Consultancy:

Establishment of the Challenge Fund for Water Users in the Tourism Sector

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Sanitary/Environmental/Mechanical Engineering

1 Introduction

1.1 Objective and General Considerations

The project Climate-Resilient Water Sector in Grenada (G-CREWS), is jointly financed by the Green Climate Fund (GCF) and the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) under its International Climate Initiative (IKI), and the Government of Grenada.
Over 6 years, the Government of Grenada, the Grenada Development Bank and the National Water and Sewage Authority (NAWASA) in partnership with the German Development Corporation (GIZ) will implement the project's five components.

The project's holistic approach addresses two main climate risks and vulnerabilities of Grenada: freshwater availability and disaster preparedness. Other Caribbean communities share these vulnerabilities, rendering this project a model for regional application.

The purpose of the Challenge Fund is to increase the resilience of two of Grenada's top commercial sectors and water users: tourism and agriculture. Both are highly vulnerable to projected climate change impacts such as reduced precipitation and droughts. The Challenge Fund promotes the adoption of water-efficient solutions in the agriculture and tourism sectors by using GCF grants to facilitate water auditing, solution design and implementation and to incentivise significant private co-finance for the purchase of water-efficient equipment. In the dry season, farmers experience a significant reduction in productivity or are unable to farm. Hotels and guesthouses suffer from unreliable water supply, rationing, water trucking costs and guest dissatisfaction.

Currently, there are many solutions available to significantly reduce the demand for water in hotels, which are not always reflected in the applicable regulations and design requirements. The use of modern technologies to reduce water consumption in hotels must consider the various efficiency levels reported by the manufacturers and the corresponding reduced water

flow rates. Regardless of the model of water efficiency rating used to calculate the total water consumption, a significant reduction in the demand is possible.
Increasing demand for water caused, for example by population growth and further development in the tourism and hotel sector, results in changes in the water balance. In addition, climate change can reduce freshwater resources. These processes increase, inter alia, the costs of obtaining freshwater and the problem of drinking water shortage. Proper management of water demand is not only a potential means of supporting the security of the future water supplies, but also is an important tool to limit the resulting environmental consequences. Hotels have great potential for water saving, especially in case of discretionary end-uses such as showering, faucets and toilets.

2 Water Consumption

2.1 Baseline Demands

Baseline demands typically include both customers' demands and non-revenue water. Usually, the average day demand in the current year is the baseline from which other demand/consumption are built. This will be the basis on which auditing, and assessment will be carried out on the guest houses and hotels.

2.2 DATA SOURCES: Customer Meter and Billing Records.

Meters are employed throughout the system, and they are be the best source of data for determining customer demands. Customers are typically billed based on a volumetric measure of usage, with meter readings taken on monthly or quarterly cycle. Using these periodically recorded usage volumes, customers' average usage rates can be computed. Billing records, therefore, provide enough information to determine fluctuations in demand over a period of time.

3.0 Organizational Chart of Challenge Fund Management

Figure 1

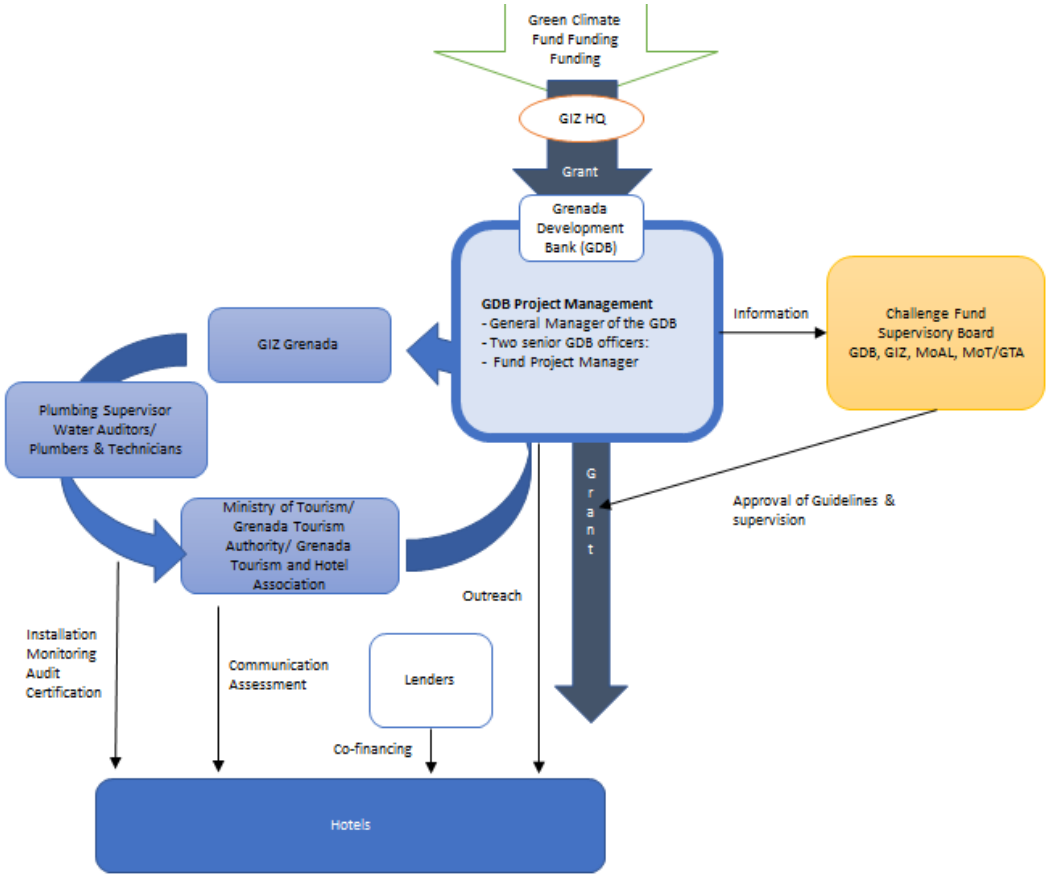
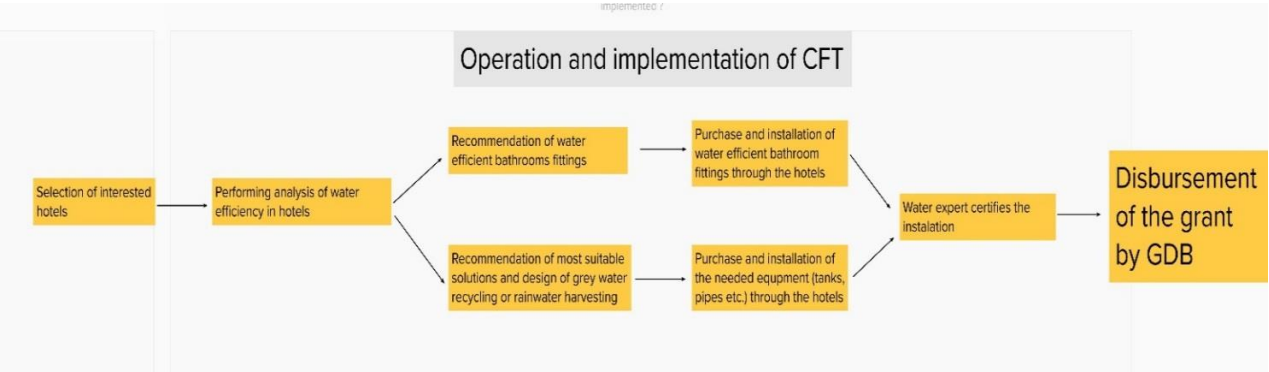


