget deficit. External aid for the development of the security zone has had a positive impact, especially in the construction sector. External technical and financial assistance is channelled through the various ministries. The main sources are DFID, the EU, and CARICOM. The UK government has provided more than £250 million in aid since the 1995 eruption.

The Disaster Management Coordination Agency (DMCA) has 8 staff and is part of the Governor’s Office. It has a coordination role in natural hazards and manages three plans: the National Disaster Plan, the Hurricanes Plan, and the Volcano Plan. These plans are evaluated each year to adjust to current situations. As in other CDEMA Participating States, the plans are based on a CDEMA model.

**THE NETHERLANDS ANTILLES**

The Netherlands Antilles consist of a federation of five main islands: Bonaire, Curacao, Saba, Sint Eustatius and Sint Maarten. The islands Curacao and Bonaire represent about 80% of the total population of 223,652 (July 2007 estimate). Sint Maarten is adjacent to St-Martin, which is an Outermost Region of
France. The capital of the Netherlands Antilles is Willemstad, on Curacao. Saba and Sint Eustatius are volcanic islands with very small populations, relying on Sint Maarten and Curacao for much of their capacity.

The Netherlands Antilles enjoy a per capita income of US$16,000 (2004 estimate). Tourism, petroleum refining, and offshore finance are the mainstays of this small economy, which is closely tied to the outside world. Most of the oil the Netherlands Antilles imports for its refineries comes from Venezuela. Almost all consumer and capital goods are imported, the US and Mexico being the major suppliers. Poor soils and inadequate water supplies hamper the development of agriculture. Budgetary problems hamper reform of the health and pension systems of an ageing population.

While the Netherlands control external affairs, each of the five islands has its own island government, and the Netherlands Antilles as a whole has a central government. By 10 October 2010 (10/10/10), Sint Maarten and Curacao should gain greater autonomy within the Kingdom of the Netherlands, whereas the other islands (Bonaire, Saba, Sint Eustatius) should integrate more closely in the Kingdom, becoming municipalities. For the latter, the Netherlands will offer support by taking over a part of the islands’ public debt, in step with progress made by the islands in terms of good governance.

The Netherlands Antilles, being an OCT, do not fully participate in the regional integration process. The Netherlands Antilles are however seeking closer ties with CARICOM, where they currently have observer status, and want to strengthen ties of cooperation with CARICOM in areas such as public health, social development, education, sport and culture.

In 1995 the island of Saint Martin (Sint Maarten and St-Martin) was affected by Hurricanes Luis and Marilyn, which caused over US$1 billion in direct and indirect damage in Sint Maarten alone. There are noticeable differences between the operation of the two fire departments: in St-Martin, it is responsible for the onsite attention to the victims; while the Dutch department’s role is limited to fire fighting and search and rescue. Although the on site intervention by the Service d'Aide Médicale Urgente (SAMU) is supervised by the fire department, the ambulance or fire fighting personnel, contrary to their Sint Maarten counterparts, are not authorised to provide emergency medical treatment without direct medical supervision (injections, perfusions, etc).

Although there are formal conventions of mutual assistance between the two parts, there is little joint planning, exercise and shared assets. Both allow each other’s fire department to intervene on request but rely mostly on their home state for support in case of severe disaster. The difference in concepts, missions and delegation of authority in this very small island illustrate the complexity of reaching a common platform for response to disasters in the Caribbean at large.

TURKS AND CAICOS ISLANDS

The Turks and Caicos Islands are exposed to various hazards and risks, including hurricanes, floods, oil spills, aircraft crashes and mass migration. Turks and Caicos was affected by Hurricanes Donna (1960) and Kate (1985), Tropical Storm Erin (1995), Hurricane Frances (2004), and in 2008 Tropical Storm Hanna which caused several deaths and severe damage in housing and infrastructure.

The Department for Disaster Management and Emergencies (DDME) is responsible for disaster management throughout the Turks and Caicos Islands, which is a multi-island jurisdiction. The main DDME office is located in Grand Turk, the capital, and is staffed by 7 people. The National Disaster Plan is updated annually and includes as priority actions:

- Emergency Operations Centre buildings – retrofit
National Warehouse Building - Retrofit
Emergency shelters – retrofit existing and new shelters
Communications systems–VHF/HF (re-install)
Public information and education

For the recovery process in the aftermath of Tropical Storm Hanna and Hurricane Ike, the Cabinet established the Recovery Task Force with a Permanent Secretary, chaired by the Ministry of Finance. Further, the Cabinet also approved the formation of the Disaster Recovery Board chaired by the Governor. The sectors work in an articulated manner and in coordination with the DDME. There is a Disaster Information Management Group, which elaborated a plan and a strategy but lacks an operative mechanism. At regional level, they are linked to the CDEMA Comprehensive Disaster Management (CDM) Strategy.

After the earthquake in Haiti, the ongoing migration of Haitians to Turks and Caicos increased sharply and will continue to do so. This complex and costly issue must be addressed regionally.

TCI is a member of the Caribbean Development Bank (CDB), CARICOM, CDEMA, and since December 2004 is a member of the Caribbean States Association.

VIRGIN ISLANDS

The Virgin Islands consist of the main islands of Tortola (capital), Virgin Gorda, Anegada and Jost Van Dyke, along with over fifty other smaller islands and cays.

VI’s geography and socioeconomic dependence on coastal zones makes them vulnerable to inland floods, hurricanes, earthquakes, and tsunamis. During the period 1992-2010, VI sustained over $90 million in property damage from hurricanes and floods, with $24 million being economic impact from Hurricane Lenny (1999) and $20 million from the November flood event in 2003. Coastal settlements and communities are projected to continue to experience rapid development and population growth; therefore the creation and implementation of mitigation efforts are essential. There are a number of factors that challenge the efforts at protecting life and property within VI, however education, training, creative thinking and involvement of the entire society are crucial in addressing these challenges.

The Department of Disaster Management (DDM) originated in the Office of the Deputy Governor in 1983 with a Desk Officer. It became an independent department in 1990 with the employment of the first full-time Disaster Preparedness Coordinator. Initial operations concentrated on the preparedness phase of the disaster management cycle until the strategy shifted to CDM which encompasses the four phases of the disaster cycle (preparedness, mitigation, response and recovery).

The DDM is, however, not the sole agency responsible for implementing this CDM Strategy. Critical support is required from all sectors, both public and private, and the approval from Cabinet gives the DDM the needed political backing.

The DDM office is co-located with the NEOC, which is the designated administrative hub for national disaster or emergency response mechanisms. It is the “nerve centre” of emergency and disaster response activities and services. The NEOC coordinates, directs and leads the response to the threat of a hazard impact by following standardised procedures on a 24-hour basis to ensure a timely and effective response.

The Department has 13 major functions as outlined below:

1. Laws and authorities
2. Hazard identification and risk assessment (HIRA)
3. Hazard mitigation
4. Resource management
5. Planning
6. Direction, control, and coordination
7. Communications and warning technology
8. Operations and procedures
9. Logistics and facilities
10. Training
11. Exercises
12. Public information and education
13. Finance and administration

There are currently 13 established employees and 1 non-established employee assigned to the DDM. The DDM’s work is divided into five Programme Areas which are managed by programme managers, and supported by the administration and finance management functions. These Programme Areas include:

- Public information, awareness and education
- CDM mainstreaming and recovery planning
  - Sub-area: capacity building
- Hazard mitigation, planning and development
- Emergency operations
  - Sub-area: shelters, disaster relief and community preparedness
  - Sub-area: emergency response systems
- DDM, CDM and programme management

The DDM’s CDM Programming Framework describes the results that the DDM and the CDM Strategy aim to achieve over the 2009-1013 period and the activities that will be implemented by the DDM in order to achieve these results and the overall goal of “reinforcing the development potential of the VI by reducing risks from all hazards”.

The DDM is heavily focused on building the capacity of its staff and ensures staff participation in numerous national and regional training and capacity building initiatives. This strengthens the knowledge and capacity of the organisation as a whole. With training and capacity building, different staff members enhance their knowledge in particular areas of CDM, ‘spreading’ knowledge within the DDM, while strengthening the entire organisation.

VI does not possess an independent hydrological or meteorological department; however the DDM is responsible for the meteorological monitoring.

1.4. Project description

The OCTs Regional Risk Reduction Initiative (R3I) covers the English and Dutch overseas countries and territories in the region, with the exception of Bermuda. Their unique ecosystems and socioeconomic dependence on tourism, the marine environment and coastal areas makes them highly vulnerable to various natural hazards and climate change impacts. This project seeks to address the risk and exposure of these small islands by providing a network of regional infrastructure, programmes, policies and protocols to strengthen their capacity to predict and prepare for natural and human-induced hazards, and thus improve resilience and reduce risk and subsequent loss.
R3I is funded by the European Commission to the tune of €4.932m covering a period of 3 years (2009-2011). By the end of the project it is expected that there will be:

- Increased capacity in hazard mapping and associated vulnerability assessments, to further be incorporated into spatial information systems to inform planning and development processes
- A regional early warning systems (EWS) pilot for the OCTs, based on the ITU automated alert protocol for warnings
- Capacity built in response, rescue and recovery, in order to shorten recovery periods through the use risk assessment and mitigation practices for development planning
- Strengthened local disaster management structures and capacities in terms of tools and best practices to support comprehensive disaster risk management
- Greater cooperation and coordination between the OCTs, with documentation and dissemination of best practices

The R3I emphasises intra-regional learning and sharing of tools, knowledge and best practices to enhance the territories’ individual and collective capacities. It will, among other activities, support OCT disaster management and GIS departments with modelling, simulation and planning; and build on the related experience and knowledge in the Cayman Islands. Further plans are to integrate results of modelling into quantitative multi-hazard vulnerability maps to support investment in hazard mitigation strategies; and complete and/or initiate building vulnerability studies and improve quantitative risk assessment of critical infrastructure to support the investment in hazard mitigation strategies.

A letter of agreement has been signed between UNESCO-IHE and UNDP. UNESCO-IHE will provide Sint Maarten with flood maps built on flood numerical models, vulnerability assessment related to floods, tsunami and storm surge simulations.

1.5. Related programmes and other activities in the relevant sector

Many disaster risk reduction programmes are currently ongoing in the Caribbean; the consultant may have to coordinate their activities with several of them. Significant institutional actors in these processes include CDEMA, the Caribbean Institute for Meteorology and Hydrology (CIMH), the Caribbean Meteorological Organisation (CMO), the United Nations Educational, Scientific and Cultural Organisation (UNESCO), and the World Meteorological Organisation (WMO), Specific attention will be given to:

UNESCO IOC working groups

WG 1: Monitoring and Detection Systems, Warning Guidance

Purpose: To review and recommend to the ICG priorities and actions required towards the full establishment of a coordinated regional tsunami warning system.

