CTCN
CLIMATE TECHNOLOGY CENTRE & NETWORK

Technical Assistance Response Plan - Terms of Reference

Country	**Grenada**
Request ID#	**2017000007**
Title	Improvement of water supply management through GIS-based monitoring and control system for water loss reduction
NDE	*Merina Jessamy, Permanent Secretary, Climate Resilience, The Environment, Forestry, Fisheries, Disaster Management and Information* *Ministry of Climate Resilience, The Environment, Forestry, Fisheries, Disaster Management and Information* *Telephone: +1473 440 26862* *E-mail: mejessamy@gmail.com; merina.jessamy@gov.gd* *Ministerial Complex,* *Sir Eric Gairy Botanical Garden,* *Tanteen, St. George's,* *Grenada, W.I*
Proponent	*Christopher Husbands* *Managing Director* *National Water and Sewerage Authority (NAWASA) Utility Management* *+1473 409-0372* *chusbands@nawasa.gd* *Carenage* *St. George's* *Grenada, W.I*

Summary of the CTCN technical assistance

As a small island developing state (SIDS), Grenada is one of the world's most at-risk countries for climate change. In the last years, the island experienced two major drought events in 2010 and 2012 which significantly affected the water supply sector. Grenada is likely to be affected by changing and increasingly erratic temporal rainfall patterns and overall trends towards higher temperatures, higher evapotranspiration, and longer and more severe dry seasons.

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[1].

In order to be effective, NAWASA's overall Non-Revenue-Water (NRW) management needs a structured and systematic approach. NAWASA's current data model, as well as 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 endeavor.

[1] Retrieved from http://www.eoearth.org/view/article/156945

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Technical Assistance Response Plan - Terms of Reference

Agreement:

(If possible, please use electronic signatures in Microsoft Word file format)

National Designated Entity to the UNFCCC Technology Mechanism
Name: Merina Jessamy
Title: Permanent Secretary
Date: 04.06.2018
Signature:

Proponent (signature of the Proponent is optional)
Name:
Title:
Date:
Signature:

UNFCCC Climate Technology Centre and Network (CTCN)

Name: Jukka Uosukainen
Title: CTCN Director
Date: 14.06.2018
Signature:

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1. Background and context

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 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[2].

Grenada is likely to be affected by changing and increasingly erratic temporal rainfall patterns and overall trends towards higher temperatures, higher evapotranspiration, and longer and more severe dry seasons. Projections are that rainfall will be reduced by the end of the century between 25 and 30 percent of current climatologically mean values[3]. Research reports forecast in one scenario for Grenada, water demand will exceed water supply by the year 2025.[4]

2. Problem statement

The National Water and Sewerage Authority (NAWASA) is estimating its Non-Revenue-Water (NRW) at 30-35% of overall water supplied, however a water balance according to international standards (IWA) to provide evidence for that estimate has not yet been established. The direct cost for water production at NAWASA is around 1.4 XCD/m (= 0.4 €/m³). Considering an annual production of 11 Mio m³, some 3.3 Mio m³ of water are lost for NAWASA each year and costs for NRW are at around 4.5 Mio XCD (1.4 Mio €) annually (data of 2014). Under changing climate conditions the impacts of NRW on the overall ability of NAWASA to supply its customers is likely to increase. As such, reducing water losses is a key component of efforts to enhance the resilience of Grenada's freshwater supply.
A fact-finding study on NAWASA Utility Management Support with a Focus on Non-Revenue Water (NRW) was carried out in 2016. It serves as a comprehensive strategy proposal (roadmap) on improved utility management (identification of short -, medium-, and long-term measures to be undertaken in order to strengthen NAWASAs management capacities) with a focus on reducing NRW significantly. Within that study, an assessment of the key problems and the cause NRW has been undertaken and a brief roadmap has been outlined to prepare the ground for larger scale measures over a time frame of approximately one year. This roadmap provides the basis for this response plan and to allow NAWASA to develop capacity of their engineers and technicians and to initiate a

[2] *NAWASA Annual Report: http://nawasa.gd/about-us/annual-reports*
[3] Grenada- Strategic Program for Climate Resilience (SPCR),Grenada, 2011 Grenada (Source: https://www.cif.climateinvestmentfunds.org/sites/default/files/final%20grenada%20_SPCR_%20mar%204%202011.pdf)
[4] An Assessment of the Economic Impact of Climate Change on the Water Sector in Grenada, UN-ECLAC:Economic Commission for Latin America and the Caribbean, 2011
(Source:http://www.cepal.org/en/publications/38580-assessment-economic-impact-climate-change-water-sector-grenada)

comprehensive approach to improve NRW.