Figure 2



4 Technical Guidelines

4.1 Conducting a Water Audit

Conducting a system water audit – which quantifies the amount of water that is being lost from a public water system or a facility – is a critical first step in developing a water loss control program. By definition, a system audit is a systematic accounting of water throughout the production, transmission, and distribution facilities of the water system.

Lack of standardized terminology has historically added to difficulties in comparing water losses from different public and private water systems. Around the year 2000, the International Water Association (IWA) and the American Water Works Association (AWWA) developed standard methods and terminology to perform water audits and to assist water utilities in tracking their distribution system losses. **The AWWA/IWA water audit methodology** is based on the **water balance table**, which specifies different types of water consumption and losses. Through the water audit, options will become apparent regarding how to proceed with further identifying where losses are occurring or where efforts to control or eliminate the losses should be concentrated.

Under this project, the Water Balance calculations will be carried out to determine water loss in the private/hotels' water system

Importance of computing water balance can be summarised as follows:

- Reveals availability/reliability of data
- Creates awareness of problems/issues
- Gives direction for improvements
- Serves as a tool for communication
- Identifies climate change adaptation measures that can be applied as water conservation interventions
- Assists in prioritising investments

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4.2 Types of Water Losses

Worldwide, water losses are occurring at both the consumer / end user side and the utility's distribution side. It is a universal problem affecting both developed and developing countries. There are two types of water losses (Sturm et al 2008, p. 5):

1. Real losses – consists of water lost from the distribution system through leaky pipes, joints and fittings and leaky reservoirs (including overflows).
2. Apparent losses – consists of water that is not physically lost but does not generate revenue because of inaccuracies in customer metering / data handling errors or any form of theft or illegal use

The various elements of a water balance (including water losses) as well defined by the IWA/AWWA Water Audit methodology. This type of water audit is the first crucial step in any active leakage management /water loss control strategy.

4.3 Pressure Management

There are four aspects to controlling real losses: pressure management, active leak control, speed and quality of repairs and infrastructure asset management (including replacement and renewal). Pressure management can be defined as the practice of managing system pressures to the optimum levels of service while reducing unnecessary excess pressure and eliminating transients both of which cause distribution systems to leak (EU 2015). Years of research has shown leakage and pipe burst frequency increase with pressure thus wasting water (EU 2015, AWWARF 2007).

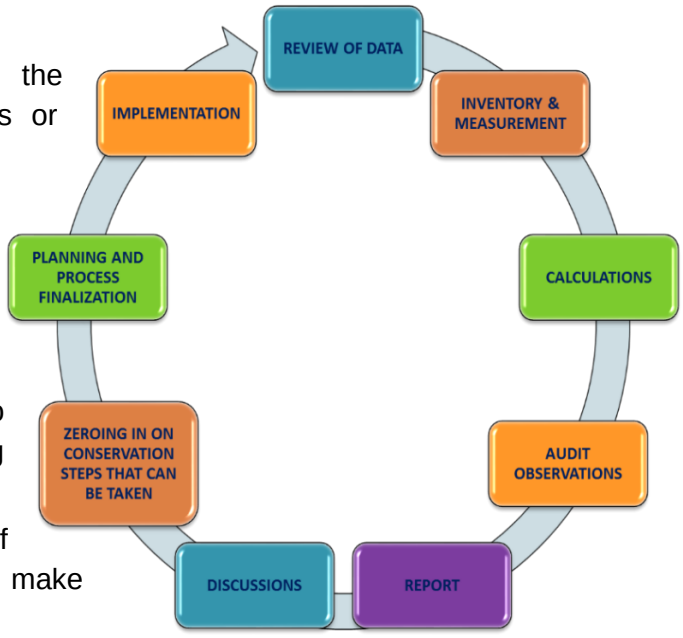
Within the context of this project, pressure management will begin on the water service connection to the premises. The inlet pressure from NAWASA's main will be checked, if is higher than 75 psi and if there is no Pressure Reducing Valve (PRV), one will be installed and regulated ensuring that the inlet pressure into the property is between 60 – 70 Psi. if there is a PRV, it will be regulated the pressure range indicated. If it cannot be regulated a new one will have to be installed by the property owner.

4.4 The AWWA/IWA Water Audit Methodology

The AWWA/IWA water audit methodology is the internationally accepted 'best practice' standard approach for water balance calculations, as the essential *first step* in practical management of water losses (Farley and Trow, 2003).