Functions:
1. Advise member states on the monitoring and detection capabilities needed for operating national tsunami warning centers.
2. Define the threshold criteria for the monitoring and warning systems.
3. Assure the compliance with the agreed standards for the detection systems.
4. Ensure the effectiveness of the warning system by promoting the open exchange of seismic, sea level and other observational data in real time.
5. Promote the sharing of experience and expertise and capacity building essential to the effective monitoring and issuance of warnings.
6. Ensure the establishment of a fully interoperable regional tsunami warning system.

WG 2: Hazard Assessment

Purpose: To advise the ICG on the identification and characterization of coastal hazards, their assessment and the required modeling.

Functions:

1. Review and evaluate the required methods and data sets, including bathymetry and coastal topography for determining the coastal hazards.
2. Advise the member states on the requirements for operating the appropriate models.
3. Develop capacity building for the appropriate modelling.

WG 3: Warning, Dissemination and Communication

Purpose: To advise the ICG on means of identifying best practices and needs, as well as solutions for information gaps and outstanding problems in receiving and disseminating warnings and advisories for an end to end early warning system.

Functions:

1. Provide technical requirements on the receiving and dissemination of messages to the decision makers and the community at large.
2. Develop strategies so that the MS can have the capacity for their NTWC based on the assessment Questionnaires.
3. Oversee institutional arrangements for warning dissemination and communication.

WG 4: Preparedness, Readiness and Resilience

Purpose: To advise and recommend to the ICG strategies to enhance the preparedness, readiness and resilience capabilities and to develop the necessary recommendations, tools and procedures.

Functions:

1. Identify the strategies that the MS can integrate into their national risk reduction programs.
2. Provide guidelines to the MS for policies and legislation for emergency prevention, mitigation and response.
3. Define strategies for the implementation of national plans for the preparedness and response of the communities which should include training, dissemination and evacuation procedures.
WMO Caribbean Regional Programme in Multi-Hazard Early Warning Systems (MHEWS)

The roadmap for the design of this programme culminates in December 2010, when a final programme document and project proposal for 2011-2012 will be presented for technical approval at the CDM Conference in Jamaica. It is being developed in consultation with national disaster management stakeholders, regional institutions and agencies (e.g. CDEMA, CMO, CIMH, OAS, CDB, IADB), and international and bi-lateral donors and implementing agencies (e.g. UNDP, World Bank, CIDA).

The overall objectives of the programme are to:

- strengthen national and regional institutional capacities and cooperation among the NMHS and DRM agencies through development/strengthening of components of EWS with a multi-hazard approach for hydrometeorological hazards in the Caribbean region
- enhance coordination among hydrometeorological warning systems (building on the existing regional coordination in tropical cyclone) as well as with other hazards (such as tsunamis)

The 6-8 year programme will be structured in phased projects, with a 1-2 year cycle for implementation, evaluation and expansion, and an associated fund mobilisation strategy.

This process has commenced, with regional consultations being conducted from July until mid-September. A first draft of the MHEWS programme is expected by mid-October, with a technical review workshop in early November. Review of the second draft is scheduled for the end of November, and submission of the final product by the end of December.

Capacity development of service institutions in the Netherlands Antilles

This is an initiative under the EU’s EDF 9 aimed at delivery of technical support to service institutions, mainly Public Works Departments and utility companies, in order to maximise their technical and organisational capacity. This includes:

- Project planning, operation and maintenance
- Upgrading of digital data management systems (GIS) and capacities
- Improving customer focus and service delivery
2. OBJECTIVE, PURPOSE AND EXPECTED RESULTS

2.1. Overall objective

The main objective of this contract is to characterise the natural and, where identified as significant, human-induced hazards to which the OCTs are exposed and identify geographic and socioeconomic areas of vulnerability. Local capacities to develop and implement mitigation strategies will then be strengthened through the provision of tools (spatial data infrastructure and models) and best practices to support comprehensive disaster risk management.

2.2. Purposes

The purposes of this contract are as follows:

- Purpose 1: To provide relevant national agencies with responsibilities for disaster risk management (preparation, mitigation, response and recovery) with risk information tools and data (hazard maps and vulnerability assessments) and a GIS framework for use in their daily work, and develop their capacity to manage risk information data.

- Purpose 2: To collect and, in some instances, produce accurate vulnerability assessments and hazard maps on which early warning systems and response and contingency plans can be based.

- Purpose 3: To strengthen the use of harmonised risk information at country level by all disaster management stakeholders including decision makers and the public.

- Purpose 4: To help the countries to integrate their vulnerability assessments and hazard maps into a regional context (harmonised OCT risk information and integration in the broader Caribbean context).

2.3. Results to be achieved by the consultant

The consultant will base their work on existing data and capacities. Therefore the results of the consultant’s work will differ for each country, whereas the purposes enunciated above shall always be pursued.

During the formulation phase of R3I project, efforts have been made to specify for each country the results expected from the consultant’s work. This is reflected in the table below. However it should be noted that the consultant shall provide advice and recommendations on other results which would help to reach the purposes stated above.
<table>
<thead>
<tr>
<th>Expected Results</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase I: HM/VA capacity assessment</strong></td>
<td></td>
</tr>
<tr>
<td>I-a Review of HM and VA capacities</td>
<td>All</td>
</tr>
<tr>
<td>I-b Data needs assessment and existing data collected</td>
<td>All</td>
</tr>
<tr>
<td>(compilation of all existing hazard maps and transcription of these maps in</td>
<td></td>
</tr>
<tr>
<td>convenient formats for working and sharing, with format updating where necessary)</td>
<td></td>
</tr>
<tr>
<td>I-c Recommendations, planning and strategy development</td>
<td>TCI, MNT, SXM, ARU CUR</td>
</tr>
<tr>
<td>1. Long term capacity development and use strategy</td>
<td>All</td>
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<tr>
<td>2. Detailed implementation methodology for the contract (overall and for each</td>
<td></td>
</tr>
<tr>
<td>country)</td>
<td></td>
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<tr>
<td><strong>Phase II: Base data and equipment acquisition</strong></td>
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</tr>
<tr>
<td>II-a Assistance for data acquisition</td>
<td>All</td>
</tr>
<tr>
<td>II-b Assistance for equipment acquisition</td>
<td>All</td>
</tr>
<tr>
<td><strong>Phase III: Coastal hazard modelling and mapping</strong></td>
<td>VI</td>
</tr>
<tr>
<td>III-a Tsunami modelling and hazard maps</td>
<td></td>
</tr>
<tr>
<td>III-b Storm surge modelling and inundation maps</td>
<td></td>
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<tr>
<td><strong>Phase IV: Vulnerability assessment and quantitative risk assessment</strong></td>
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<tr>
<td>IV-a Preliminary vulnerability assessment</td>
<td>TCI, MNT, ARU, CUR, BON</td>
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<tr>
<td>IV-b Structural vulnerability (critical buildings, facilities and infrastructure)</td>
<td>CI, TCI, MNT, ARU, CUR, BON</td>
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<tr>
<td>IV-c Loss estimation studies and vulnerability curves</td>
<td>CI</td>
</tr>
<tr>
<td>IV-d Operational vulnerability assessment</td>
<td>CI</td>
</tr>
<tr>
<td>IV-e Social vulnerability assessment</td>
<td>CI</td>
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<tr>
<td>IV-f Environmental vulnerability assessment</td>
<td>CI</td>
</tr>
<tr>
<td>IV-g Proposition and estimation of mitigation measures</td>
<td>CI, TCI, MNT, ARU, CUR, BON</td>
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<tr>
<td>IV-h Technical review panel and public outreach</td>
<td>CI, TCI, MNT, ARU, CUR, BON</td>
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<tr>
<td><strong>Phase V: Vulnerability assessment and hazard mapping applications</strong></td>
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</tr>
<tr>
<td>V-a Hazard database:</td>
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</tr>
<tr>
<td>1. Multi-hazard risk map</td>
<td>All</td>
</tr>
<tr>
<td>2. GIS database</td>
<td>All</td>
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<td>3. Customised GIS graphic user interface</td>
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<td><strong>Expected Results</strong></td>
<td><strong>Countries</strong></td>
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<td>4. Hazard atlas</td>
<td>AXA, VI, TCI, EUS, CUR</td>
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<td><strong>V-b</strong> Disaster management applications</td>
<td>All esp TCI, MNT, ARU, CUR, BON</td>
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<td>1. Use of GIS for hazard mapping and vulnerability assessment</td>
<td>All esp TCI, MNT, ARU, CUR, BON</td>
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<td>2. Use of GIS for contingency and logistical planning and emergency management operations and coordination</td>
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<td><strong>V-c</strong> Input for early warning systems</td>
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<td>1. Point maps of the components of the national warning system</td>
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<tr>
<td><strong>V-d</strong> Adaptation of tools and products for decision makers and public awareness</td>
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3. ASSUMPTIONS AND RISKS

3.1. Assumptions underlying the project intervention

The main underlying assumptions relate to:

- The accessibility of existing data in different institutions and organisations.
  - While it is the responsibility of the consultant to complete all necessary investigations and requests, UNDP together with country authorities and the Caribbean Disaster Management Network will facilitate this process.
- The timeframe of the project implementation is short.
  - The consultant is explicitly requested to mobilise all necessary human resources for a timely execution of their duty.
- Time allocated to the acquisition of new data through surveys and investigations.
  - This will be one of the first concerns of the consultant during Phase I and one of the major components of the “red-line” in the implementation of the contract. The necessary time for identification, procurement, contracting and execution of data acquisition contracts should not be underestimated.
  - The consultant is requested to adapt their methodology in order to advance the project as much as possible prior to the availability of new data.
  - Support from regional and international partners will also facilitate this process.

3.2. Risks

Each assumption above presents a certain level of risk, if not closely managed by the consultant. Other risks are to be considered:

- The occurrence of a natural disaster is a possible threat to the successful execution of the project.
  - A suspension of activity can be considered by the Contracting Authority in case of a major event.
  - During execution planning, the consultant should take into account a lowered availability of disaster management stakeholders during the hurricane season.
  - The consultant should draw from the lessons learned from any disasters which may occur during the implementation timeframe of the project.
  - Quality control measures should be implemented to ensure the resilience of the contract outputs undertaken by the consultant.
- Changes in the political status of the Netherlands Antilles after 10/10/10 may induce a period of uncertainty in the definition of some stakeholders’ roles.
  - The changing political climate may require investigation into the creation of new points of contact.
4. SCOPE OF THE WORK

4.1. General

4.1.1. Geographical area to be covered

The present Terms of Reference (ToR) cover the same geographical area as the R3I project, namely English and Dutch overseas countries and territories in the Caribbean region.