The study recommended establishing a sound Geographical Information System (GIS) as the back bone of all operations, including the water loss reduction activity. Based on the implemented GIS, improved work procedures for billing and collection, repair and maintenance, leak detection and emergencies have to be established.

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.

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3. Logical Framework for the CTCN Technical Assistance:

	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Objective: Efficiently and effectively reduce the currently high Non Revenue Water (NRW) in Grenada												
Outcome: Capacities strengthened for the management of a GIS-based monitoring and control system for water loss reduction and leakage detection in Grenada												
Output 1: Development of implementation planning and communication documents												
Activity 1: *All implementers must undertake the following activities at the beginning and at the end of the CTCN technical assistance.* i) A detailed work plan of all activities, deliveries, outputs, deadlines and responsible persons/organisations and detailed budget to implement the Response Plan. The detailed work plan and budget must be based directly on this Response Plan; ii) Based on the work plan, a monitoring and evaluation plan with specific, measurable, achievable, relevant, and time-bound indicators used to monitor and evaluate the timeliness and appropriateness of the implementation. The monitoring and evaluation plan should apply selected indicators from the Closure and Data Collection report template and enable the lead implementer to complete the CTCN Closure and Data collection report at the end of the assignment (please refer to item iv below and section 14 in the Response Plan); iii) A two-page CTCN Impact Description formulated in the beginning of the technical assistance and update/revised once the technical assistance is fully delivered (a template will be provided); iv) A Closure and Data Collection report completed at the end of the technical assistance (a template will be provided).												
Deliverable 1: 1. Detailed work plan 2. Monitoring and evaluation plan 3. CTCN Impact Description 4. Closure and Data Collection report	1 - 2 - 3											4
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 database.

- 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. 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 model.

Activity 2.2: Review for 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 the 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[5]. 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[6]. 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 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.

[5] 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

[6] Final report, Transformation Parameters Report, Regional Disaster Vulnerability Reduction Project - Geodetic Control Survey

- 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. New customer applications have to be transferred to the GIS unit once a first field visit by the technical officers has been effectuated. 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, if relevant.

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[7]. 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

[7] Technical Specification, Acquisition of Lidar Topography and Aerial Photography Data, Regional Disaster Vulnerability Reduction Project, Grenada, November 2016

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). • 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 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.											
Deliverables 5-14: 5. Report presenting the evaluation of type and quality of all available spatial data 6. Report presenting the evaluation of potential GIS softwares 7. Data model for the collection and management of spatial data needed to enhance the resilience of the water supply 8. Data interface and data exchange protocol 9. 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 10. Job requirement description for the GIS unit 11. On the job training on the collection and management of GIS data 12. Excel document with description of all available data 13. Excel document listing the missing information and related data collection methods 14. Reports on field data collection/verification in selected sites		5 6		7 8	9- 10	11	12 13	14				
Output 3: District Metered Areas (DMA) pilot												
Activity 3.1: 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 NWASA 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.													
Deliverables 15-17: 15. Report on the infrastructure of the selected area(s) 16. Report on real and commercial losses 17. Water balance for each selected areas											15 16	17
Output 4: South-South Learning													
Activity 4.1: 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 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 18: 18. Mission report								18					

4. **Resources required and itemized budget:**

Activities and Outputs	Input: Human Resources	Input: Travel[8]	Inputs: Meetings/events	Input: Equipment/Material	Estimated cost	
					Minimum	Maximum
Output 1: Development of implementation planning and communication documents						
Activity 1.1: Formulation of i) Detailed work plan, ii) Monitoring and evaluation plan, iii) CTCN Impact Description, iv) Closure and Data Collection report.	Project manager/water expert, 1-2 work days				*900*	*1,300*
	Gender expert, 2-3 work days (for the Monitoring and Evaluation plan, the Closure and Data collection report, and the reviewing of relevant deliverables)				*800*	*1,800*
Output 2: : Establishment of a						

[8] Regular in-situ coordination and support have been presented as essential in the implementation of the activities (particularly 2.2). The CTCN encourages the participation of a local/regional expert under the supervision of an international expert, to strengthen regional capacity and reduce the cost of the overall implementation. Therefore the budget allocated to travel gives an estimation of the number of necessary missions, all depending on the participation or not of local/regional expert.