- Typical steps in an audit include:
- Gathering information;
- Determining flows into and out of the distribution system based on estimates or metering;
- Calculating the standard performance indicator values and assessing water loss standing by comparing these values with ranges of values from audits from other water utilities/facilities;
- Assessing where water losses appear to be occurring based on available metering and estimates;
- Analyzing data gaps (e.g., determining if more information is necessary to make comparisons and an informed decision);

Figure 3



***Source*: USEPA, 2010**

- Considering options and making economic and cost-benefit comparisons of potential actions; and Selecting the appropriate interventions.

4.5 Implementation of the Challenge Fund

4.5.1 End-use Water Audit

An end-use water audit is a systematic accounting of water uses by end users (residential, commercial, or industrial), often used to identify potential areas for water reduction, conservation, or efficiency improvement.

In practice, it is an on-site survey and assessment of water-using hardware, fixtures, equipment, landscaping and management practices to determine the efficiency of water use and to develop recommendations for improving water-use efficiency.

The methodology for conducting an end-use water audit on this project can be summarized as follows:

1. Collect and Review water usage history of premises from billing records/water bills (Check NAWASA if it is necessary) and the level of occupancy for the past three years;
2. Calculate the average daily (theoretical) consumption via the no of rooms/beds multiply by the accepted local per capita consumption taking into consideration the occupancy of the hotel in a given period (such as yearly);
3. Compare this average daily theoretical consumption with the actual average daily consumption over the last three years;
4. Compare the average daily consumption with international bench marks;
5. Check water Pressure at the entrance of the incoming water main/Service connection
6. If the pressure is greater than 75 Psi, check to see if there is a Pressure Reducing Valve (PRV), if there is one regulate it. If it cannot be regulated the owner must change it. If there is no PRV, the owner must install a new one and regulate it;
7. Conduct an interview with the relevant owner/manager/maintenance personnel in charge of the facility and in in process of completion of the Water Audit Form;
8. Conduct visual inspection of water meter, plumbing, water points; wastewater treatment facilities and building structure for evidence of leaks or inefficient water use;
9. Measure (bucket) flows of fixtures/leaks and take lineal measurements as required;
10. Draw schematic of premises showing water points/related features; and water flow chart;
11. With all fixtures turned off, isolate water supply and check for spinning meter;
12. Calculate flows, i.e., calculate the average daily consumption based on number of fixtures units and compare with international benchmarks;
13. Compile water audit report to include observations/comments/conclusions/and recommendations for water use efficiency or requisite water conservation intervention; (Please see the algorithm below)
14. Determine the real losses of including leaks;
15. If these losses cause water consumption be more that 5% than the international bench marks, then carry out retrofitting as a conservation intervention. Retrofitting will still be recommended if the fixtures are none efficient or of non-water conserving-types;
16. Rainwater harvesting and/or recycling of greywater will be considered independently of water losses since it is a good practice to reduce the overall water consumption from NAWASA’s mains;
17. Technically speaking, the facility is then eligible to participate in the challenge fund.

4.5.2 Bathroom Upgrades.

During the visit to apartments and hotels, the water expert will propose a set of bathroom installations in accordance to the requested water saving standards. It is planned that the "EPA water sense system" approach which lists certified water sense products as a guideline will be used(see "EPA water sense"; https://www.epa.gov/watersense/watersense-products). The interested hotels will then purchase the fittings and install them in accordance with the standards developed by the expert. Hotel and guesthouse owners will choose the equipment most suitable for their establishments that meet the standard criteria.

After installation the experts will visit every retrofitted room and fill out a certification form detailing the type and number of devices that were installed. This form will be presented to the hotel owner who will submit it accompanied by all purchase receipts and other supporting documentation to request the grant from GDB. The form has to be signed by the expert and at least one GTA officer. The disbursement of the grant from GDB will occur only after the aforementioned step has taken place. The recipients of this grant will be encouraged to set aside in their internal budget allocation for training of plumbers to maintain the new devices/fixtures they have installed.