4.1.2. Target groups

Disaster management offices

These are the primary target stakeholders of the present ToR as they should benefit from the capacity building (training, tools, and data) provided under the consultant’s contract.

However it is important to note that they will also provide some level of logistical and human resources support to the contractor in order to facilitate:

- better ownership and understanding of the project outcomes;
- more efficient access to information and data; and
- greater value for money

A strong partnership between the consultant and disaster management offices must be built for the duration of the project.

National disaster management stakeholders

All national stakeholders involved in disaster management related activities (preparation, response, mitigation, recovery) are subject to be beneficiaries of the consultant’s work. Among them special attention will be given to decision makers; planning and land administration offices; fire and police departments; hydrometeorological services; hospitals and schools; and water, electrical and telecommunication utilities.

Population

The final beneficiary of the project is the population. The population is also a specific target group as far as public outreach and public awareness activities are concerned. Additionally, the input provided by the population itself (e.g. through surveys) should not be underestimated.

Throughout all of their activities, the consultant will address the explicit concerns of specific sub-groups such as the disabled, tourists, and youth. Gender issues must also be explicitly addressed in each of the consultant’s activities.
### 4.2. Specific activities

#### 4.2.1. Phased structure

The activities described hereunder are organised in suggested chronological phases. It will however be possible to start a new phase before the total completion of the previous one.

Each Phase shall start upon the receipt by the consultant of a service order issued by the Contracting Authority.

<table>
<thead>
<tr>
<th>OUTPUT 1 : Hazard Mapping and Vulnerability Assessment – RFP 1 GIS lead</th>
<th>AXA</th>
<th>VI</th>
<th>CI</th>
<th>TCI</th>
<th>MNT</th>
<th>SAB</th>
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<td><strong>Phase I: HM/VA capacity assessment</strong></td>
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<td>I-a Review of HM and VA capacities</td>
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<td>I-b Data collection and data needs assessment</td>
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<td>I-c Recommendations, planning and strategy development</td>
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<td>1. Long term capacity development and use strategy</td>
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<td>2. Detailed implementation methodology for the contract (overall and per country)</td>
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<td><strong>Phase II: Base data and equipment acquisition</strong></td>
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<td>II-a Assistance (ToR development) in data acquisition (aerial photography/LIDAR and data take off, bathymetry, etc.)</td>
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<td><strong>Phase III: Coastal hazard modelling and mapping</strong></td>
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<td>III-a Tsunami modelling and hazard maps</td>
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<td><strong>Phase IV: Vulnerability assessment and quantitative risk assessment</strong></td>
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<td>IV-b Structural vulnerability (critical buildings, facilities and infrastructure)</td>
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<td>IV-c Loss estimation studies and vulnerability curves</td>
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<td>IV-d Operational vulnerability assessment</td>
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### OUTPUT 1: Hazard Mapping and Vulnerability Assessment - RFP 1 GIS lead

| IV-e Social vulnerability assessment | AXA | VI | CI | TCI | MNT | SAB | EUS | SXM | ARU | CUR | BON |
| IV-f Environmental vulnerability assessment | | | | | | | | | | | |
| IV-g Proposition and estimation of mitigation measures | | | | | | | | | | | |
| IV-h Technical review panel and public outreach | | | | | | | | | | | |

#### Phase V: Vulnerability assessment and hazard mapping applications

| V-a Hazard database | AXA | VI | CI | TCI | MNT | SAB | EUS | SXM | ARU | CUR | BON |
| Multi-hazard risk map | | | | | | | | | | | |
| GIS database | | | | | | | | | | | |
| Customised GIS graphic user interface | | | | | | | | | | | |
| Hazard atlas | | | | | | | | | | | |

| V-b Disaster management applications | AXA | VI | CI | TCI | MNT | SAB | EUS | SXM | ARU | CUR | BON |
| Use of GIS for hazard mapping and vulnerability assessment | | | | | | | | | | | |
| Use of GIS for contingency and logistical planning and emergency management operations and coordination | | | | | | | | | | | |

| V-c Input for early warning systems | AXA | VI | CI | TCI | MNT | SAB | EUS | SXM | ARU | CUR | BON |
| Point map of the components of the national warning system | | | | | | | | | | | |
| Public warning zoning adapted to scenarios | | | | | | | | | | | |

| V-d Adaptation of tool and products for decision makers and public awareness | AXA | VI | CI | TCI | MNT | SAB | EUS | SXM | ARU | CUR | BON |

#### 4.2.2. Phase I – HM/VA capacity assessment

Phase I is comprised of three sub-activities:

- I-a: Review of hazard mapping and vulnerability assessment capacities
- I-b: Data collection and data needs assessment
- I-c: Recommendation, planning and long term strategy development
**I-a Review of HM and VA capacities**

The activity should be limited to a desktop evaluation, and should not absorb much of the consultant’s time. The result expected from this activity is a synthesis of all surveys relevant to disaster management in the OCTs or broader groups of countries. An indicative list of these studies is given below:

- B-Tool assessment conducted in May-June 2010 by R3I and earlier assessments
- UNESCO-IHE work on flooding in St Maarten
- Countries strategy papers (disaster management work plans)
- Baseline assessment tool (CDEMA)
- IT assessment (CDEMA)
- Economics of Climate Adaptation study for Cayman Islands (CCRIF)
- 2006 UN Inter-Agency Task Force for Disaster Reduction (IATF/DR) global survey
- 2006 Meteorological Services for Civil Aviation
- 2008 IOC UNESCO ICG Carib
- 2008 UNISDR-PPEW / UNU-EHS Joint Early Warning Questionnaire
- 2009 CDEMA TCHWS Project Country Assessment Questionnaire

The synthesis should provide an analysis of each country’s capacity, including the following points:

- In-country capacities in terms of software, hardware, and human resources (special focus on GIS)
- Access to regional or national capacities (e.g. UK or Netherlands).
- Recommendations for the project plan and long term strategy development to be developed in I-c

**I-b Data collection and data needs assessment**

This activity is key to the success of the services described under these Terms of Reference, as the data collection will have a direct impact on the relevance of Phases III, IV and V.

Much data related to OCT hazards and vulnerability already exist in various organisations. Therefore, before acquiring new data at the expense of the project, the consultant must investigate thoroughly all possible sources of data which may be useful for the project. The UNDP R3I team, as well as OCTs’ disaster management offices and authorities will assist the consultant in acquiring access to relevant data.

The generic term “data” covers for the purpose of this contract:

- Raw spatial data: aerial photos, topography, bathymetry, GIS layers, statistics, etc.
- Processed information: existing evaluations, hazard maps, vulnerability assessments, etc.
- Information which will be produced or delivered under other ongoing activities.

It is important to note that the consultant has the responsibility to gather geographical information and GIS outputs produced by other consultants (operating under different contracts) contracted under R3I such as geological assessments, volcanic assessments, landslide hazard maps, flood and storm surge hazard maps, hazardous material management, and early warning systems outputs.

An indicative list of organisations to be consulted is given below:

- All stakeholders in OCTs including:
  - Disaster management department
  - Hydrological and meteorological services
• Lands and surveys department and/or land administration offices
• Planning departments
• Pertinent local NGOs e.g. the Red Cross
• Water, electricity and communication utilities
• Airport and harbour authorities
• Department of environment and/or environmental health
• Hazardous materials regulatory authority
• Pertinent private sector companies and local associations

• International
  • UN-SPIDER for all satellite support
  • PAHO\(^1\)

• Regional
  • CIMH
  • CDEMA
  • Caribbean Catastrophe Risk Insurance Facility (CCRIF)
  • CMO
  • University of Puerto Rico and Puerto Rico Seismic Network (PRSN)
  • Montserrat Volcano Observatory (MVO)\(^2\)
  • Conseil Généraux de Martinique et Guadeloupe
  • Institute of Marine Affairs in Trinidad and Tobago

• Extra-regional
  • National Oceanographic and Atmospheric Administration (NOAA)
  • United States Geological Survey (USGS)
  • The University of the West Indies (UWI) and its Seismic Research Centre
  • Meteo-France
  • British and US Navies
  • Royal Netherlands Academy of Arts and Sciences (KNAW)\(^3\)
  • International Association of Volcanology and Chemistry of the Earth’s Interior (IAVCEI)
  • Caribbean Volcanoes\(^4\)

This activity also includes:

• All necessary travel and communication to acquire existing data;
• Transcription of data into usable spatial formats for the purpose of further activities undertaken by this project; and
• Critical analysis of the quality of data acquired in terms of:
  • Utility and usability at country level
  • Accuracy of the information
  • Vintage
  • Resolution
  • Presentation

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\(^1\) See [http://www.paho.org/english/dd/ped/caribbeanwindhazardmaps.htm](http://www.paho.org/english/dd/ped/caribbeanwindhazardmaps.htm) for wind hazard maps

\(^2\) [http://www.montserratvolcanoobservatory.info/](http://www.montserratvolcanoobservatory.info/)

\(^3\) [http://www.knaw.nl/edita/antilles/volcanology.cfm](http://www.knaw.nl/edita/antilles/volcanology.cfm)

\(^4\) [http://www.caribbeanvolcanoes.com/](http://www.caribbeanvolcanoes.com/)
I-c Recommendations, planning and strategy development

One of the R3I implementation principles is to base the project activities on country-specific capacities and information (relevance) and to facilitate a continuity of activity in-country once the project is finished (sustainability).

Therefore it is not only crucial that the consultant helps country stakeholders to make steps forward, but also to assists them in developing a long term vision. This is why the R3I implementation strategy and the long term strategic development of hazard mapping and vulnerability capacities are intimately linked.

Long term development strategy

The long term development strategy should focus on hazard mapping and vulnerability assessment capacity development. The indicative themes to cover include:

- Human and material resources
- Training and skills continuity
- Sustainable investment and operational budget
- Medium and long term objectives

These themes will be developed at the local level in direct partnership with the disaster management offices and under recommendations provided by the Lot 1 consultant (responsible for executing Phases I, II, IV and V) who will provide guidance for integration and harmonisation between OCTs at a regional level.

This activity is not proposed for Saba, Sint Eustatius and Bonaire, which will acquire a special status after 10/10/10 and closer relations with the Netherlands; this should greatly influence the development of public services. Further, this activity is not proposed for countries which already have well established development strategies like Anguilla, VI or Cayman Islands.

Short term planning and implementation planning

The short term development planning is coherent with the R3I implementation period and the consultant shall therefore develop a detailed work plan for their own work and for the immediate development capacities of the disaster management offices. The methodology suggested by applicants in their proposal, as well as the detailed implementation plan produced in this first Phase should focus on:

- Partnership with disaster management offices
- Transfer of skills through training applied to the real exercise of hazard mapping and vulnerability assessment
- A presence on the ground

A specific attention will be brought to interfaces / synergies with UNESCO-IHE work in Sint Maarten.