GIS data structure and procedures						
Activity 2.1: Development of GIS-data model	Project manager/water expert, 5-7 work days GIS expert/ database developer, 15-20 work days	1-2 Missions to meet NAWASA team, identify data and discuss software options			*15,650*	*29,300*
Activity 2.2: Recommendations for data management (including back-up) procedures for GIS unit	Project manager, 5 work days GIS expert/ database developer, 20-30 work days O&M / commercial process design expert 20 work days	1-3 Missions to analyze data management and procedures			*27,850*	*48,500*
Activity 2.3: Update GIS	Project manager/water expert, 5-7 work days GIS expert/ database developer, 30-35 work days	1-2 mission for On-the-job training			*23,850*	*37,550*
Output 3: District Metered Areas (DMA) pilot						
Activity 3.1: Identification of NRW in a piloted DMA	Project manager/water expert, 5-10 work days GIS expert/ database developer, 15 work days O&M / commercial process design expert	2-4 missions for piloting			*27,250*	*40,750*

	15 work days					
Output 4: South-South Learning						
Activity 4.1: South-South Learning mission	Project manager/water expert, 4 work days	1 mission to a Caribbean country, 3 people – 3 days			*3,540*	*5,960*
Estimated range of costing for the entire Response Plan					*99,840*	*165,160*

5. Profile and experience of experts

Experts required	Brief description of required profile
Project manager/water expert	Water expert with relevant education on water management and infrastructure with experience in similar project management, preferably with work experience in developing countries (SIDS/ Central America and Caribbean would be an asset)
GIS database developer/ Expert	Proven 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
O&M/ Commercial and process design expert	Engineer/ economist with proven experience in technical water loss reduction campaigns in water utilities and redesigning NRW related procedures in water utilities
Gender expert	Gender expert with experience in the water sector, specifically water supply and delivery

6. Intended contribution to impact over time

Short term:

- Better understanding of the reasons for the losses in the water system and the factors that influence these losses
- Faster response times for providing solutions in case of leakage, etc. due to improved management systems and data and information flow. This will result in improved services for approx. 38,000 connections in Grenada (in total approx.. 100,000 people)
- Support for preventive maintenance and exchange of pipelines
- Skill development of technical staff to address NRW
- Enhanced data management in the water sector

Medium term:

- Support the reduction of NAWASA's non-revenue water from an estimated level of 30-35% to 20%, which means saving of approx.. 1.1 billion liters per year, which is available to enhance supply in particular during the more frequently expected dry periods.
- Reduced water risks deriving from lack of storage
- Reduction on operation & maintenance cost of water infrastructure.
- Improved water access for communities

Long term:

- Increased health of the population
- Contribute towards improved infrastructure development
- Increased resilience to droughts
- Contribute towards increased local employment

7. Relevance to NDCs and other national priorities

Improving water resource management is the third adaptation priority of Grenada's NDC (2016), specifically stating that "*the management of water resources, like that of the coastal environment is crucial to the long term development of Grenada as a nation. (...) In addition, improved capture, storage, distribution and conservation of water increases the adaptive capacity of individuals and communities*"

Grenada has recently completed a vulnerability assessment of the water sector (http://finance.gd/index.php/projects/climate-resilient-water-sector-in-grenada-g-crews) and developed a national adaptation plan and action plan for the water sector, mapping and water quality testing of informal water sources.

Grenada is currently undertaking its technology needs assessments (TNA) and has selected the water, agriculture and tourism as the focal sectors. Water was identified as the more dominant crosscutting sector. The results of the TNA will provide the necessary information on technology needs for Grenada to continue its resilience building activities.

8. Linkages to relevant parallel on-going activities:

The Grenada Water Stakeholder Platform (G-WASP) of the global International Water Stewardship Programme (IWASP) is jointly implemented by the Land Use Division of the Ministry of Agriculture, Lands, Forestry and Fisheries in Grenada and the German Agency of International Cooperation (GIZ). In Grenada, IWaSP is anchored in the bilateral Integrated Climate Change Adaptation Strategies (ICCAS) programme, implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

The GCF has just approved the proposal presented by Grenada, with GiZ as implementing partner,

for a Climate-Resilient Water Sector in Grenada (G-CREWS). The GCF project will start in the first semester of 2019. The CTCN technical assistance will address short term needs in terms of the setup and updating procedure of the GIS system (infrastructure and customer) and the piloting of this system in a DMA enabling NAWASA to assess water balance of this area. The GCF funding will build on this basic GIS system and develop other work processes such as the improvement of the NRW calculation and water balancing as well as the replacement/renovation of the infrastructure and integration of energy efficiency and generation into the activities.