4.5.3 The Decision Algorithms

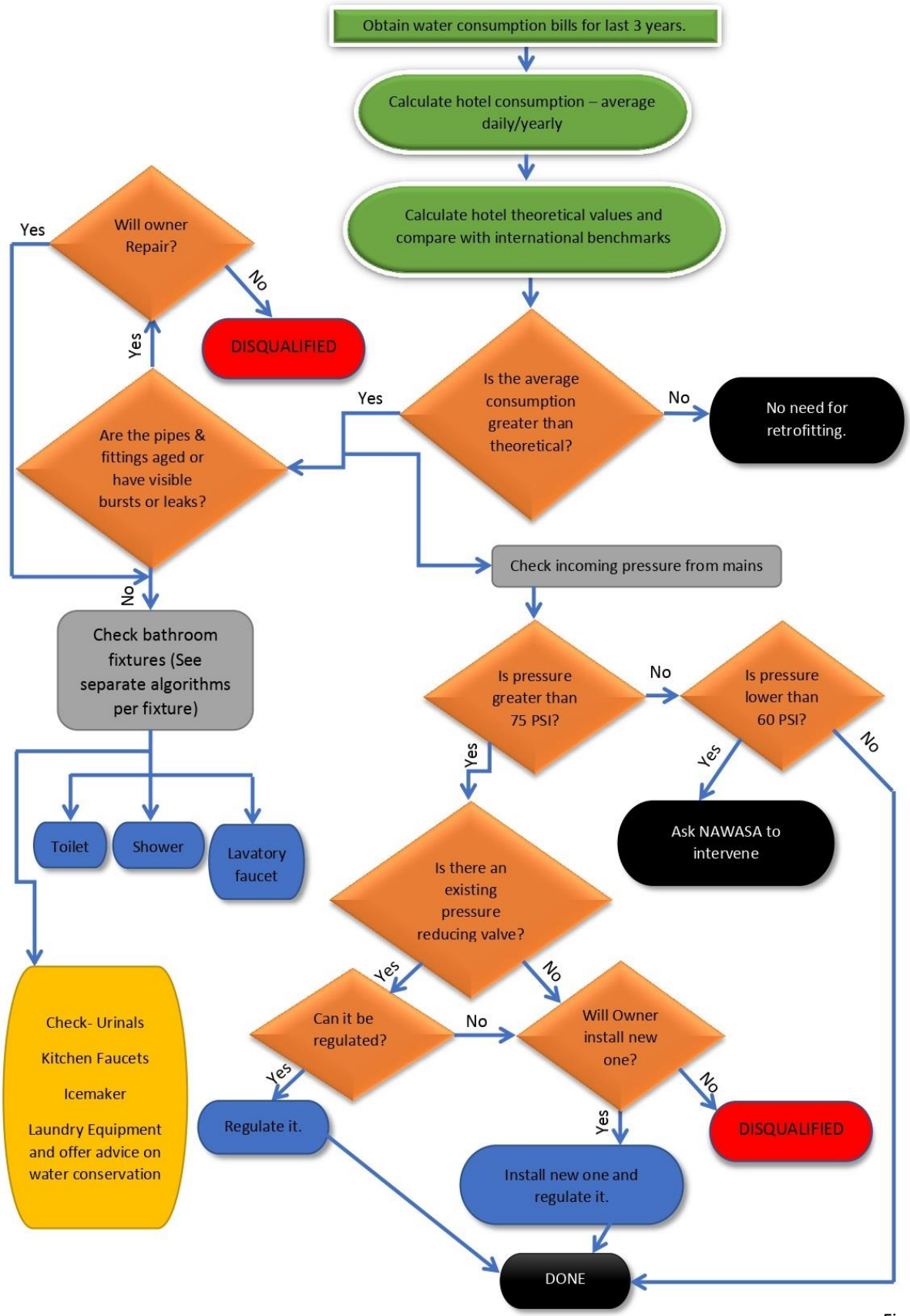


Figure 4

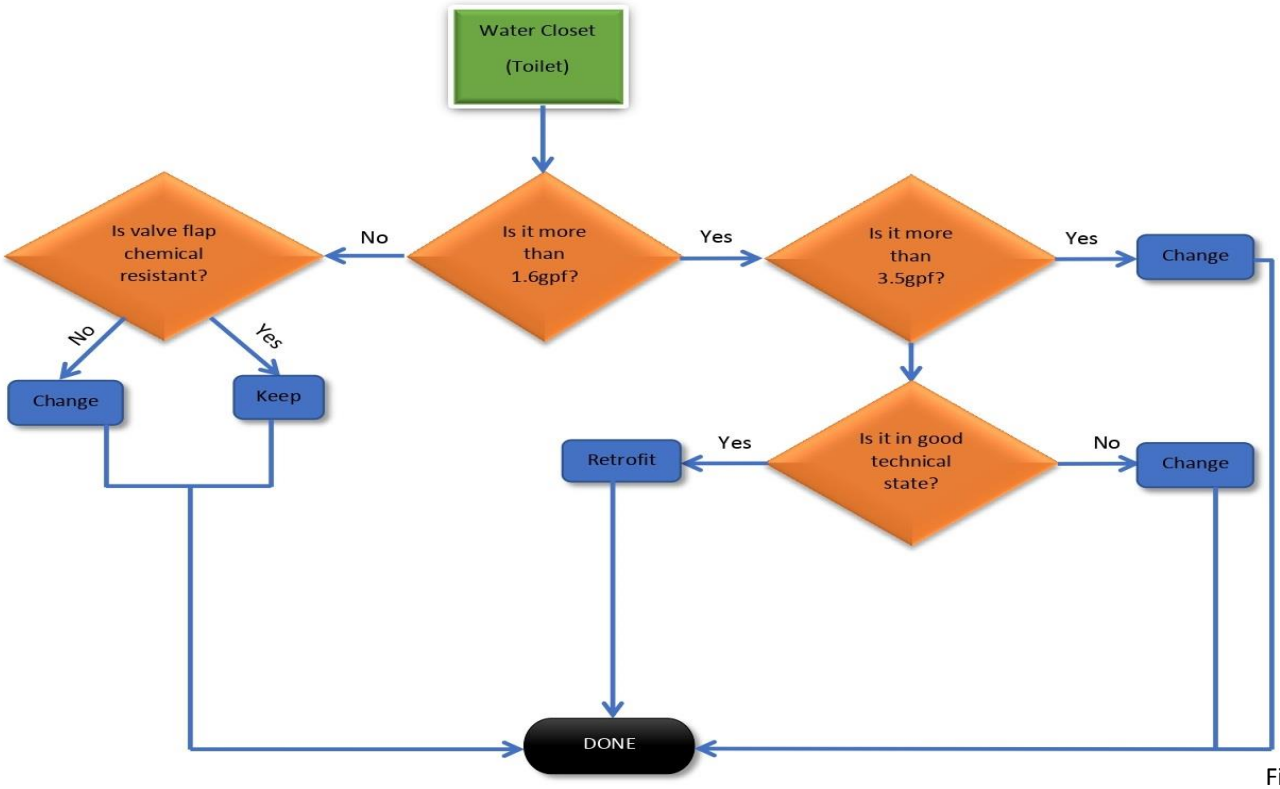


Figure 5

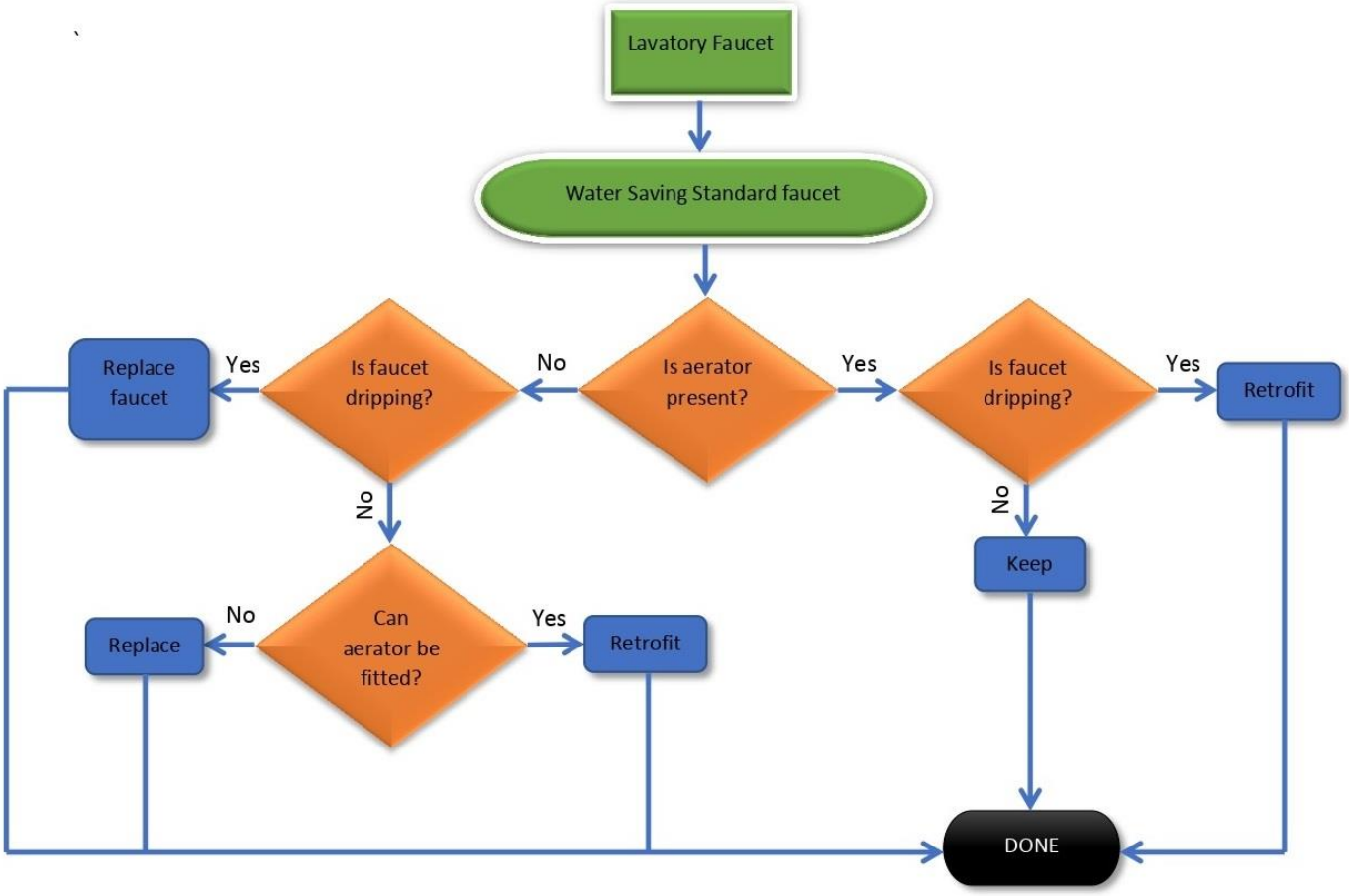


Figure 6

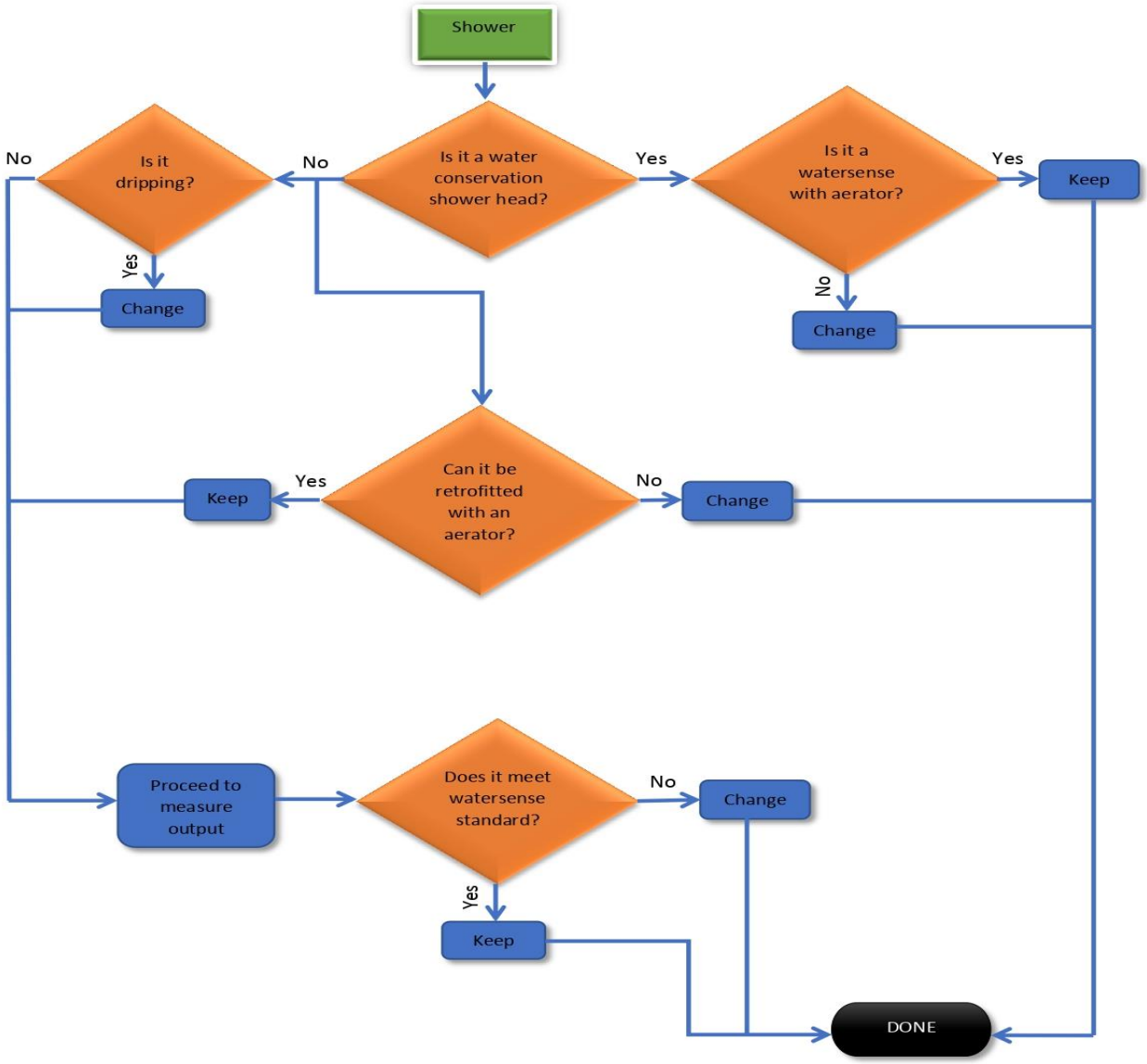

Shower
Is it a water conservation shower head?
No
Is it dripping?
No
Yes
Change
Yes
Is it a watersense with aerator?
Yes
Keep
No
Change
Can it be retrofitted with an aerator?
Yes
Keep
No
Change
Proceed to measure output
Does it meet watersense standard?
No
Change
Yes
Keep
DONE

Figure 7

4.6 Low Water Pressure in the Network

When there is acute fluctuation on the water pressure of the internal network, particular attention has to be paid to the low-pressure situations. Showerheads/faucets suitable for low-pressure applications have to be installed. This is important to guarantee the proper functioning of the fixtures/devices at all times. If the pressure is constantly less than 20 psi, water sense labeled products are not recommended.

4.7 Rainwater harvesting (RWH)

Climate change poses a severe threat to Grenada's water supply sector, since it relies heavily on surface water sources and rainwater catchments. During the rainy season the available water supply exceeds the island's water demand. However, there is a considerable deficit in the dry season. Climate change will aggravate this dry season situation due to the low projected annual rainfall. One of the options foreseen to augment water supply and significantly reduce the effects of periods of extended dry spells, is adopting more widespread Rainwater Harvesting (RWH) approaches.

This approach shall augment existing potable supplies, and shall be a readily accessible emergency source of water during natural disasters. Weather events like hurricanes and floods, are those which disrupt access to the main water supply.

The Global Water Partnership-Caribbean (GWP-C) has developed a Rain Water Harvesting (RWH) concept which will be adopted under this project.