Legal context

The consultant shall provide a synthesis of all relevant national laws and regulations (e.g. the UK Coast Protection Act 1949) associated with the activities to be undertaken in the contract. They must ensure that their strategies and plans are coherent with the legal context.
4.2.3. Phase II – Base data and equipment acquisition

Approximately US$800,000.00 has been set aside by the project to purchase necessary data and equipment under Output 1 (Hazard Mapping and Vulnerability Assessment). These funds are to be committed by UNDP directly and therefore this amount shall not appear in applicant’s Proposal.

The consultant’s role is one of “procurement assistance” to UNDP and the Technical Management Team (TMT). Under activity I-b, the consultant will have searched carefully for available (existing) data and made sure that the data proposed to be purchased by the UNDP under R3I funds are not already available at no cost.

This covers:

a) Identification of needs in terms of equipment (hardware and software) but also and mainly in terms of data. This includes, but is not limited to:
   i. Bathymetry (for tsunami and storm surge modelling)
   ii. Aerial photography
   iii. Topography
   iv. Surveys (buildings, households, etc.)
   v. Any other relevant investigations (rainfall, stream, temperature, structural, social, environmental data)

b) Drafting of the Terms of Reference for data and equipment procurement.

c) The creation of a data license agreement for each country representative to sign. The draft agreement must be approved by the R3I TMT before negotiations are to commence.

d) Assistance to UNDP for the Request for Proposals or Request for Quotations montage (e.g. selection and evaluation criteria, payment modalities, delays).

e) Provison of technical expertise and assistance during the procurement process (e.g. provison of answers to questions, evaluation of offers, and final contracting).

f) Monitoring and control of data acquisition

g) Monitoring of data receipt. When issuing a data receipt certificate, to be signed by the Contracting Authority and given to the provider, the consultant must be satisfied that relevant, reliable, and sufficient evidence exists that:
   a. The data have been properly delivered; and
   b. The amounts claimed by the provider have actually and necessarily been incurred in accordance with the provider’s contract.

In partnership with the disaster management office, the consultant should be well placed to deliver this expertise, and will use the data provided for the GIS activities specified in this document.

Sub-contracting by the consultant is not foreseen for reasons of transparency and competition openness in the procurement process. The consultant will include the data acquired, through collection or purchase, in an adequate GIS format for the purposes of Phases III, IV and V. The contractor should assume that the quality and format of the spatial data acquired from the participating countries will vary, and must supply data in formats compatible with those used in-country. Therefore, the quality control, cleaning and format transformation of existing spatial data in order to proceed with all GIS activities specified in this document is within the scope of this contract. This may include but is not limited to:

- CAD to GIS transformations
- Topology building
- Arc network building
- Attribute uniformity calculations
- Aerial mosaicing
4.2.4. Phase III – Coastal hazard mapping and modelling

Conditions

The consultant may submit a Proposal on Lot 1 (Phases I, II, IV and V) only, Lot 2 (Phase III) only or Lots 1 and 2 (the entire Terms of Reference). Phase III refers specifically to work to be executed in the VI only.

The consultant is required to define the proposed methodology and hydrodynamic model that will be used to undertake the work defined in the Organisation and Methodology section in the Proposal. The model selected shall be done with consideration of utilising this model for any of the other participating countries in the future. The end product shall be capable of easily incorporating localised data from other countries.

An evaluation of the selected model versus alternative models should be provided. The evaluation should include models used for existing and completed regional tsunami modelling projects including those by the Seismic Research Unit, the University of Puerto Rico, the Norwegian Technical Institute, the University of Guadeloupe or other specialised centres or institutions. The consultant will pay special attention to the integration of their work in the UNESCO IOC context and will provide a specific synthesis on this subject.

The formation of partnerships with existing tsunami experts and researchers in the region is highly encouraged.

The consultant can include the proposed scope of work, criteria, and project area associated with the collection of any required additional topographic or bathymetric measurements required for Phase III in the Proposal. The depth and resolution defined for collection of bathymetric data needs to be sufficient for both storm surge analysis and tsunami modelling.

Alternatively, the consultant will prepare the Terms of Reference and assist the Contracting Authority in the procurement of any additional survey/topographical and bathymetric measurements. It is advised to undertake this step at an early stage of the project. The depth and resolution defined for collection of bathymetric data needs to be sufficient for both storm surge analysis and tsunami modelling.

III-a Tsunami modelling and hazard maps

The consultant will conduct probabilistic risk assessment for the potential impact of tsunamis in the VI. The outcomes of the risk assessment will be used to undertake numerical modelling to determine tsunami wave amplitude and inundation depths for the populated coastal areas including, but not limited to Road Town (Tortola), Spanish Town (Virgin Gorda), North Coast (Anegada), The Settlement (Anegada), and Great Harbour (Jost Van Dyke). The deliverables will include quantitative hazard maps detailing tsunami wave amplitude and inundation for selected scenarios and coastal areas.

The recommended approach is as follows:

1. Collect all relevant existing information in terms of:

   - Detailed multi-beam bathymetry mapping of the regions surrounding the islands, both nearshore and farther offshore (grid resolution greater than \( \frac{1}{3} \) arc second \( \sim \)10m). Note: bathymetry
collected will also be used for storm surge modelling. Mapped areas are shown in the figure following.

- Coastal topography
- Digital elevation models
- Existing GIS data which can include but are not limited to roads, buildings, cadastre, planning/land use zones, environmental zones, utility infrastructure, and any other existing spatial data as specified by the VI DDM.

2. Conduct a literature review and evaluation of potential tsunami sources including local earthquakes, teletsunamis, submarine and subaerial landslides, and volcanic eruptions.

3. Determine probable and credible scenarios for tsunami generation. This step could include study of tsunami deposits onshore in selected areas for past tsunami history. The justification of the scenarios chosen must be directly linked with disaster management, land use, and early warning system purposes. A “worst case scenario” will be included. The VI DDM must approve the consultant’s proposed scenarios before any analysis is commenced. The DDM reserves the right to request the alteration of the consultant’s proposed scenarios should they feel it is necessary.

4. Assemble available bathymetry and newly acquired bathymetry into a coherent nested grid for tsunami modelling.
5. Analyse the multi-beam bathymetric data and collection of additional geophysical studies, when necessary, to investigate potential near-field sources (e.g. submarine landslides).

6. Perform hydrodynamic models of specific sources outlined in tasks 2 and 5. These models should both address general wave propagation toward the islands, and specific models for select population centres or industrial facilities of interest. These models can be tested by comparing the predicted flooding to flooding evidence in sites of tsunami deposits.

7. Outputs should include:
   - Graphical and hard copy simulations and presentation of the model outputs
   - Elaboration and integration of tsunami scenario hazard maps in the multi-hazard GIS. Maps shall have a resolution coherent with a scale between 1/5000 and 1/10 000
   - Development of all tsunami-related GIS data layers in order to perform the tasks included in Phase IV. The data include but are not limited to:
     - Land use planning (zoning) and construction codes
     - Public warning system zoning
     - Evacuation zones and routes
     - Infrastructure loss estimation
   - As part of the regional capacity building mandate, the consultant shall provide training courses on how to utilise the model and incorporate localised data to the VI DDM and any other country representatives as specified by the R3I TMT. This may include but is not limited to:
     - Existing GIS staff in the participating countries
     - The R3I TMT
     - Regional researchers such as seismologists, meteorologists, oceanographers

III-b Storm surge modelling and inundation maps

The consultant will conduct a probabilistic risk assessment for the potential impact of storm surge in the VI. The outcomes of the risk assessment will be used to undertake numerical modelling to determine storm surge wave amplitude and inundation depths for the populated coastal areas including, but not limited to Road Town (Tortola), Spanish Town (Virgin Gorda), North Coast (Anegada), The Settlement (Anegada), and Great Harbour (Jost Van Dyke). The deliverables will include quantitative hazard maps detailing storm surge wave amplitude and inundation for selected return periods and coastal areas.

This process must demonstrate a sound understanding of the likely return period and potential impact for storm surge by accurate modelling of selected historical storms (i.e. model the hurricane wind field for each storm and related waves and storm surge). For example, with the appropriate level of modelling, quantifiable baseline/historical conditions can be reasonably accurately determined, thus making it possible to assign actual return periods to design storms. The analysis should also include hurricane wind speeds, and the resulting water level changes due to storm surge and wave impacts.

The consultant is required to undertake additional model runs in order to obtain some understanding of potential risk/damage during future events, where the hurricane intensity is increased and other factors (e.g. sea level rise, tidal amplitude) are simultaneously taken into consideration to determine the overall potential magnitude and impact of the events. This approach will provide sound baseline data for engineering design and planning purposes.
With respect to the potential threat posed by sea level rise, it is specifically recommended that the analysis of water levels should incorporate the most recently available regional (i.e. Caribbean) estimates of projected sea level rise, provided in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007). These values are based both on actual observation and model runs, and have been subjected to extensive global peer review.

The proposed methodology is as follows:

1. Collect all relevant existing information in terms of:
   - Historical records of hurricanes with data on wind distributions, track details, central pressure, forward speed, radius to maximum winds and maximum wind speeds.
   - Bathymetry from the shoreline out to a 100m water depth contour (grid resolution greater than \(\frac{1}{3}\) arc second (~10m). Note: bathymetry collected will also be used for tsunami modelling.
   - Beach profile data for the area(s) in question
   - Coastal topography
   - Digital elevation models
   - Existing GIS data which can include but are not limited to roads, buildings, cadastre, planning/land use zones, environmental zones, utility infrastructure, and any other existing spatial data as specified by the VI DDM.

