



United Nations Industrial Development Organization

## TERMS OF REFERENCE (TOR)

**Title: Improvement of water supply management through a GIS-based monitoring and control system for water loss reduction in Grenada**

CTCN request reference number: 2017000007

Country: Grenada

### **1 BACKGROUND INFORMATION**

The Climate Technology Centre and Network (CTCN) is the operational arm of the United Nations Framework Convention on Climate Change (UNFCCC) Technology Mechanism and hosted by the United Nations Environment Programme (UNEP) in collaboration with the United Nations Industrial Development Organization (UNIDO) and supported by 11 partner institutions with expertise in climate technologies.

The mission of the CTCN is to promote accelerated deployment and transfer of climate technologies at the request of developing countries for energy-efficient, low-carbon and climate-resilient development.

These requests for Technical Assistance (TA) are being submitted to the CTCN by the National Designated Entity (NDE) of the respective country. The scope of services under these Terms of Reference shall be executed based on a restricted solicitation process. By mandate, only accepted Members of the CTC Network are eligible to submit proposals and execute the required services to implement the response.

In case you are not a CTC Network member yet, you may bid for implementation of the technical assistance, subject to the condition that you submit your completed application for CTC Network membership before the bid closure and the same is acknowledged by the CTCN. Furthermore, the contract award – should your bid be selected – is conditional to your network membership application having been successfully approved by the Director of CTCN. Should the bidder partner with another institution to deliver the services described in these Terms of Reference, it is expected that the partner institution also joins the CTC Network.

The maximum estimated budget for this contract is **USD 180,000** and is subject to a competitive bidding.

### **2 CONTEXT OF THE ASSIGNMENT**

As a small island developing state (SIDS), Grenada is one of the world's most at-risk countries for climate change. Impacts from changes to the global climate system include warmer temperatures, rising sea levels, and potentially more frequent and severe extreme weather events such as hurricanes and storms which cause extensive disruption to key infrastructure like electricity, tourism, agriculture and the water sector. The island's freshwater supply is mainly depending on rainfed surface waters (approx. 90%), which is collected in smaller dams and lakes. In the last years, the island experienced two major drought events



## United Nations Industrial Development Organization

in 2010 and 2012 which significantly affected the water supply sector and decreased in the peak time up to 75% of normal production on certain water supply systems in Grenada.

Projections are that rainfall will be reduced by the end of the century between 25 and 30 percent of current climatologically mean values. Research reports for Grenada forecast that water demand will exceed water supply by the year 2025.

The National Water and Sewerage Authority (NAWASA) is responsible for the provision of potable water and sanitation services for the whole of Grenada. Due to the prevailing hydrologic and climatic conditions, sustainable water supply is a major challenge. The entire population (rural and urban) has access to domestic water supply. About 80% of the island is connected to the public water supply, 7% to standpipes while the remainder is supplied by rain water catchments (2009) Water profile of Grenada.

In order to be effective, NAWASA's overall NRW management needs a structured and systematic approach. Good industrial standard is to establish a detailed monitoring system on water balances of District Metered Areas (DMAs), which allows quick and focused actions to reduce NRW. Establishing DMA requires reliable and up-to-date GIS data on customer, pipelines and other elements of relevance for the monitoring of NRW, and to accordingly structure management processes to support the information and data flow between the different divisions which are part of a water utility's NRW management process. NAWASA's current structure of the data model, as well as of the linked management processes, requires a complete review and redesign. The required GIS data model has to allow systematic and automated data analysis and therefore has to follow examples of internationally recommended systems. The CTCN will assist the country in this endeavour.

### 3 OBJECTIVE OF THE CONTRACT

The objective of this TA is to efficiently and effectively reduce the currently high Non Revenue Water (NRW) in Grenada by strengthening the capacity of NAWASA's staff in the management of a GIS-based monitoring and control system for water loss reduction and leakage detection.

Specifically, the objectives are to:

- Develop planning and communication documents
- Establish a GIS data structure and procedures.
- Build capacities of NAWASA staff to update the GIS database.
- Pilot the updated structure in District Metered Areas (DMA) for identifying NRW.
- Organise a South-South learning mission.
- Organise a regional South-South exchange event



## United Nations Industrial Development Organization

### Scope and activities of the proposed contracted services

Once this contract is signed, the CTCN will organize a kick-off call among all relevant parties involved in the request to introduce the Contractor to the NDE and Proponent, to present the activities, their timeline and clarify roles and responsibilities.