The expert will visit the hotels interested in rainwater harvesting or greywater recycling and recommend the most suitable solutions. In this case the hotel owners shall decide to install the system which the expert will design as the best solution for the hotel (greywater recycling or rainwater harvesting, including the related water use/reuse options). The design details will be presented in a report. The hotel owners will purchase the required equipment (tanks, pipes, pumps, and other appurtenances, etc.). The hotel owner will carry out the installation with support of a plumber/water specialist or construction company on his own initiative and costs and in accordance with the specifications in the design report. The rainwater tanks must be installed and located in accordance with local planning authority's guidelines and acceptable best practices and fulfilling the water collecting/harvesting standards laid out in the expert's design.

The expert will visit the hotel after installation and conduct a review of the said installation. If the system was installed in accordance to the design and criteria stipulated, the expert will release a certification which has to be signed by the expert and at least one GTA officer. The document together with all supporting payment receipts will be presented by the hotel owner to request the grant from the Grenada Development Bank (GDB). The disbursement of the grant from GDB will occur only after the last step.

4.8 Water Audit Form

Name of Auditor: Daniel & Daniel Engineering Inc		**Do you own a fish tank?**	
Location:		**If yes, how often do you clean it?**	
Date:		**Describe the type of pipe/plumbing used?**	
Greetings/ salutations		**Do you fix or change fixtures frequently?**	
Purpose of visit		**How often?**	
How many rooms are in the hotel?		**Do you have pets?**	
Frequency of baths/showers per person?		**If yes, how often do you bathe them?**	
What is the average occupancy?		**Have you noticed any sweating walls/ wet spots?**	
Is the property owned, or leased?		**If yes, please explain where.**	
Is permission solicited to enter & walk around?		**Do you have tanks/cisterns?**	
What is the approximate age of the building/facility?		**If yes, what is the size of the tank or cistern?**	
Property acreage		**Is there a water heating system in use?**	
Can you grant permission to turn off all fixtures/equipment on compound to observe NAWASA meter?		**Do you have a swimming pool? Does it have a make-up water tank or automatic or manual make-up /top-up device such as hose/pipe?**	