2. Predict storm surge values at the shoreline by:
   - Estimating the deep water wave and water level conditions using both historical data and forecasted future events.
   - Generating computational grids representing the bathymetry and topography of the study area. This grid should extend beyond the island shelf in order to allow the input of deepwater conditions to the numerical model. It is recommended that the grid should have a reasonably good resolution in order to represent any bathymetric or topographic features that may affect the transformation of wave and water level conditions, or their impact on the shore areas.
   - Using the selected model to transform the hurricane waves from deep to shallow water. The selected model should be able to simulate the complex nearshore processes that lead to storm surge and take into account the impact of wind on local wave generation.
   - Estimating the nearshore values for both waves and storm surge. The outputs should include maximum values of the static storm surge level and wave heights predicted at different sections of the shoreline to be used for planning and preparedness activities.
   - Map the storm surge levels and inundation zones. It is recommended that the following approximate guide be used: 1 in 50, 1 in 100 and 1 in 150 year return period events can be considered roughly equivalent to a Category 3, Category 4 and Category 5 event, respectively. Tsunami-related GIS data layers should be developed to ensure the tasks included in Phase IV can be performed. For example:
     - Land use planning (zoning) and construction codes.
     - Public warning system zoning (areas to be where the population must be warned and evacuated)
- Evacuation routes
- Loss estimation

4.2.5. Phase IV – Vulnerability assessment and quantitative risk assessment

IV-a Preliminary vulnerability assessment

The methodology suggested for this preliminary vulnerability assessment is inspired by the tutorial on community vulnerability assessment available on the NOAA website\(^5\), more specifically Step 1 – hazard identification and Step 2 – hazard analysis. The consultant will also take into account the methods utilised in similar work previously undertaken for Cayman Islands and from the Quantitative Risk Assessment Project\(^6\) (QRAP) performed in Virgin Islands.

This preliminary vulnerability assessment will be completed for the territories of Turks and Caicos Islands, Montserrat, Aruba, Curacao and Bonaire. In the case of Montserrat, the consultant will update and strengthen the integrated vulnerability assessment conducted in 2002.

The work of the consultant should build on the benchmarking exercise performed in May and June 2010 in all islands covered by R3I. The tool used for this exercise was the USAID-OECS Vulnerability Benchmarking Tool\(^7\) (B-Tool). Activities I-a and I-b described above should also provide the consultant with a solid base for the current activity IV-a.

This vulnerability assessment should not be a mere repetition of work previously done. It should provide added value in terms of precision, resolution, quantitative data, and capacity building. Specific attention will be paid to this section when assessing tender proposals.

1. Hazard identification, classification, and prioritisation

The consultant must define the scope of natural and human-induced hazards that could affect or have previously affected the participating communities. The probability and consequences will be analysed and the hazards then prioritised. The format below may be used:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Hazard</th>
<th>Scientific details including impacts and vulnerability</th>
<th>Likelihood</th>
<th>Consequence severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flood</td>
<td>Flooding event impacts villages and farms causing localised and severe property damage Vulnerabilities: school, storm creek bridge; no evacuation plan</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

**LIKELIHOOD**

6: frequent or very likely  
5: moderate or likely  
4: occasional, slight chance  
3: unlikely, improbable  
2: highly unlikely (rare event)  
1: very rare event

**CONSEQUENCE: impact and vulnerability**

4: very high  
3: high  
2: low  
1: very low

The consultant will dedicate research to:

- Multi-hazard situations
- Diseases, epidemics, and infestations that may arise from a primary natural or human-induced hazard
- The collation of regional and localised existing reports such as (but not limited to);
  - scientific hazard assessments
  - reports outlining lessons learned from historical hazard impacts
  - regional and/or international case studies
- Variables that may affect the priority ranking e.g. seasonal sea temperatures, population increases due to tourist arrivals, etc.
2. Hazard analysis

In this step the consultant will utilise GIS to identify and define vulnerability to each hazard in order to identify high risk locations for mitigation projects. It is expected that the consultant will have to update and complete the hazard maps gathered by their own analysis; this makes the preliminary collection of previous works and data at local, national, and regional levels crucial to avoid any replication (activity I-b). While the consultant is not expected to provide detailed models (e.g. flood models, tsunami models), they will provide preliminary hazard maps based on primary models. These may include, but are not limited to:

- Floods, floodplain maps and maximal flood areas
- Storm surge: SLOSH model
- Inland wind models
- Preliminary tsunami maps (maximum level mapped without numerical run-up model)
- Analysis based on soils, land cover, erosion rates and location of hazardous material facilities
- Global Earthquake Model
- Volcanic risk maps

The quality of the approach chosen to analyse the risks, as well as the added value of this approach in terms of capacity building will be important criteria for the evaluation of the technical quality of the offers.

IV-b Structural vulnerability (critical buildings, facilities and infrastructure)

A quantitative risk assessment is the cornerstone of a well designed hazard mitigation planning process. Risk assessment can be considered to measure the potential loss of life, personal injury, economic impact and property damage resulting from the impact of the identified hazards. It builds on a quantitative analysis of hazards and can be implemented through the five activities below:

1. Collect critical buildings and infrastructure vulnerability information
2. Implement a loss estimation study and vulnerability curves
3. Conduct operational, socioeconomic and environmental vulnerability assessment
4. Proposition of mitigation measures and estimation of their potential impact
5. Convene technical review panels and conduct public outreach campaigns

Step 1 above is the subject of the present IV-b activity. The scope for the countries concerned follows as outlined below.

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9 http://www.globalquakemodel.org/
CAYMAN ISLANDS

Building on the recommendations of the preliminary vulnerability assessment of Grand Cayman, the work of the consultant will focus on petroleum and liquid propane gas facilities as well as on the road network.

The list of critical buildings and facilities is to be provided by Cayman Islands.

TURKS AND CAICOS, MONTSERRAT, ARUBA, CURACAO AND BONAIRE

The consultant will be in charge of the collection of the identified building and infrastructure information for the following categories of facilities. This list may be adjusted based on the actual availability and cost of data collection for each category of facility. Any changes to this list must be with the written agreement of participating OCTs.

- Government buildings
- Emergency service facilities, including emergency shelters, police and fire departments
- Hospitals, nursing homes and elderly homes
- Schools
- Airport and seaport
- Utilities: electric, water and sewage, telecommunications
- Petroleum and liquid propane gas depots, hazardous material facilities
- Major businesses and financial institutions
- Major hotels and resorts

The consultant will develop the data collection forms and guidelines and will train the local personnel and individuals involved in data collection, which will be carried out through site visits and review of existing building plans and engineering information. The participating countries will facilitate the consultant’s work by assembling the existing GIS data related to the critical facilities and infrastructure components targeted under this study as applicable. The damage history due to past events must also be considered. The participating OCTs will also develop complete lists of these facilities for use in data collection.

<table>
<thead>
<tr>
<th>Number of facilities / buildings to cover</th>
<th>TCI</th>
<th>MNT</th>
<th>ARU</th>
<th>CUR</th>
<th>BON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>200</td>
<td>50</td>
<td>200</td>
<td>200</td>
<td>100</td>
</tr>
</tbody>
</table>
The following form is suggested to assess the vulnerability of critical buildings. It might however be adapted by the consultant for a more rigorous evaluation:

<table>
<thead>
<tr>
<th>Facility name</th>
<th>Tsunami</th>
<th>Surge</th>
<th>Wind</th>
<th>Flood</th>
<th>Erosion</th>
<th>Wildfire</th>
<th>Earthquake</th>
<th>Volcano</th>
<th>Hazmat</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence of hazard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depends on frequency and magnitude of hazard at the facilities location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage history score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 = no history; 2 = no damage; 4 = moderate damage; 6 = significant damage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural vulnerability score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0= exceeds codes or incorporate hazard specific protections; 1=meets applicable codes; 2 = does not meet codes ; 3 known deficiency for hazard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operational vulnerability score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 = no effect; 1 = minimal effect; 2 = significant effect; 3 = life threatening impact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facility vulnerability score (a+b+c+d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vulnerability determination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(low/moderate/high)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A set of basic facts will also be collected for each critical facility evaluated. This information shall be entered as spatial attributes into the hazard geo-database and will be utilised in the vulnerability and quantitative risk assessments. The following list will be adjusted and agreed between the disaster manager and the consultant before the execution of the work:

- Name and address of the building
- Geo-coordinates for a precise location on the GIS
- Building materials
- Replacement cost
- Contact information: name of building director/manager, telephone number (including 24-hour telephone) and address
- Photo of the entire building from entrance
Access details (e.g. presence of gates, width of the road, vulnerable access)
Hours and days of operation; occupancy during closed hours
Specific contingency plans, emergency plans, security measures

**Options**

The consultant may propose in their offer to bring special attention to:

- hospitals, health facilities and elderly homes; and/or
- schools and nurseries

This option will not be part of the evaluation, but might be included in the contract at a later stage.

**Hospitals**

Based on the PAHO/WHO “Hospitals safe from disasters” methodology, the consultant would:

- Collect information on previous evaluation and work plans in hospitals and health centres.
- Estimate the hospital or health centre safety index (HSI).
- If specific structural expertise is needed (resistance of the building to winds, earthquake etc.), the consultant will provide assistance to the Contracting Authority for the procurement of these services.
- Provide a quantitative hospital and health centre risk assessment in terms of potential loss of life, injuries, economic and social impacts.
- Develop recommendations and a work plan to build resilience in coordination with hospitals and health centres directors.

**Schools**

Develop and implement a similar methodology for schools, leading to a quantitative risk assessment, recommendation and work plan (in close coordination with school authorities).

**IV-c Loss estimation studies and vulnerability curves**

This activity will be implemented for Cayman Islands and the Virgin Islands.

Using the probabilistic hazard maps developed within the present contract or collected in activity I-b, the consultant will implement an infrastructure loss estimation study in the selected countries.

Based on a review of the types of buildings and infrastructure included in the quantitative risk assessment, the consultant will identify categories of facilities or infrastructure components that have similar vulnerability to a given hazard. For each of these categories, the consultant will develop damageability/vulnerability curves to allow the determination of estimated loss for the category at different hazard magnitudes. The results should be presented in a user-friendly application allowing for rapid consultation of quantitative impacts to be expected under each hazard scenario.

For each hazard a range of selected events is to be identified for use in the study and should include both moderate and maximum impacts. The consultant will then calculate the expected loss for each scenario,
based on the vulnerability to that hazard (as expressed in the vulnerability curves) and the building/infrastructure replacement cost.

A vulnerability assessment usually includes an economic component; however economic vulnerability assessments are not included in the present scope because such work is currently being performed by the Caribbean Community Climate Change Centre (CCCCC) and the CCRIF. The consultant will however ensure that their work does not overlap or conflict with the work being performed by these other institutions.

**IV-d Operational vulnerability assessment**

The operational vulnerability assessment will be conducted for the Cayman Islands only.

An operational vulnerability score for main critical facilities has already been provided by the June 2009 preliminary vulnerability assessment\(^\text{10}\) (similar to that requested in activity IV-b for the other countries). The consultant will therefore build on this study and execute its recommendation, which is to define the potential operational impact on each critical facility from each hazard. The most catastrophic or life-threatening impacts must be assessed.

The consultant will also provide operational guidelines (or a Standard Operating Procedures template), easily adaptable by each facility concerned to build operational resilience to hazards.