To get a better understanding of the objectives of the request for technical assistance, it is recommended that the Contractor refers to the request and the complete Response Plan 2017000007 available here: <https://www.ctc-n.org/technical-assistance/projects/improvement-water-supply-management-through-gis-based-monitoring-and>. Particular attention should be paid to the following sections: Linkages to relevant parallel ongoing activities, intended contribution to impact over time, main in-country partners, Gender and co-benefits. Regarding section 4 of the response plan, please take into consideration that the estimated budget breakdown is presented on an indicative basis.

**It is mandatory for the implementer(s) to allocate at least 1% of the budget to integrate a gender-approach to the activities.** Please refer to the CTCN Gender Mainstreaming Tool for Response Plan Development for guidance at <https://www.ctc-n.org/technologies/ctcn-gender-mainstreaming-tool-response-plan-development>.

The Contractor is expected to undertake the following activities:

#### **Output 1: Development of implementation planning and communication documents**

##### **Activity 1.1: Development of planning and communication documents**

- i) A detailed **work plan** of all activities, deliverables, outputs, deadlines, budget, responsible persons/organizations to implement the Response Plan.
- ii) A **monitoring and evaluation plan** using the CTCN template available at: <https://www.ctc-n.org/technical-assistance/introduction> (in English); including measurable, viable and relevant indicators.
- iii) One page description of intended outcomes and impacts from this TA drafted at initiation of implementation and revised at closure, filling the section 5 of the TA '**Closure and Data Collection Report**' template located at: <https://www.ctc-n.org/technical-assistance/introduction> (in English).;
- iv) A TA '**Closure and Data Collection Report**' using the template available at: <https://www.ctc-n.org/technical-assistance/introduction> (in English).

##### **Deliverable 1:**

1. Work plan
2. Monitoring and evaluation plan
3. CTCN Impact Description
4. Closure and Data Collection report



## United Nations Industrial Development Organization

### Output 2: Establishment of a GIS data structure and procedures

#### Activity 2.1: Development of GIS-data model

The activity consists of the following sub-activities:

- Collection, analysis and evaluation of type and quality of all available data in customer database, financial database and GIS: all types of information and data in NAWASA's database needs to be described in terms of content, type of field and quality. This exercise is essential for the design of the new GIS data model. NAWASA's will make the database available to the implementer. The NDE will assist in the access of other relevant national databases.
- Investigation and evaluation of potential GIS software types and structures: currently, an ArcView/ArcGIS version (manufactured by ESRI/USA) as single user version is running in NAWASA. Another software, SUPERGEO, has been acquired by NAWASA but has not been applied in the utility. In order to proceed, an analysis of software features and functionality would be carried out as well as an analysis of its suitability with the features required for a well-functioning GIS integration into the system. This review could form the basis of a procurement process carried out by NAWASA.
- Development of a GIS data model according to the software requirements and needs: consultations with NAWASA will be required during this sub-activity to make sure that the data model reflects the user's needs with regards to reducing losses associate with NRW. Based on the examples of successfully implemented data models in other countries, a logic and comprehensive NRW management data model respecting the existing databases for customer, billing and accounting will be proposed for NAWASA's approval.
- Implement revised data model and database structure: the approved data model has to be implemented in the NAWASA local area data network on a server, preferably dedicated to the GIS data storage only. The system needs to be connected to the other databases like customer and billing databases. The implementer will assist NAWASA's staff in installing the data model in the server.
- Develop data interface and data exchange protocol (online or via batch files): in order to connect the customer database, billing information, accounting database and eventually any other NAWASA database relevant to enhancing the resilience of the water supply (like the warehouse database or repair information), interfaces and exchange protocols have to be developed and interlinked to the new GIS system. The interface needs to refer to the GIS primary key of the GIS data model. The interface has to allow interconnectivity to the other databases. The interfaces will also have to link to the existing data. In order to achieve access to the various fields in that software and avoid redundancy in the data model, NAWASA will acquire necessary modules and adds-on to the current software (provided by NorthStar) or an appropriate new software with the required suite of modules. The implementer will identify the necessary modules and adds-on to the NorthStar software, or support the selection of a new software, for effective data modelling.