Are there any other water sources? (rainwater),(Desal. Plants)		**Does the facility have a laundry/washing machines?**	
If yes, what are the other sources?		**If yes, how many times/loads per week do you wash?**	
Were there any recent plumbing repairs?		**Does fridge have an ice maker?**	
Are there any leaks on the premises?		**Does tank take long to fill after flush?**	
Do you have a filter on the main?		**Do you have to 'jiggle' toilet handle after flush?**	
Are there filters elsewhere?		**Any visible water running in bowl constantly?**	
What is the size of the mains?		**What is the condition of angle valves on sink/toilet?**	
Is the meter in a chamber?		**What is the working condition of the shower head?**	

Meter location		**Do you drink tap water?**	
Meter reading (include date & time)		**Quality of water supplied to property?**	
Is bill reading/interpretation assistance needed?		**How would you rate knowledge of water system of facility?**	
How often is meter read?		**How often do you clean grease trap?**	
When last did meter reader pass?		**Thank customer for cooperation**	
Any recent unusual water bills?			
Does neighbour connect to your water supply?			
Are you satisfied with water pressure?			
Do you have a pump on the system?			
What is your pump operating pressure?			
Do you know location of shut off valve?			
Do you have 24-hour supply?			
Number of stand pipes or hose bibs (see water flow chart following)			
Number of exterior fixtures			
Do you hear unusual/excessive sounds from fixtures?			
Number of indoor fixtures (appliances)			
Any kitchen gardening practise?			
Any flower gardening or landscape irrigation practise?			
If yes, how often do you water your plants?			
How do you water plants (hose/drip irrigation/ sprinkler?)			
Do you practice any water recycling/Rain Water Harvesting/conservation practices?			
Any additional water uses other than the normal use at the facility?			
What method of Disposal of Wastewater is used on the compound?			
Where is the sewer connection & septic tank - soakaway system located?			
Do you own vehicles?			
If yes, how often do you wash them?			