\(^{10}\)http://www.caymanprepared.ky/pls/portal/docs/PAGE/NEMHOME/RESOURCES/PUBLICATIONS/PRELIMINARYVULNERABILITYASSESSMENTCAYMANISLANDS19062009.PDF
IV-e Social vulnerability assessment

The social vulnerability assessment will be conducted for the Cayman Islands only, with reference to Step 4 of the aforementioned NOAA methodology.\(^\text{11}\)


The consultant will:

1. Identify areas of special consideration

The target areas are those locations (preferably at the neighbourhood level) where financial resources are minimal and therefore the personal resources needed to cope with hazards can be extremely limited. These areas could be highly dependent on public resources after a disaster and thus could be good investment areas for hazard mitigation activities. The consultant will identify special consideration areas by utilising existing low-to-moderate income designations for community development grants or by analysing key census data categories.

It is important for residents to understand why they are more or less vulnerable than others, therefore the vulnerability inputs will be narrowly defined and rationalised. For example, persons aged 65 and over have an increased death rate due to systemic vascular resistance in hot weather. This will be seen as a vulnerability, however elderly persons may have years of previous experience and knowledge with a particular hazard or have valuable skills (e.g. retired doctor or nurse) which may also make them a community asset.

Examples of special consideration areas may include but are not limited to:

- Minority populations
  - Language or cultural considerations (may have difficulty reading important press releases from the disaster management authorities)
- Limited financial resources
  - Households living in poverty
    - Limited resources
    - Living in weak infrastructure
  - Populations over age 65
  - Single parent households with limited financial, social and family resources
  - Populations with low literacy levels
  - Households with limited resources and reliant on social welfare assistance
  - Persons in rented housing (see the ECLAC Hurricane Ivan report\(^\text{12}\))
    - Safety measures such as hurricane shutters may not be deemed as priority for the landlord
    - Landlords may focus on repairing their own residences after a disaster and see rental properties as second priority
    - Potential lack of rental housing in post disaster situations
  - Housing units with no vehicle available, which may have difficulty evacuating hazardous areas
  - Any vulnerabilities that are caused or enhanced by gender issues
    - Class, caste, age, sexuality, ethnicity, religion, nationality, and other factors that may increase women’s vulnerability to hazards

A process to identify risk perception in the population should also be included in this first step.

2. Identify intersections of special consideration areas with high risk areas.

To further target areas for potential hazard mitigation activities, the consultant will identify special consideration areas that are located in high risk areas. This will also help to determine which mitigation strategies should be focused on different neighbourhoods. The consultant will overlay the special consideration neighbourhoods with the hazard risk consideration areas.

3. Conduct a general inventory of special consideration/high risk locations

To help prioritise potential mitigation options, the consultant will conduct a general inventory of structures in the special consideration/high risk intersections. By providing a count of residential units within these areas, the consultant will summarise the households of special consideration to be targeted for assistance and indicate the level of societal vulnerability to each hazard. The consultant will also identify and provide recommendations to target these structures for analysis in the future.

\(^{12}\) http://www.caymanprepared.ky/portal/page?_pageid=1143,1482605&_dad=portal&_schema=PORTAL
IV-f Environmental vulnerability assessment

The environmental vulnerability assessment will be conducted for the Cayman Islands only, with reference to step 4 of the aforementioned NOAA methodology. It should include an environmental impact assessment (EIA) for a range of selected events for each hazard. The selected events should include both moderate and maximum credible events.

The consultant will:

1. Identify secondary hazard risk consideration sites and key environmental resource sites

The purpose of this analysis is to identify locations where there is potential for secondary environmental impacts from natural hazards and to target vulnerable locations for hazard mitigation activities. Secondary impacts occur when natural hazard events create new hazards such as toxic releases or hazardous spills. The consultant will identify key sites where hazardous or toxic materials exist.

Key sites where hazardous or toxic materials exist will also be mapped for Aruba, Curacao Bonaire, TCI and Montserrat under activity IV-b.

2. Identify intersections of secondary risk sites, environmentally sensitive areas, and natural hazard risk consideration areas

To further target areas for potential hazard mitigation activities, the consultant will identify secondary risk sites that are located in high natural hazard risk areas. The consultant will overlay the environmental sites with the hazard risk consideration areas.

3. Identify key environmental resource locations and their proximity to secondary risk sites

To prioritise secondary risk sites for potential hazard mitigation, the consultant will identify significant environmental resource locations, particularly those that would be sensitive to secondary hazard impacts. The consultant will use the proximity of these environmentally sensitive locations to the secondary risk sites to determine the overall risks from these facilities.

4. Conduct vulnerability analysis on priority secondary risk sites as critical facilities

Based on the outcome of the previous step, the consultant will identify environmental hazard sites that are at risk for impacts from natural hazard events. The consultant will provide recommendations to target these sites as partners in hazard mitigation activities and add those sites to the critical facilities lists. The consultant will provide guidelines to conduct detailed assessments of vulnerability on these structures.

**IV-g Proposition and estimation of mitigation measures**

The consultant will estimate the impacts (physical, societal, environmental and financial) of selected mitigation measures for the selected hazards, and the building and infrastructure categories analysed in this Phase of the study.

This activity will be conducted for the Virgin Islands, Cayman Islands, Turks and Caicos Islands, Montserrat, Aruba, Curacao and Bonaire. The consultant will review current national policies that may contribute to the vulnerability of the environment in these areas and recommend national legislative creation or change. These may include, but are not limited to planning and environmental regulations or the creation of a hazmat registration system.

**IV-h Technical review panel and public outreach**

The consultant will prepare a final Phase IV report, which is to include a detailed description of the methodology used, data collected, vulnerability curves developed, estimated losses, operational, social environmental assessments and mitigation measures. The results are to be grouped and presented in multiple ways to facilitate their use by agencies and organisations in the participating countries, including summaries of estimated losses by hazard, by building/infrastructure category and by geographic location (e.g. by zones or islands). The final report will contain an executive summary, which is appropriate to distribute independently of the full report.

The results must also presented in the form of maps and be incorporated in the GIS developed under Phase II.

The consultant will present the results of the analysis to the TMT convened by UNDP.

In each participating country, the consultant will organise technical review workshops with a panel of representatives from the main country “vulnerability” stakeholders. The purpose of these workshops will be to:

- Evaluate the quality of the work provided by the consultant and provide them with necessary feedback (however this should be limited as the consultant is specifically asked to work in collaboration with the institutions and organisations concerned).
• Provide the stakeholders with a good understanding of the factors affecting their vulnerability, the indices used and the suggested work plan for strengthening their resilience.
• Develop a long term strategy in a view to monitor and update the vulnerability indices.

Increased public awareness is considered as a way to reduce vulnerability, therefore the consultant will develop the messages and the methodology to efficiently reach the public. Based on the consultant’s work, disaster management offices must be able to execute public awareness activities.

4.2.6. Phase V – Vulnerability assessment and hazard mapping applications

Phase V comprises all the activities that need to be undertaken to achieve effective and sustainable use of the project products. Therefore, there are two types of activities:

• Capacity building activities, performed mainly through partnership and training
• Adaptation of products to specifics purposes

These two types of activity are intimately linked and therefore will be often implemented together.

V-a Hazard database

This activity relates to the customisation of geographical hazard information into tools that should allow:

• Convenient and rapid consultation of all information collected and produced
• Direct use of this information, in conformity with users’ capacities and interests
• Exchanges of data between stakeholders in-country, between OCTs, and between OCTs and their Caribbean neighbours (this is especially related to regional hazards; this also means that levels of confidentiality can be applied by country stakeholders)
• A sustainable conservation of data
• Evolution possibilities

Four levels of outputs have been identified:

1. A multi-hazard risk map

This map will be a synthesis of all information collected in terms of hazard and vulnerability in Phases I, II, III and IV.

2. Integrated multi-hazard GIS

This geographical information system will contain all the data collected and produced under the present contract (Phase I, II, III and IV), including the raw data. This general database is the basis on which levels 3 and 4 hereunder will be built. However its purpose is also to allow the data to be available for any further development outside of this present contract context.

• The geospatial data will be collated and provided in a geodatabase format.
- The spatial data will contain metadata which explain information about the data such as source, vintage, etc. The data provision standards will be refined by the consultant and presented to the Contracting Authority for comment and revision.

3 Customised GIS user interface

This product should be designed to be used by non-GIS specialists. It will be a desktop-based software application the purpose of which is to respond to users’ needs in a direct and user-friendly way.

The application will:

- Spatially represent all hazards, vulnerability and risk geographical information covered by the present contract.
- Allow the analysis of layers to assist the decision making process in terms of planning and response.
- Be virtually “indestructible” in current use mode. This means that no false manipulation can alter the software or the data on which it is based.
- Allow easy exportation of maps and data visualised and contained by the software (e.g. exportation in JPEG, PDF, and shapefile formats; prints, etc)

4 Hazard atlas

This book must be made available in digital (PDF) and hard copy formats and will target the broadest range of disaster-aware users. While it should be easily readable, it is not expected that it will detail disaster management concepts.

The book will contain all hazard maps with adapted resolutions (between 1/2,500 and 1/25,000). The printed book should be sturdy and durable with a hard cover and glossy paper. 100 copies per country covered are to be provided under this contract.

**V-b Disaster management applications**

Most of the activities mentioned in the present Terms of Reference should be implemented in direct partnership with the disaster management office. This should allow the disaster management officers to be able to reproduce the work performed and have a clear insight into the products. However, in certain cases, it might be necessary to complete the capacity building with specific training. OCTs with a specific need for capacity development, such as Montserrat, Turks and Caicos, Aruba, Curacao and Bonaire will be specifically targeted (however training sessions may also include participants from other countries).

1. Training in the use of GIS as applied to hazard mapping and vulnerability assessment

In accordance with the implementation plan and the long term strategy defined in their offer and in Phase I, the consultant will provide training to disaster management personnel which will allow them to:

- Understand and use all the data provided
- Produce hazard maps and vulnerability maps
- Update regularly the integrated multi-hazard and vulnerability GIS database
2. Training in the use of GIS for contingency and logistical planning and emergency management operations and coordination

This training should allow the participants to produce and update all necessary GIS and maps to support the definition and revision of contingency plans, logistical plans and for emergency management coordination.

**V-c Input for early warning systems**

The consultant will provide all the training and assistance necessary to:

- Include all the EWS detection and equipment in the disaster management GIS
- Map warning zones coherent with the scenarios developed under Phases I and II
- Develop, in conjunction with the EWS consultant, public awareness maps (e.g. maps informing the public of evacuation routes and location of shelters)

This activity will target specifically pilot countries under Output 2 of the project, namely Anguilla, VI, Montserrat and St Maarten (the latter in cooperation with UNESCO IHE).