## United Nations Industrial Development Organization

### Activity 2.2: Review of data management (including back-up) procedures for GIS unit

The GIS unit is not currently an integral part of work procedures in the NAWASA. At present, information on customers and networks is provided to the GIS unit after all administrative and technical procedures have been completed. No quality control procedures for the GIS data is active. This leads to incorrect data entries and missing data in the GIS unit, as information is not always provided by the technical and administrative units. Within the GIS unit, no formalized work procedures and quality management processes are applied. In order to assure proper communication and exchange of all data between the technical or administrative units and the GIS unit, new workflows have to be developed and implemented, integrating the GIS into the dataflow. Preferably, the GIS unit should occupy an obligatory step in the workflows.

In NAWASA, a commercial customer and financial software is providing options to back-up and secure relevant data (work performed by the IT unit). The GIS software and related data is stored on the hard disk of the GIS workstation. Back-up of the data is done sporadically and with low degree of organization on external hard disks, which are stored in undefined locations. A risk of severe data loss is given for the GIS data.

Activity 2.2 will consist of the on-the-job recommendation in the following instances:

- Review of workflow for data management of new GIS data model: the storage of the GIS data and the GIS software have to be on an IT server in NAWASA, and have to be accessible over the network and eventually via VPN from outside. Therefore new security and access procedures have to be developed and implemented by NAWASA. Also handling of the data for the model requires defined rules and limitations as well as an obligation for quality control procedures. The implementer will review the data workflow together with NAWASA staff on the job and provide recommendations on procedures for data sharing and storage.
- Recommendations on how to integrate GIS and surveying unit data: the surveyors of NAWASA provide topographic designs for new or reviewed network and infrastructure. The data is produced in a CAD format. Storage of the data is on a server in NAWASA. However, only spatial data is stored, without unique ID keys (so not useful for analysis). In 2018, geodetic surveys were undertaken across the country<sup>1</sup>. The results of survey work are used for realization of horizontal and vertical geodetic datums that form a foundation of the national spatial data infrastructure. Another report was published providing an accuracy assessment for selection of the best transformation models<sup>2</sup>. NAWASA needs to transfer the spatial data to the GIS database with attributes and classification. The implementer will recommend workflows and quality checks procedures.
- Recommendations on how to integrate GIS into O&M procedures: the repair and maintenance teams work record is not providing any spatial information. The analysis of repair data requires spatial information, exact time stamps (date and time) for work's start and completion. The repair

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<sup>1</sup> Final report, Consultancy for Preparation of Detailed Specifications and Scope of Works for Geodetic Survey and Provision of Supervision Services during Survey, Regional Disaster Vulnerability Reduction Project, Grenada, April 2018: available at: <https://www.ctc-n.org/content/pre-ta-consultancy-preparation-detailed-specifications-and-scope-works-geodetic-survey-and>

<sup>2</sup> Final report, Transformation Parameters Report, Regional Disaster Vulnerability Reduction Project - Geodetic Control Survey: available here: <https://www.ctc-n.org/content/pre-ta-transformation-parameters-report-regional-disaster-vulnerability-reduction-project>



## United Nations Industrial Development Organization

and maintenance teams are required to provide coordinates for each executed work (GPS or marks on a topographic map). The implementer will recommend how this data should be entered (procedures) and classified in the GIS database.

- Recommendations on how to integrate GIS into customer department procedures: The GIS data is lacking a complete and updated set of customer information. In order to allow more reliable and more up-to-date information in the GIS database it is required to integrate the GIS unit into the workflow for any changes in the customer database. The customer's unique identification number has to be generated and stored in both the GIS and customer database. The implementer will provide recommendation on the best standards for customer identification number in GIS database taking into account the requirements/limitations of the selected software.
- Job requirement description: based on the above sub-activities and activity 2.1, the implementer will prepare job requirements for the GIS unit.

### **Activity 2.3: Update GIS**

The implementation of the above described workflows and procedures have to be tested. In order to achieve sustainable changes, the implementation of any new or changed workflows requires close assistance and support during the testing phase. **This activity consists of an on-the-job training where the implementer is expected to be on-site with NAWASA's personnel.** This activity is composed of the following sub-activities:

- Collect all available network and infrastructure data within the NAWASA (survey department, drawing/planning department): All stored data in the GIS database needs to be analysed and documented on a list (excel file) providing key information of the content, name and path of the file, date of the file, size and type. All files prepared by the surveyors as there are the files of as-build drawings, the maps and drawings from the planning and development departments as well as the available base map data from other sources (governmental and commercial institutions) have to be registered and described. It has to be taken into consideration that these files prepared by surveyors are stored in a CAD format (LisCAS). It is recommended to incorporate as appropriate the LIDAR survey data to avoid duplication of work<sup>3</sup>. The implementer's role in this sub-activity will be to supervise and guide NAWASA's personnel in the collection of the data and its correct insertion in the excel document.
- Convert sets of available data into GIS with geographic address: the data collected in the sub-activity above has to be transferred to the server in NAWASA and the GIS database. The implementer will supervise and guide NAWASA's personnel in this task. It has to be noted that CAD formats provided by the surveyors require manual review work before the conversion to the GIS database.
- Identify missing information and data collection methods: based on the documentation of available data in the GIS database, the implementer will identify the missing information. For each missing information category, a method for data collection has to be prepared for the NAWASA's personnel to follow. The trained staff will lead to the creation of an internal help desk (responsibility of NAWASA).

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<sup>3</sup> Technical Specification, Acquisition of Lidar Topography and Aerial Photography Data, Regional Disaster Vulnerability Reduction Project, Grenada, November 2016: available here: <https://www.ctc-n.org/content/pre-ta-technical-specification-acquisition-lidar-topography-and-aerial-photography-data>



## United Nations Industrial Development Organization

- Update base map (houses, other infrastructure and point of delivery) and connect to customer database. NAWASA will acquire new satellite images or other appropriate information sources (e.g. aerial photographs, maps) which will have to be imported to the GIS system. The LIDAR Dataset acquired under the Pilot Program for Climate Resilience (PPCR) Project can assist with this task. The satellite images or aerial photographs will have to be analysed and infrastructure not yet digitized transferred to the GIS. NAWASA's Surveyors or GIS unit staff will be assigned and equipped (i.e. vehicle transport and GPS/ surveying instruments) to verify the base map. The equipment (i.e. vehicle transport and GPS/ surveying instruments) will be provided by NAWASA. The implementer will accompany them and provide guidance on selected sites. Regarding the underground infrastructure provided by the surveying unit, wherever there exists unclear information (attributes for diameter or material of pipes, etc), the infrastructure has to be verified by conducting investigation and interviews with technicians. These verifications undertaken by the GIS unit staff have to be done onsite when relevant. The implementer will accompany them and provide guidance on selected sites. The sites will be selected by NAWASA, in consultation with the implementer and the NDE. The implementer's participation to the field visits will serve as on-the-job training so that ultimately NAWASA's staff can conduct the GIS updated base map by themselves.

### **Deliverable 2:**

1. Report presenting the evaluation of type and quality of all available spatial data
2. Report presenting the evaluation of potential GIS softwares
3. Data model for the collection and management of spatial data needed to enhance the resilience of the water supply
4. Data interface and data exchange protocol
5. Best practices and lessons learned on: procedures for data sharing and storage, workflows and quality checks procedures for the integration of surveyors data into the GIS, procedures and classification of repair and maintenance data, best standards for customer identification in GIS database
6. Job requirements description for the GIS unit
7. On the job training on the collection and management of GIS data
8. Excel document with description of all available data
9. Excel document listing the missing information and related data collection methods
10. Reports on field data collection/verification in selected sites

### **Output 3: South-South Learning**

#### **Activity 3.1: South-South Learning mission**

The implementer will organize and accompany 2 NAWASA staff members on a south-south exchange mission (2-3 days mission) to another Caribbean water utility which is more advanced in terms of comprehensive GIS systems usage. The implementer will also be responsible to cover the logistical cost of the 2 NAWASA staff members.



## United Nations Industrial Development Organization

The country will be selected together with NAWASA and the NDE based on the analysis and recommendation of the implementer in activity 2.1. The mission will take place after the completion of output 2.

### **Deliverable 3:**

Mission report

### **Output 4: District Metered Areas (DMA) pilot**

#### **Activity 4.1: Identification of NRW in a piloted DMA**

According to GIS data, the complete network is separated into defined DMA's. However, these DMAs lack the standard implementation procedures. The simple desktop analysis of the network plans bears high risks of forgotten interconnectivities between different DMA. The pilot will help in first verifying the selected DMA and train the NAWASA staff in improving their DMA implementation procedures. It will be used to apply the standard water balancing procedures (IWA standard water balance) and NRW reductions measures in the pilot area. Zero Pressure Test (ZPT) will be performed in the pilot area to confirm the DMA is fully isolated.