Figure 8

The information captured during the visit and interview with the hoteliers will be recorded in the Audit Form in Figure 8. The technical data, flow measurement and calculations will be reported on separately.

4.9 Example of Water flow Chart

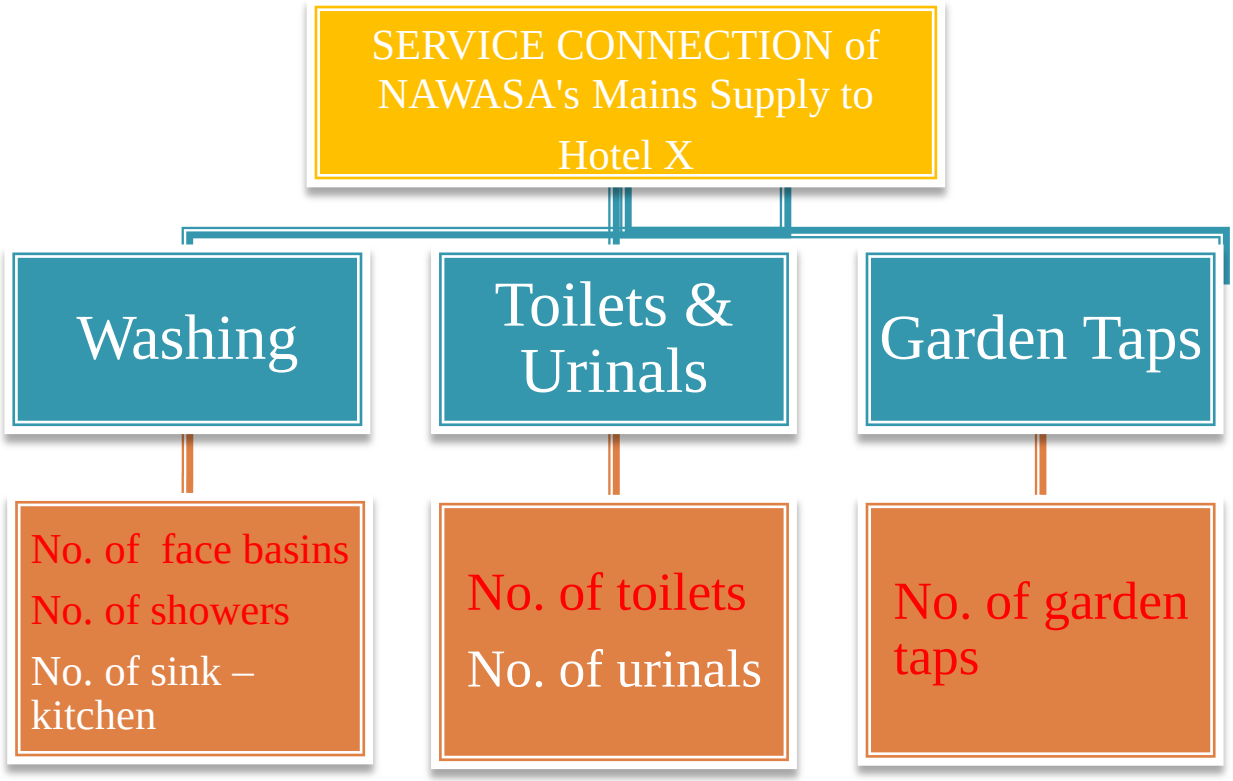


Figure 9

4.10 General Specifications for Retrofit of Bathrooms

The following recommendations for retrofits will be adopted for use under this project:

- Outfit storage tank with float valve.
- Outfit all toilets that are up to 3.5 gpf with universal fluid master valves and toilet dams.
- Replace or retrofit (depending on the conditions of the toilet) all toilets that are more than 3.5 gpf with low flush toilets (1.6 gpf or 1.23 gpf).
- Change all non-aerated face basin faucets with water conserving-type faucet (or retrofit the faucet with aerators).
- Outfit faucets with aerators.

- Retrofit urinals in public areas and general bathrooms outfit with metering taps. (optional)
- Outfit showers with low-flow showerheads.
- Insert toilet dams in toilet bowls.
- Showers: Replace 2.5 gpm shower head with a free Water Sense-labeled showerhead that can reduce the flow to 1.5 gpm.
- Bathroom and Kitchen Faucets: The average household faucet can flow up to 3 gpm. Installing low-flow aerators can convert a bathroom faucet aerator that uses only 1.0 gallons per minute and a kitchen aerator that uses only 1.5 gallons per minute.

Other Retrofit issues to be considered/recommended to Hotel owner:

- Traditional taps versus pillar metering/concussive.
- Lavatory faucets versus sensor-operated faucets.
- Traditional urinal valves versus automatic flush valves.
- Different pipe material and pipe sizes.
- Traditional kitchen faucets versus foot and knee-operated valves.
- Traditional standpipes for drinking and janitorial uses versus drinking water fountains and janitorial sinks.

4.11 Environmental Guidelines

Water Conservation Encompasses the policies, strategies and activities to manage fresh water as a sustainable resource, to protect the water environment and to meet current and future human demand. Water loss reduction is a good first step in the overall management of this precious resource. We must be mindful that factors such as climate change will increase pressures on natural water resources.