**V-d Adaptation of tools and products for decision makers and public awareness**

Based on the outputs of R3I project, including that of the current contract (Output 1), the consultant will develop all specific products (booklet and maps) required to:

- Provide decision makers with adequate tools in terms of emergency management
- Raise public awareness on:
  - Hazards and vulnerability of the country
  - Mitigation measures to undertake
  - Emergency situation reaction and adequate behaviour
  - Location of shelter and evacuation routes

The consultant will provide all training and assistance necessary to produce the GIS information related to public awareness campaigns for disaster mitigation measures.
4.3. **Project management**

4.3.1. **Responsible body**

UNDP Barbados and the OECS sub-regional office (SRO) is the only entity responsible for the management of the contract. The SRO has established a R3I project team responsible for the daily management of all contracts signed under R3I project. The team is composed of a project coordinator and a project officer.

4.3.2. **Management structure**

The following diagram describes the management structure of the R3I, constituted by a Project Board for oversight, the implementation team or management unit and the TMTs. The consultant’s work will be monitored by:

- Disaster management offices of the OCTs where work is being executed.
- The TMT for Output 1, the purpose of which is to support the project team and disaster management offices in the management of the project. TMT 1 is composed of representatives from Aruba, VI, Cayman Islands and St Maarten disaster management offices, and the R3I project team.
- Regional experts, who may assist with the quality control of consultants work on an ad hoc basis.
Based on advice given by the three monitoring entities mentioned above, the R3I project team will comment on and approve the consultant’s reports.

4.3.3. Facilities to be provided by the Contracting Authority and/or other parties

The Contracting Authority will support the organisation of major regional events (workshops or seminars). Therefore the consultant is not expected to support costs related to regional meetings. However, the consultant will support all national workshops related to their contract.

Disaster management offices will provide one office space with a desk in their premises. IT equipment, communication costs and additional office space will be supported by the consultant. Disaster management offices will also facilitate small meeting rooms for technical meetings.

Each country will also provide minor logistical support as well as limited GIS support for collection of data (when GIS capacity is available a disaster management level).

5. LOGISTICS AND TIMING

5.1. Location

The project’s location is the 11 British and Dutch OCTs (listed in Section 1.1) and the consultant is expected to ensure a certain level of on the ground presence in each of them. Without this the consultation and involvement of country stakeholders, partnerships, training and awareness campaigns are unlikely to occur satisfactorily.

It is the consultant’s responsibility to propose the details of the allocation of their teams and their time schedule to be spent on each island. It can be supposed for instance, that the consultant will establish sub-regional bases, from where the teams will travel easily to the countries covered. A moving team spending a significant amount of time on each island is another possibility.

A minimum of 70% of the experts’ time covered by the current contract must be spent within the OCTs.

The consultant’s headquarters, if located outside of the Caribbean region, shall be a limited location for the project’s work. However it is understood that some parts of the work could be done there, especially as regards administrative and backstopping tasks.

The locations of the consultant’s work may include, on an ad hoc basis, other Caribbean countries e.g. Barbados (where UNDP is based), Trinidad and Tobago (where CMO is based), Puerto Rico or French Outermost Regions (for potential exchange of good practices).
5.2. **Commencement date and period of implementation**

The intended commencement date is 1 December 2010 and the maximal period of implementation of the contract will be 28 months from this date. However, at the time of writing, the project implementation period runs until 31 December 2011 and the project extension required to facilitate this length of contract period is awaiting approval.

The planning hereunder is indicative. A precise execution plan will be submitted by the consultant in their offer and in the recommendation report. It shall be noted that activity V-a is placed at the end. The hazard database shall include all GIS information (hazard, vulnerability and risk maps) produced for the countries concerned, including those produced under R3I by contracts other than the present one.
### OUTPUT 1: Hazard Mapping and Vulnerability Assessment – RFP 1 GIS lead

<table>
<thead>
<tr>
<th>Phase I: HM/VA capacity assessment</th>
<th>YEAR 1</th>
<th>YEAR 2</th>
<th>YEAR 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I-a</strong> Synthesis of B-Tool and other studies</td>
<td><img src="image1" alt="Phase I: HM/VA capacity assessment YEAR 1" /></td>
<td><img src="image2" alt="Phase I: HM/VA capacity assessment YEAR 2" /></td>
<td><img src="image3" alt="Phase I: HM/VA capacity assessment YEAR 3" /></td>
</tr>
<tr>
<td><strong>I-b</strong> Data collection and data needs assessment</td>
<td><img src="image4" alt="Phase I: HM/VA capacity assessment YEAR 1" /></td>
<td><img src="image5" alt="Phase I: HM/VA capacity assessment YEAR 2" /></td>
<td><img src="image6" alt="Phase I: HM/VA capacity assessment YEAR 3" /></td>
</tr>
<tr>
<td><strong>I-c</strong> Recommendations, planning and strategy development</td>
<td><img src="image7" alt="Phase I: HM/VA capacity assessment YEAR 1" /></td>
<td><img src="image8" alt="Phase I: HM/VA capacity assessment YEAR 2" /></td>
<td><img src="image9" alt="Phase I: HM/VA capacity assessment YEAR 3" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase II: Base data and equipment acquisition</th>
<th>YEAR 1</th>
<th>YEAR 2</th>
<th>YEAR 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>II-a</strong> Assistance for data acquisition</td>
<td><img src="image10" alt="Phase II: Base data and equipment acquisition YEAR 1" /></td>
<td><img src="image11" alt="Phase II: Base data and equipment acquisition YEAR 2" /></td>
<td><img src="image12" alt="Phase II: Base data and equipment acquisition YEAR 3" /></td>
</tr>
<tr>
<td><strong>II-b</strong> Assistance for equipment acquisition</td>
<td><img src="image13" alt="Phase II: Base data and equipment acquisition YEAR 1" /></td>
<td><img src="image14" alt="Phase II: Base data and equipment acquisition YEAR 2" /></td>
<td><img src="image15" alt="Phase II: Base data and equipment acquisition YEAR 3" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase III: Coastal hazard modelling and mapping</th>
<th>YEAR 1</th>
<th>YEAR 2</th>
<th>YEAR 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>III-a</strong> - Tsunami modelling and hazard maps</td>
<td><img src="image16" alt="Phase III: Coastal hazard modelling and mapping YEAR 1" /></td>
<td><img src="image17" alt="Phase III: Coastal hazard modelling and mapping YEAR 2" /></td>
<td><img src="image18" alt="Phase III: Coastal hazard modelling and mapping YEAR 3" /></td>
</tr>
<tr>
<td><strong>III-b</strong> – Storm surge modelling and inundation maps</td>
<td><img src="image19" alt="Phase III: Coastal hazard modelling and mapping YEAR 1" /></td>
<td><img src="image20" alt="Phase III: Coastal hazard modelling and mapping YEAR 2" /></td>
<td><img src="image21" alt="Phase III: Coastal hazard modelling and mapping YEAR 3" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase IV: Vulnerability assessment and quantitative risk assessment</th>
<th>YEAR 1</th>
<th>YEAR 2</th>
<th>YEAR 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IV-a</strong> Preliminary vulnerability assessment</td>
<td><img src="image22" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 1" /></td>
<td><img src="image23" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 2" /></td>
<td><img src="image24" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 3" /></td>
</tr>
<tr>
<td><strong>IV-b</strong> Structural vulnerability (critical buildings, facilities and infrastructure)</td>
<td><img src="image25" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 1" /></td>
<td><img src="image26" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 2" /></td>
<td><img src="image27" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 3" /></td>
</tr>
<tr>
<td><strong>IV-c</strong> Loss estimation studies and vulnerability curves</td>
<td><img src="image28" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 1" /></td>
<td><img src="image29" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 2" /></td>
<td><img src="image30" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 3" /></td>
</tr>
<tr>
<td><strong>IV-d</strong> Operational vulnerability assessment</td>
<td><img src="image31" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 1" /></td>
<td><img src="image32" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 2" /></td>
<td><img src="image33" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 3" /></td>
</tr>
<tr>
<td><strong>IV-e</strong> Social vulnerability assessment</td>
<td><img src="image34" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 1" /></td>
<td><img src="image35" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 2" /></td>
<td><img src="image36" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 3" /></td>
</tr>
<tr>
<td><strong>IV-f</strong> Environmental vulnerability assessment</td>
<td><img src="image37" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 1" /></td>
<td><img src="image38" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 2" /></td>
<td><img src="image39" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 3" /></td>
</tr>
<tr>
<td><strong>IV-g</strong> Proposition and estimation of mitigation measures</td>
<td><img src="image40" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 1" /></td>
<td><img src="image41" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 2" /></td>
<td><img src="image42" alt="Phase IV: Vulnerability assessment and quantitative risk assessment YEAR 3" /></td>
</tr>
<tr>
<td>OUTPUT 1 : Hazard Mapping and Vulnerability Assessment – RFP 1 GIS lead</td>
<td>YEAR 1</td>
<td>YEAR 2</td>
<td>YEAR 3</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
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</tr>
<tr>
<td><strong>IV-h</strong> Technical review panel and public outreach</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Phase V: Vulnerability assessment and hazard mapping applications**

**V-a** Hazard database

1. Multi-hazard risk map
2. GIS database
3. Customised GIS graphic user interface
4. Hazard atlas

**V-b** Disaster management applications

1. Use of GIS for hazard mapping and vulnerability assessment
2. Use of GIS for contingency and logistical planning and emergency management operations and coordination

**V-c** Input for early warning systems

1. Point map of the components of the national warning system
2. Public warning zoning adapted to scenarios

**V-d** Adaptation of tool and products for decision makers and public awareness
6. REQUIREMENTS

6.1. Personnel

6.1.1. Key experts

All experts who have a crucial role in implementing the contract are referred to as key experts. It is estimated that 3 to 5 key experts are necessary for the execution of this contract. Their profiles must include the following areas of expertise:

Expertise 1 (for LOT 1): GIS and mapping applied to disaster management

The qualification criteria are:

1. Masters degree or equivalent in GIS (very extensive, recognised and specific experience in GIS related to hazard mapping and vulnerability assessment can be submitted in lieu of a diploma)
2. Preferably 15 years of general experience with a minimum of 10 years
3. Preferably 12 years of specific experience in GIS but a minimum of 8 years is required
4. Experience in the fields related to the skills described below

The qualification and skills covered by this area of expertise are:

- GIS applied to hazard mapping and vulnerability assessment
- Treatment of satellite imagery, orthophotos and other topographic, bathymetric, geotechnical and geological spatial data for inclusion in a GIS
- GIS training capacities (pedagogy and presentation)
- Development of customised GIS systems
- Map design for communication purposes (public awareness)

Expertise 2 (For LOT 2): Tsunami and storm surge modelling

The qualification criteria are:

1. Masters degree or equivalent in oceanography, coastal hazards, hydraulics, environment or earth science
2. Preferably 12 years of general experience with a minimum of 8 years
3. Preferably 8 years of specific experience in tsunami and coastal hazard modelling but a minimum of 5 years is required
4. Experience in the fields related to the skills described below

The qualification and skills covered by this area of expertise are:

- Physical oceanography, seismology, geophysics, marine science and coastal hazard expertise with a special focus on tsunamis and storm surge
- Tsunami numerical models
- Caribbean earthquake hazards
- Collection of bathymetric data
• Training and pedagogy

Expertise 3 (For LOT 1): Physical, structural, social, and environmental vulnerability assessment

The qualification criteria are:

1. Masters degree or equivalent in civil engineering, urban and social sciences, environment or disaster management
2. Preferably 12 years of general experience with a minimum of 8 years
3. Preferably 8 years of specific experience in physical, social, environmental and operational vulnerability assessments but a minimum of 5 years is required
4. Experience in the fields related to the skills described below

The qualification and skills covered by this area of expertise are:

• Quantitative risk assessment, vulnerability assessment
• Environmental impact assessment
• Socioeconomic evaluation
• Physical, structural and operational vulnerability assessment
• Economic and financial analysis
• Household surveys and statistical analysis

Team leadership

One of the key experts will be designated as team leader. Additional qualification and skills requirements apply to the team leader:

• Project management including:
  o Team management
  o Procurement and contractual management
• Communication and presentation skills
• Some experience in the Caribbean region

Other criteria applying to the team

1. All key experts must be fluent in English
2. At least one member of the team speaks Dutch fluently (preferably one of the key experts)
3. At least two members of the team have Caribbean expertise in the field of disaster management (preferably 2 of the key experts)

6.1.2. Other experts

CVs for experts other than the key experts are not examined prior to the signature of the contract. They should not be included in tenders. The consultant shall select and hire other experts as required according to the profiles identified in their Organisation and Methodology proposal. They must indicate clearly which profile they have so it is clear which fee rates in the budget breakdown will apply. All experts must be independent and free from conflicts of interest in the responsibilities accorded to them.
The selection procedures used by the consultant to select these other experts shall be transparent, and shall be based on pre-defined criteria, including professional qualifications, language skills and work experience. The findings of the selection panel shall be recorded. The selection of experts shall be subject to approval by the Contracting Authority.

Note that civil servants and other staff of the public administration of the beneficiary or any other countries cannot be recruited as experts, unless certain conditions are met (which will be specified upon request) and prior written approval has been obtained from the Contracting Authority.

6.1.3. Support staff and backstopping

Backstopping and support staff (technicians, surveyors, secretaries, etc.) costs must be encompassed in the fee rates of the experts (not detailed in a separate line).

6.2. Office accommodation

Office accommodation of a reasonable standard and of approximately 10m² for each expert working on the contract is to be provided by the consultant. The costs of the office accommodation are to be covered by the fee rates of the experts. This should however not include provisions described in Section 4.3.3.

6.3. Facilities to be provided by the consultant

The consultant shall ensure that experts are adequately supported and equipped. In particular they shall ensure that there is sufficient administrative, secretarial and interpreting provision to enable experts to concentrate on their primary responsibilities. They must also transfer funds as necessary to support their activities under the contract and to ensure that their employees are paid regularly and in a timely fashion.

If the consultant is a consortium, the arrangements should allow for the maximum flexibility in project implementation. Arrangements offering each consortium member a fixed percentage of the work to be undertaken under the contract should be avoided.

6.4. Equipment

No equipment is to be purchased on behalf of the Contracting Authority or beneficiary country as part of this contract or transferred to the Contracting Authority or beneficiary country at the end of this contract. Any equipment related to this contract which is to be acquired by the beneficiary country must be purchased by means of a separate supply tender procedure.

7. REPORTING AND OWNERSHIP

7.1. Reporting requirements

The following table summarises the reports to be provided by the consultant.
<table>
<thead>
<tr>
<th>Expected Results</th>
<th>Report code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inception</strong></td>
<td>INC</td>
<td>Inception report due 2 weeks after signature of contract</td>
</tr>
<tr>
<td><strong>Phase I: HM/VA capacity assessment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-a Synthesis of B-Tool and other studies</td>
<td>R-I-a</td>
<td>1 regional report</td>
</tr>
<tr>
<td>I-b Data needs assessment and existing data collected</td>
<td>C-I-b&amp;c</td>
<td>11 country reports on I-b and I-c</td>
</tr>
<tr>
<td>I-c Recommendations, planning and strategy development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Long term capacity development and use strategy</td>
<td>C-I-b&amp;c</td>
<td>1 regional report</td>
</tr>
<tr>
<td>2. Detailed implementation methodology for the contract (overall and for each country)</td>
<td>R-I-c</td>
<td>1 regional report</td>
</tr>
<tr>
<td><strong>Phase II: Base data and equipment acquisition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II-a Assistance for data acquisition</td>
<td>R-II-a</td>
<td>Ad hoc outputs as determined</td>
</tr>
<tr>
<td>II-b Assistance for equipment acquisition</td>
<td>R-II-b</td>
<td>1 intermediary and 1 final regional report</td>
</tr>
<tr>
<td><strong>Phase III: Coastal hazard modelling and mapping</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III-a Tsunami modelling and hazard maps</td>
<td>BVI-III-a</td>
<td>1 country report</td>
</tr>
<tr>
<td>III-b Storm surge modelling and inundation maps</td>
<td>BVI-III-b</td>
<td>1 country report</td>
</tr>
<tr>
<td><strong>Phase IV: Vulnerability assessment and quantitative risk assessment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV-a Preliminary vulnerability assessment</td>
<td>C-IV-a&amp;b</td>
<td>5 country reports – TCI, MNT, ARU, BON, CUR</td>
</tr>
<tr>
<td>IV-b Structural vulnerability (critical buildings, facilities and infrastructure)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV-c Loss estimation studies and vulnerability curves</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Expected Results

<table>
<thead>
<tr>
<th>IV-d</th>
<th>Operational vulnerability assessment</th>
<th>C-IV-c&amp;d&amp;e&amp;f</th>
<th>1 country report – CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV-e</td>
<td>Social vulnerability assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV-f</td>
<td>Environmental vulnerability assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV-g</td>
<td>Proposition and estimation of mitigation measures</td>
<td>C-IV-g&amp;h</td>
<td>7 country reports – TCI, MNT, ARU, BON, CUR, CI</td>
</tr>
<tr>
<td>IV-h</td>
<td>Technical review panel and public outreach</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Phase V: Vulnerability assessment and hazard mapping applications

<table>
<thead>
<tr>
<th>V-a</th>
<th>Hazard database</th>
<th>R-V-a</th>
<th>1 intermediary and 1 final regional report</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specific ad hoc outputs per country</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(database on DVD, customised interface,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>risk maps, hazard atlas)</td>
</tr>
<tr>
<td>V-b</td>
<td>Disaster management applications</td>
<td>C-V-b</td>
<td>11 country reports on capacity building at</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>the local disaster management level</td>
</tr>
<tr>
<td>V-c</td>
<td>Input for early warning systems</td>
<td>R-V-c</td>
<td>1 regional report</td>
</tr>
<tr>
<td>V-d</td>
<td>Adaptation of tools and products for decision makers and public awareness</td>
<td>R-V-d</td>
<td>1 regional report</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Public awareness brochures</td>
</tr>
</tbody>
</table>

### Conclusion

| FIN | Final report to be submitted no later than 1 month after completion of all activities |
All deliverables shall, in the first instance, be provided in digital format, notably the draft versions.

12 hard copies of the Regional (“R”) and 2 hard copies of the Country specific (“C”) final reports shall also be submitted. All documents as outlined in the ToR shall be submitted in PDF format, and graphics format (JPEG of GIF) files for all diagrams in the reports and for all maps which shall also be submitted. All GIS files should be in a format compatible with the countries’ national GIS database and should have full metadata information.

Technical reports must be provided along with the corresponding invoice. The draft technical reports must be submitted at least two weeks before the end of the period of implementation of the tasks concerned.

There must be a final report, a final invoice and the financial report at the end of the period of implementation of the tasks. The draft final report must be submitted at least one month before the end of the period of implementation of the tasks.

Each report shall consist of a narrative section and a financial section. The financial section must contain details of the time inputs of the experts and of the incidental expenditure.

7.2. Submission and approval of progress reports

Only electronic copies of the reports referred to above must be submitted to the project coordinator for approval. The progress reports must be written in English. The project coordinator is responsible for approving the reports.

Only final and approved reports will be submitted in hard copy in the quantities given above.

7.3. Copyright and ownership

The consultant shall deliver all information, datasets, thematic layers, metadata, models, coding, software, reports, and all other outputs and generated data to the country in question. The consultant shall not assume ownership or copyright for any product created during the execution of this contract. These shall all be solely owned by the respective OCTs. UNDP shall retain digital and hard copies of all reports and finished maps for the purposes of further implementation of the R3I and the Disaster Risk Reduction programme.
8. MONITORING AND EVALUATION

8.1. Definition of indicators

Monitoring and evaluation of the performance of the consultant will be measured in the light of:

- The general and specific objectives articulated in Section 2.
- The project’s objectives described in Section 1.4.
- The B-Tool assessment. The B-Tool total index score (TDRMI), and in particular the scores related to section A on risk identification, can be considered as a good indicator. The consultant will notice that many questions refer to local capacity building, planning, etc.

The B-Tool indicators (questions) will be used by disaster management offices and the quality control experts to monitor the consultant’s activity.

8.2. Special requirements

Sustainability

The consultant will enhance the sustainability of their outputs by associating country stakeholder in their work regularly and form an early stage. They will emphasise providing “in the field” training throughout each step of their work.

Further, the consultant will ensure that the context of their work guarantees and facilitates sustainable use of their products. If no “sustainability plan” or relevant mobilisation of resources exists in the country, the consultant will alert the Contracting Authority, as well as TMT 1 members on the risk of producing reports which may not have future use. The consultant should also provide recommendations to foster “after-project sustainability”.

Gender

Gender issues must also be explicitly addressed in each of the consultant’s activities (this is crucial in surveys, social vulnerability assessment and contingency planning, for instance).\(^\text{14}\)

Visibility

The consultant must observe UNDP visibility rules and the most recent Communication and Visibility Manual for EU External Actions\(^\text{15}\) concerning acknowledgement of EU financing of the project.

* * *

\(^\text{14}\) More information on UNDP approach for mainstreaming gender in disaster risk reduction in the Caribbean region may be found at: http://www.undp.org.eu/crmi/genderstudy/index.asp

\(^\text{15}\) http://ec.europa.eu/europeaid/work/visibility/index_en.htm