The pilot will be consisting of the following sub-activities:

- Identification of pilot zones for DMA: the implementer will prioritize, together with NAWASA, one or two pilot areas from the following networks: Lance aux Epines, True Blue, Westerhall Point, Fort Julie, Rived Road. For the selected zone(s), the implementer, with the assistance of NAWASA staff, will document all infrastructure on and underground in detail in the GIS and identify for each house or building the customer details by database analysis. The implementer will also run a ZPT.
- Investigate real losses: the implementer will run a minimum night flow measurement and document the results. The results will be compared to international documentation and the Infrastructure Leakage Index (ILI) will be calculated according to international standards.
- Investigate commercial losses: the implementer, together with NAWASA, will identify all water users in the DMA selected in the customer database and identify them in the GIS database. They will extract all houses and commercial/industrial/agricultural infrastructure and verify these on-site for eventual connection to the NAWASA network. Additionally, the implementer will provide on-the-job training to NAWASA GIS unit by developing and running routines to extract the consumption data of all water users inside the DMA (assessment of the inflow and consumption figures).
- Water balance according to IWA standard: by combining all the available data of the selected pilot areas, a first IWA standard water balance will be produced by the implementer for each selected area.

### **Deliverable 4:**

1. Report on the infrastructure of the selected area(s)
2. Report on real and commercial losses



## United Nations Industrial Development Organization

3. Water balance for each selected areas

### Output 5: Regional South-South exchange event

#### **Activity 5.1: Organization of the South-South exchange event**

In order to strengthen knowledge transfer and explore the replicability potential in the region, the implementer will organize a one-day South-South Exchange Event inviting up to 10 participants from the region (5 NDEs and their country's water authority representative). The objective will be to share the lessons learned during the technical assistance and allow the other countries to present their experience and challenges in water conservation. The implementer will also be responsible to cover the logistical costs of the 10 participants.

#### **Deliverable 5:**

Event report, including PowerPoint presentations and information material (agenda, pictures, etc.).

## 4 GENERAL TIME SCHEDULE

The activities under this contract have an expected duration of thirteen months from the contract signature.

## 5 PERSONNEL IN THE FIELD (PROFESSIONAL EXPERIENCE AND QUALIFICATIONS)

The Contractor is expected to provide the services of a team that should ideally comprise the following competencies:

- Proven expertise in water management, water conservation and infrastructure
- Proven expertise in GIS and data management in the water sector
- Demonstrated experience in the design and use of geographic information systems to enhance the resilience of water supplies using a wide range of tools for information sharing, in the water sector as well as in the implementation and operation of GIS systems in water utilities
- Demonstrated experience in technical water loss reduction campaigns in water utilities and redesigning NRW related procedures in water utilities
- Demonstrated experience in contribution to adaptation project/programme in SIDS; in Central America and Caribbean would be an asset
- Proven experience in designing and delivering the training for associated technicians in water infrastructure / database management
- Excellent written and communication skills in English

The CVs of the respective experts assigned to this assignment by the Contractor must be provided.



United Nations Industrial Development Organization

## 6 LANGUAGE REQUIREMENTS

The working language for the purposes of this assignment is English, thus an excellent command of English is required for the proposed personnel. The deliverables must be submitted in English.

All delivered documents must be of such a quality, that no further editing shall be required.



United Nations Industrial Development Organization

7 DELIVERABLES AND SCHEDULE

The table below details the indicative schedule for this assistance.

Output	Delivery date (after contract start date) in 13 months											
<b>Output 1: Development of implementation planning and communication documents</b>												
Work plan	■											
Monitoring and evaluation plan	■											
CTCN Impact Description	■											
Closure and Data Collection report												■
<b>Output 2: Establishment of a GIS data structure and procedures</b>												
Report presenting the evaluation of type and quality of all available spatial data		■										
Report presenting the evaluation of potential GIS softwares		■										
Data model for the collection and management of spatial data needed to enhance the resilience of the water supply			■									
Data interface and data exchange protocol			■									
Best practices and lessons learned on: procedures for data sharing and storage, workflows and quality checks procedures for the integration of surveyors data into the GIS, procedures and classification of repair and maintenance data, best standards for customer identification in GIS database			■									
Job requirement description for the GIS unit			■									
On the job training on the collection and management of GIS data				■								
Excel document with description of all available data				■								
Excel document listing the missing information and related data collection methods				■								
Reports on field data collection/verification in selected sites					■							
<b>Output 3: South-South Learning</b>												