The following environmental guidelines will be crucial for the implementation of this project:

1. Correct selection of materials – e.g. Soil corrosiveness, proximity of the property to the sea, etc. will be taken into consideration during design/specification for procurement. Acid soil with low pH (using soil pH home testing kit) should be noted and the pipes used in this soil should indicate acid resistant.
2. Materials less vulnerable to extreme weather conditions /events should be specified/recommend for installation etc. – e.g. clear water tanks will attract algal growth as against dark High-Density Polyethylene (HDPE) tanks.
3. Materials specified are already approved by USEPA Water Sense so we do not expect that after retrofitting the water quality will be compromised.
4. Pipes network should be arranged in a way that can prevent cross flow from one to another during pipe repairs.
5. Fittings and branches for pipes should be of same quality.

6. Where construction is taking place, the network should be shielded from accidents while using tools or equipment.
7. It should be noted that the strength and flexibility of PE make it the preferred material for replacement and rehabilitation of existing pipe networks in difficult conditions.
8. Covered pipes or hard to find pipes along internal face of walls should be of cast iron or steel.
9. The contractor should record location of pipes to provide suitable location in the future and this should be carried out in accordance with D&D. It will be necessary to record details of individual pipe lengths, diameter and PN rating.
10. Handling of pipes and storing should be given much attention to preserve the integrity of the pipes before installation

Rainwater harvesting from roofs, collects only a minimal percentage of water within a catchment; this does not affect the water balance in the catchment. There are beneficial effects when rainwater is stored during intense rainfall events, which would otherwise increase the runoff and cause erosion and flooding.

Other benefits of RWH are:

- Improving access to domestic water
- Buffering rainfall variability
- Overcoming dry spells
- Helping to cope with extreme events (flooding, soil erosion)
- Provides a source of water at the point where it is needed.
- It is owner-operated and managed
- It provides an essential reserve in times of emergency and/or breakdown of public water supply systems Particularly following natural disasters
- Reduces run-off
- The construction of a rooftop rainwater catchment system is simple
- Can be built to meet almost any requirement
- Hotels can start with a single small tank and add more when they can afford them
- Operating costs are low
- The physical and chemical properties of rainwater are often superior to those of groundwater or surface water

We note that rainwater harvesting will be recommended for hotels carrying out gardening of commercial crops and/or maintaining non-commercial greenery such as trees, lawns, etc. In some cases, hotels may use rainwater for showering, washing, flushing and cooking. In this case the necessary treatment such as prefiltration, first flushing systems, disinfection and operations and maintenance procedures will be specified.

- It is recommended to use covered/closed tanks to avoid contamination by animal waste, leaves etc.
- Contaminants washed from a roof are usually concentrated in the first part of the run-off. After this initial run-off has washed, the roof water is considerably safer for use. So, it is recommended to remove the first part of the rainfall using a first flush diverter.
- Recent research suggests a rule of thumb: that for each mm of first flush, the contamination load would be reduced to half.

- It was observed that both the “first flush devices “installed on the roof at one location removed approximately 10% of the first 1 mm of rain, i.e. the first flush diverters should at least hold 10 times as much this volume.
- For large roofs (larger than 100 m^2/1076 ft^2) a rain filter should be considered to reduce the level of contamination.

Recycling of Greywater however, will be recommended only for those properties that maintain non-commercial greenery such as trees, lawns, and for washing yards, pavements and the outside walls of the buildings. To avoid a groundwater contamination the greywater hast to be treated properly before use in irrigation.

4.12 Financial Guidelines

The Equipment Grant would operate as follows:

- The finance to purchase fittings and fixtures to meet water efficiency requirements have to be secured by the owners of the hotels. Upon certification duly signed by the Consultant and 1 GTA officer, GDB will re-imbursed to a maximum of 80% of the C.I.F cost of these purchases.
- The proposed fund size of the CFT for installations and equipment is approximately EUR 0.230 million (US$ 0.270) which is approx. EC$ 730,000.00.
- The equipment to be purchased shall be via competitive bidding, i.e., by comparing prices from different sources.
- The GDB will process the refund grant within seven working days of receipt of all supporting documentation

The Breakdown is as follows:

a) Bathroom retrofitting: -

- Interested hotels will choose and purchase the fixtures/fittings and install them on their own costs. This shall be accomplished with three different bathroom components: Showerhead, faucet, toilet (cistern and/or tank).
- Equipment costs will be subsidized by 80 % grants funding (up to 400 $US/bathroom and 20,000 $US per hotel).

b) Rainwater harvesting

- Equipment costs will be subsidized by 80 % grants funding (up to 10,800 $ US per small hotel or guesthouse, and 55,200 $ US for large hotel).

4.13 Grant Eligibility Criteria

- Properties must be licensed / registered with the Grenada Tourism Authority (GTA)
- Audit of the property must be conducted by the approved expert
- Property owners must be willing to implement the recommendations of the water audit
- Purchase and installation of equipment of water efficiency solutions is to be carried out by the property owner prior to disbursement of the grant.

- Approval and certification of the installation by the water expert is a prerequisite for grant disbursement

5 Monitoring System for Application of Guidelines

5.1 Procurement Guidelines

- A list of fixtures/fittings/devices (toilets, lavatory faucets, shower heads, flushing urinals, flush and fill valve for toilets, spray sprinklers, irrigation controllers, etc) will be generated with water sense labels.
- The above-mentioned information will be agreed between D&D and the hotel.
- From this information a procurement list will be generated by the owner and approved by D&D in keeping with the recommendations established.
- Installation instruction will be part of the training program to be delivered; however, the installation will be properly supervised.
- The installed fixtures will be tested and monitored during use to ensure that they meet the specifications stated.
- All these activities will be logged for reference.

5.2 Monitoring of works to be done by the approved contractor

- A form or worksheet will be developed for the evaluation of the works to be carried out.
- Development of a work-breakdown structure will be part of the management process.
- Attach the work breakdown structure to the schedule of works with milestones/deliverables.
- Data from audit, where possible, can be compared to international benchmarks.
- On-site awareness in efficient use of water shall be instilled in the workers and the owners so they can pass this information on to the guests on a regular basis, over the life of the project.

Submitted by:

Alphonsus Daniel

Expert 1 and Team Leader