IWaSP partners in this region include the Ministry of Agriculture, Lands, Forestry, Fisheries and the Environment, the National Water and Sewerage Authority (NAWASA), the Grenada Hotel and Tourism Association (GHTA), the Inter Agency Group of Development Organisations (IAGDO) and St. George's University. IWaSP[9] is an international water security programme which combines global best practice in water stewardship with local know-how. Currently active in seven countries, the six-year programme (2013-2018) facilitates partnerships between the public sector, the private sector and civil society to address shared water risks, while improving stakeholders' use and management of water and building their capacity to develop their own solutions. GIZ manages IWaSP on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ) and the UK Department for International Development (DfID).

In association with the Ministry of Health, the water authority NAWASA has adopted the drinking water quality standards proposed by the World Health Organization (WHO). A regular programme of sampling and bacteriological analyses of treated waters is carried out by the Authority. The quality of the potable water supplies at the national level is monitored by NAWASA on a monthly basis. All tests are implemented by the NAWASA's laboratory facility.

9. Anticipated follow up activities after this technical assistance is completed:

The basis of all improvement processes is a functioning and updated GIS database and related work procedures and management processes. Building on the GIS information, the definition and establishment of District Metered Area (DMAs) will be implemented in the field and documented, also in the GIS system, as part of the CTCN support. This information will be used by NAWASA for strategic decision making on the structuring of the water supply network and for ongoing, improved monitoring of water pressure and water losses. The calculation of an IWA water balance of the DMA's will be based on data analysis of the customer data base, linked to the GIS system will be used as a monitoring tool to assess the effectiveness of the new NRW strategies.

With the successful completion of the technical assistance the government of Grenada plans to feed the data and findings into national strategies and policies. Concrete plans could, for example address, the tourism sector. The expectation is that with the involvement of key stakeholders from the tourism sector (e.g. hotels) the water utility receives support and input from end consumer level to translate the proposed follow up measures of the technical assistance into actions, such as incentive programs for rainwater and grey water use in hotels or the leak reduction in pipelines, as well as use of more efficient water appliances with the hotel premises. The capacity building component of the technical assistance is expected to enable the stakeholders to follow up on the implementation and introduce sustainable monitoring instruments.

10. Gender and co-benefits:

Imbedded in design of the activities:	The Government of Grenada in cooperation with GIZ has conducted a gender assessment for the Climate Resilient Water Sector in Grenada" (CREWS) to

[9] http://www.iwasp.org/where-we-work/where-we-work/grenada

	the Green Climate Fund (GCF) in 2017. This assessment is available and covers all main aspects in regard to improving the climate resilience of Grenada's water supply system in order to increase the country's adaptive capacity to climate change . It is recommended that this CTCN technical assistance build on this. In regard to the activities and outputs outlined in section 3 of this response plan this concerns: • Gender-equal job requirement descriptions • Gender equitable stakeholders' consultations • On the job training of women and men on the collection and management of GIS data • Where feasible, collection of gender sensitive data
Gender and co-benefits intended as result of the activities:	Grenada has a high number of female-headed households where women have to provide for the family alone. If there is a lack of water, the situation is especially difficult for these women because they are simply alone with this task. Especially economically disadvantaged households benefit from improved data availability and management through: • Better access to water: Improved water data allows for better water management and benefits households, especially of the most vulnerable, to apply water saving measures. • Sustainable water delivery to the communities: With more informed planning, water cuts will be avoided and a more better informed supply structure will be put in place. • Improved health: an improved water system will forster access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situation

11. Main in-country stakeholders in implementation of the technical assistance activities:

In country stakeholder	**Role in implementation of the technical assistance**
National Water and Sewerage Authority (NAWASA), Grenada	*Primary contact for request and stakeholder coordination; technical input*
Ministry of Climate Resilience, Environment, Forestry, Fisheries, Disaster Management and Information	*NDE, overall process consultation regarding CTCN process*
Climate Resilience/ Environment Division of the Ministry	*Information sharing , consultation and coordination with regard to national climate policies, TNA process and National Adaptation Plan*
Land Use Division, Ministry of Agriculture, Lands, Forestry & Fisheries	*Information sharing and consultation in regard to water usage in the sectors aagriculture, lands, forestry &fisheries*
Grenada Water Stakeholder Platform (G-WASP) of the global International Water	*Information sharing and consultation regarding the fact-finding study on NAWASA Utility Management*

Stewardship Programme (IWASP), jointly implemented by the Land Use Division of the Ministry of Agriculture, Lands, Forestry and Fisheries in Grenada and the German Agency of International Cooperation (GIZ).	*Support with a Focus on Non-Revenue Water*
Pilot Programme "Integrated Climate Change Adaptation Strategies" (ICCAS), funded by the German Federal Ministry of Environment (BMUB) and implemented by GIZ and UNDP.	*Information sharing and consultation and link to Grenada's Climate Policy and National Adaptation Plan processes.*
Stakeholders from Grenada's tourism sector	*Hotel owners and businesses from the tourism sector are key stakeholders in implementing water resource management on the ground; they play a crucial role in information sharing and hence play a role as resource persons and multipliers.*

12. SDG Contributions:

Goal	Sustainable Development Goal	Direct contribution from CTCN TA (1 sentence for top 1-3 SDGs)
1	End poverty in all its forms everywhere	
2	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	
3	Ensure healthy lives and promote well-being for all at all ages	
4	Ensure inclusive and equitable quality education and promote life-long learning opportunities for all	
5	Achieve gender equality and empower all women and girls	
6	Ensure availability and sustainable management of water and sanitation for all	The technical assistance will provide Grenada with the establishment of a GIS-based monitoring and control system for water loss reduction and leakage detection
7	Ensure access to affordable, reliable, sustainable, and modern energy for all (consider adding targets for 7)	
	7.1 - By 2030, ensure universal access to affordable, reliable and modern energy services	
	7.2 - By 2030, increase substantially the share of renewable energy in the global energy mix	
	7.3 - By 2030, double the global rate of improvement in energy efficiency	
	7.a - By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology	
	7.b - By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support	
8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	CTCN technical assistance will participate in the country's resilient water management system and ensure that proper infrastructure is put in place.
10	Reduce inequality within and among countries	
11	Make cities and human settlements inclusive, safe, resilient and sustainable	
12	Ensure sustainable consumption and production patterns	
13	Take urgent action to combat climate change and its impacts	*All TAs should indicate relevance to Goal 13 and at least one target below (13.1 to 13.b).*
	13.1 - Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	Grenada is facing water shortage and increased number of droughts which will be worsen by the effect of climate change. By limiting the leakages and

		Non-Revenue Water, the CTCN technical assistance increases the resilience of the country to climate-related natural disasters.
	13.2 - Integrate climate change measures into national policies, strategies and planning	
	13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	
	13.a - Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible	
	13.b - Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities	
14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	
15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	
16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	
17	Strengthen the means of implementation and revitalize the global partnership for sustainable development	

13. Classification of technical assistance:

Please tick off the relevant boxes below	*Primary*	*Secondary*
☐ 1. Decision-making tools and/or information provision	☐	X
☐ 2. Sectoral roadmaps and strategies	☐	☐
☐ 3. Recommendations for law, policy and regulations	☐	☐
☐ 4. Financing facilitation	☐	☐
☐ 5. Private sector engagement and market creation	☐	☐
☐ 6. Research and development of technologies	☐	☐
☐ 7. Feasibility of technology options	☐	☐
☐ 8. Piloting and deployment of technologies in local conditions	X	☐
☐ 9. Technology identification and prioritisation	☐	☐

14. Monitoring and Evaluation process

Upon contracting of the implementing partners to implement this Response Plan, the lead implementer will produce a monitoring and evaluation plan for the technical assistance. The monitoring and evaluation plan must include specific, measurable, achievable, relevant, and time-bound indicators that will be used to monitor and evaluate the timeliness and appropriateness of the implementation. The CTCN Technology Manager responsible for the technical assistance will monitor the timeliness and appropriateness of the Response Plan implementation. Upon completion of all activities and outputs, evaluation forms will be completed by the (i) NDE about overall satisfaction level with the technical assistance service provided; (ii) the Lead Implementer about the knowledge and learning gained through delivery of technical assistance; and (iii) the CTCN Director about timeliness and appropriateness of the delivery of the activities and outputs.